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Kinship, Computing, and Anthropology

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This article proposes two important points about genealogical software: (a) Not all such software need necessarily be complicated or address high level theoretical issues, and (b) diversity of data, processing, and infrastructure means that it is particularly desirable that scholars begin to understand software tools as utilities that should have flexibility, including platform independence built into the design from the outset. Following a discussion of high performance packages used by White and Houseman to analyze social networks from marital data, the authors present examples from their research that suggest that even apparently trivial, nonanalytic tasks that form part of the process of preparing data for higher end analyses may yield exciting and productive results. The authors conclude with a statement on the nature of e-science in anthropology and the implications for the types of software that will be most useful.

Keywords: *kinship; software; anthropology; e-science*

Kinship is central to anthropology. Setting aside the historical connection between the subject of the family and the growth of the discipline, there are valid reasons why anthropology has persisted in devoting so much attention to the principles, rules, behaviors, and attitudes associated with this universal, cross-culturally variable thing that we label *kinship*. The reasons for this, we believe, are obvious but are worth briefly reviewing here.

- Kinship terminologies are based on generative principles for ordering relationships among actual individuals. As such, terminologies provide valuable clues about the way humans organize and process information that shapes their lives.
- The family frequently provides the primary locus for the reproduction of social patterns including gender, power relationships, individual and social identification, language, and religion.
- Reciprocal relationships inherent in kin groups often provide mechanisms for defining allies, organizing labor, arranging marriages, and providing social security in the event of disaster, old age, or death.

In this article, we do two things. First, we review some software packages for working with genealogical data. The packages range from those intended more for presentation than for analysis to sophisticated specialist research packages designed and used by anthropologists and other social scientists interested in social networks analysis. We touch only peripherally on packages that focus primarily or exclusively on kinship terminologies such as the kinship algebra expert system (KAES; Read & Behrens, 1990; Read & Fischer, 2005; see this issue).

This article is driven by genealogical rather than terminological research questions, though in our concluding remarks we suggest that an e-science approach to anthropology means that we do not prematurely rule out currently untraveled research paths. Second, in the process of reviewing genealogical software and suggesting a particular direction for all kinds of anthropological software in the future, we present some real anthropological puzzles that have been addressed using specific software packages, specifically Pajek (Batagelj & Mrvar, 1998, 2001) and the Centre for Social Anthropology and Computing (CSAC) XML Kinship Editor (Fischer, 2005).

Kinship Software

Most genealogical manipulation packages these days provide a text output for data. Formats such as that for GEDCOM (a standard file format for genealogical information developed by the Church of Jesus Christ of Latter-day Saints) are adequate and easy to convert to what we believe to be formats more amenable to reuse such as extensible markup language (XML; Bradley, 2000; see also Bagg, Fischer, & Bharwani, 2000, for a good example of XML used in a historical anthropological research). XML itself does not provide a common standard, rather it offers a way of constructing standardized formats that are then relatively easy to convert from one to another if the structure information is made available. So although some years back incompatibility may have been a powerful argument against certain genealogy packages, that no longer seems to be a decisive factor if they can produce an interchange format. A standardized XML output format would in our view render all conforming genealogy packages more compatible with a wider range of existing and emerging software, but that is only one factor in our choice of software tools. The main problem with the packages designed for widespread use is the ethnocentric bias built into the structures in the package. We do not say this out of a heightened sensitivity toward political correctness but rather out of very pragmatic necessities of trying to accommodate irregular kinship relations within the software. Brother's Keeper (BK; <http://www.bkwin.net/>), Family Matters (FM; <http://www.matterware.com/>), and ohmiGene (<http://ohmi.celeonet.fr/ohmiGene/>) all assume the nuclear family (narrowly defined) to be the central unit.

Genealogical Display Packages

Anthropologists working with kinship have largely been disappointed in commercial genealogical software, and reviews of kinship software in the past (White, Batagelj, & Mrvar, 1999) have without exception dismissed them as ill suited for the kinds of work anthropologists do. We separately trialed a small number of such programs to verify whether this inadequacy was still the case or if some happy circumstances had led commercial genealogical software developers to think about the unusual needs of kinship analysts. We looked at three packages. Two of these run in the Windows operating system environment and one in the Macintosh environment.

BK and FM, Windows-based genealogy programs, offer a range of language interfaces so long as the user is content with Latin alphabets (which is fine for Lyon but poses some unwelcome constraints on Magliveras). The programs target Europeans and Americans interested

in their ancestry. They provide some attractive family tree graphics but are not designed to conduct serious analytical research on the implications of genealogical patterns within a culture or a society and do not provide tools that are capable of such tasks. Nevertheless, we believe that such programs may have their place in fieldwork (though at the pace that software develops, we make no claims that this will be the case in 2 years). FM allows GEDCOM exports and so may prove useful for simple data entry, assuming the family structures of the people involved conform to assumptions about family built into the software.

OhmiGene is a shareware package for the Macintosh platform. Like the Windows-based packages, BK and FM, it is designed for amateur family tree enthusiasts. Despite opting for the neutral term *union* (for something like marriage), ohmiGene restricts unions to individuals who have different genders. The gender options are *s*—undetermined, *M*—male, and *F*—female. A union between an undetermined gender individual and a male is disallowed. Similarly, same sex unions are disallowed. Although same sex unions as sanctioned relationships that legitimate offspring are somewhat rare, they are sufficiently common across different cultures that any genealogical resource for anthropology must permit them without subterfuge or trickery.¹ OhmiGene does provide a good range of export options, though, so it is possible that it could be very useful for an ethnographer working in a community that conformed to ohmiGene's assumptions about families and unions. The package offers a GEDCOM, Genealogies Connection (GmC), compressed row storage, tab delimited, and, most important for our purposes, XML export. Unsurprisingly, the package itself offers little in the way of sophisticated analytical tool kits for doing much with genealogies.

Consequently, although these mass consumption packages require little training and offer attractive graphical user interfaces and pretty graphical representations of European style normative family structures, they have little to recommend them beyond simply being a convenient way of entering data about individuals when collecting family genealogies (assuming the individuals involved all have compatible kinship relationships). These packages might serve some purposes rather well, however, so we do not exclude them out of hand.

Academic Genealogical Packages

While recognizing that commercially available packages may indeed have some limited use, it is clear that the kinds of complex analyses kinship experts seek cannot be addressed within their constraints. A number of reviews of kinship analysis software have appeared, and it is not our intention to reproduce such efforts (see White et al., 1999, for a review of select software tools; see White & Jorion, 1992, for an introduction to the concept of p-graphs; see Batagelj & Mrvar, 1998, for a discussion of Pajek; and for a concise summary of features of different tool kits, see White's web site: <http://eclectic.ss.uci.edu/~drwhite/pgraph/toolkit.html>). Nevertheless it is useful to restate a select number of the problems raised by others here. Without wishing to exclude the very wide range of work being carried out in these areas, we chose to focus on the work of Doug White and his collaborators (Houseman & White, 1998; White et al., 1999; White & Houseman, 2002; White & Jorion, 1992). White, with others, has for some time been at the forefront of large network analysis. The problems of delimitation, cohesion, computational capacity, and manageability in his work well represent those confronting most social anthropologists working with similar data types (which, we suggest, accounts for most social anthropologists whether they recognize it or not, even if not with computer-based tools). Following a brief discussion

of White's extensive work, we suggest that even more restricted analytical ambitions with regard to kinship data can benefit from specialist software, and we offer two examples from our research in which certain phenomena only became apparent after reviewing them within the software package.

Social Network Analysis

The social networks that emerge from the sets of formally recognized and defined categorical networks (such as kinship) are difficult for most anthropologists to cope with. First, they are frequently (if not always) unknown in their totality by any single individual. Second, they may not be the result of motivated decisions to generate them (indeed if they are, one should not need specialist software to identify them). Last though by no means exhaustively, they can involve a very large number of connections among even a small set of individual people or nodes. White and Houseman (2002; Houseman & White, 1998) have demonstrated the ways in which analyzing genealogical data can yield powerful results not predicted by the formal structures alone. White and Houseman's (2002) results shed light on long-standing anthropological concerns about dual organizations (moieties) in marriage systems and make it possible to deal with sidedness (choosing sides) in a more systematic way. Reexamining Leach's (1961) Pul Eliya data, they pose a number of questions about emergent patterns in sidedness in a social context that should not formally permit dual marital organizations of the kind Lévi-Strauss discussed. Lévi-Strauss' dual marital organizations, White and Houseman (2002) argue, cannot apply to Leach's (1961) marriage data from Pul Eliya in Sri Lanka, a Dravidian kinship system in which all sidedness marriage rules are purely local; however, they posit that despite the local nature of sidedness, global sidedness patterns could emerge. Indeed when the marital data were analyzed using Pajek, White and Houseman (2002) found:

A social model of sidedness was evident in the patterns of marriage with cognates. Further, a *shared decision model* of marriage choice—prohibiting marriage with properly sided cognates—was implied by the social model. (p. 24)

The exceptions to the social model of sidedness stem from patterned cognatic exceptions to patrilineal inheritance and normal virilocal residence.²

This kind of social network analysis provides a way of interrogating genealogical data at high levels to address complex theoretical questions about culture theory, social models, and decision-making models. Pajek and P-graph (Batagelj & Mrvar, 1998; White & Jorion, 1992) analyze the patterns of connections among nodes in a network and generate appropriate graphical maps of such networks. When dealing with formal organigrams from corporate institutions, such maps may be unnecessary. But if one is interested in the clusters of relationships that emerge from real connections among nodes in a social context, then such a tool is indispensable.

XML Kinship Editor

When looking for tools to process genealogical data, we sought packages that rendered the data in reasonable graphical form for dissemination both in the field and in publication and research seminars, but equally we sought easily exportable text versions of the data. BK, consequently, did not satisfy our needs. FM and ohmiGene resolved some issues, but the prob-

lems of ethnocentric assumptions about marriage and family persisted. Each of us initially sought a tool that would allow us to enter genealogical data as our informants presented it to us. Fischer (1999), at the Centre for Social Anthropology and Computing at the University of Kent, has produced a package that addressed many of our needs. The CSAC XML Kinship Editor is not a tool for computerphobes (nor are Pajek or P-graph, for that matter), but it does a number of things that are notable for their utility in dealing with anthropological problems. First, it effectively resolves exportability issues by storing all data in XML as the native format. The data need not be exported at all, in fact. The XML Kinship Editor saves all data in an XML text file that can be opened directly in any text editor. Second, the Kinship Editor makes no assumptions about what kind of person may be joined in a union, nor about the number of people who may be joined in a union that serves to legitimize offspring. So Nuer ghost marriage, woman-woman marriage (Evans-Pritchard, 1951; Hutchinson, 1996), or Navajo nadle unions (Cucchiari, 1981) are as unproblematic as polygynous, polyandrous, serial monogamist, or lifelong monogamist unions (at least at the level of data entry and graphical representation, if not at the level of sociological explanations).

Although XML Kinship Editor data files are not meant to be edited by hand, it is in fact remarkably easy to decipher the relationships among people in the data set from an examination of the XML data file. This is in contrast to the GEDCOM output of ohmiGene, which is decipherable but only with some effort (see Table 1). Readability at this level is actually irrelevant, but versatility in usage of the data is not. GEDCOM, we suggest, would be adequate if nongenealogical editors and other packages were being developed to use this format. However that does not seem to be the case. Consequently, XML seems the safer option for the foreseeable future (the XML can be converted to other formats, such as GEDCOM, or even into a computer program, as in Fischer, 1999).

One feature of the XML Kinship Editor that, as far as we know, is unique among genealogical packages is called step-to. Users define a beginning and ending year, and the package steps through that period year by year. This shows a yearly snapshot of births, beginnings of unions, ends of unions, and deaths. It does not sound particularly impressive, but we have found this to be one of the more powerful features of the program (see the case of Bhalot, Pakistan, below for a brief description of how this affected the direction of Lyon's research while in the field).

In addition to the XML Kinship Editor, Fischer (Fischer, Kortendick, & Zeitlyn, 1996) has produced the CSAC XML Fieldnotes Editor and the XML Fieldnotes Search Engine (<http://csac.anthropology.ac.uk/XML/Tools/>). These provide software implementation for the inclusion of a user-expandable collection of metadata for formally coding the context around field notes. CSAC software, as powerful and versatile as it is, unfortunately remains disconnected. The various tools are clearly converging and have been designed to operate seamlessly, but they are not yet at that point. They are sufficiently robust to provide a coherent if isolated set of tools, and the framework in which they may operate together to address complex anthropological issues is visible on the horizon but for the moment slightly beyond reach. These criticisms notwithstanding, we present below some anthropological puzzles that emerged as a direct result of the use of the XML Kinship Editor. In the first case, the Kinship Editor highlighted phenomena that contradicted local perception. In the second, the anthropologist was made aware of a particular period that required additional investigation thanks to genealogical software. And the third case raises the importance of modularity and integration among anthropological software tools.

Table 1
Comparison of Text Output in GEDCOM Format and XML Format

GEDCOM Export generated by ohmiGene	XML native format of CSAC XML Kinship Editor
<pre> 0 @I1@ INDI 1 NAME A/MALIK/ 1 SEX M 1 BIRT 2 DATE 1 APR, 1959 1 FAMS @F1@ 1 RIN 2005-07-10 23:53:34 #084913 Malik 0 @I2@ INDI 1 NAME /MALIKA B/ 1 SEX F 1 BIRT 2 DATE 1 APR, 1963 1 FAMS @F1@ 1 RIN 2005-07-10 23:54:22 #409769 Malik 0 @I3@ INDI 1 NAME /MALIK C/ 1 SEX M 1 BIRT 2 DATE 1 APR, 1910 1 DEAT 2 DATE 1 APR, 1982 2 AGE 72y 1 FAMS @F2@ 1 RIN 2005-07-10 23:54:58 #700188 Malik 0 @I4@ INDI 1 NAME /MALIK D/ 1 SEX M 1 BIRT 2 DATE 1 APR, 1900 1 DEAT 2 DATE 1 APR, 1970 2 AGE 70y 1 FAMS @F3@ 1 RIN 2005-07-10 23:56:19 #682946 Malik </pre>	<pre> <person> <name>Malika E</name><id>4</id><sex>Female</sex> <stats><born q="9">NA</born><died q="9">NA</died></stats> <location><x>235</x><y>81</y></location> <comment>No Comment</comment> </person> <person> <name>Malik A</name><id>5</id><sex>Male</sex> <stats><born q="9">NA</born><died q="9">NA</died></stats> <location><x>316</x><y>146</y></location> <comment>No Comment</comment> </person> <person> <name>Malika B</name><id>6</id><sex>Female</sex> <stats><born q="9">NA</born><died q="9">NA</died></stats> <location><x>368</x><y>147</y></location> <comment>No Comment</comment> </person> </pre>

Addressing Anthropological Problems

The best method for assessing whether software does something interesting is of course to use it with real data. We have done this with three real anthropological problems in different parts of the world. First, we discuss Magliveras' attempt to use nonspecialist software to make sense of complex networks of kinship and patronage in a Greek village. Second, we describe Lyon's analysis of complex marital ties among family branches in a Pakistani village. Third, we outline the obstacles to developing e-science tools for interrogating and analyzing diverse and disparate data (including genealogies) in the Southern Highlands of Papua New Guinea.

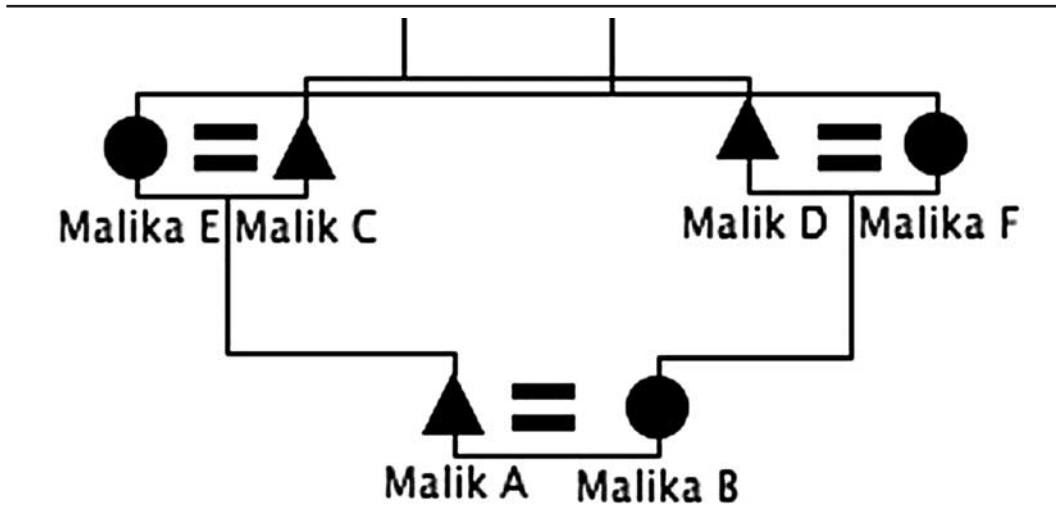
Gogofis, Greece

Gogofis (pseudonym) is an agricultural village near Athens. The majority of residents of Gogofis are known as *Arvanites* in Greece, indicating distant Albanian ancestry. Some Arvanite lineages might extend more than 800 years because the ancestors had lived in some part of modern day Albania. In addition to this group, Gogofis is home to more recent Albanian immigrants (people who have come since shortly after the death of Hoxha and the collapse of the communist regime) and Athenian commuters. Magliveras' study concentrates on the complex interactions between Arvanites and Albanians.³ Among Arvanites, both patrilineal and matrilineal kin are enmeshed in ongoing reciprocal obligations for goods, services, and other kinds of support. Previously, the Arvanites constituted an endogamous marriage group as well, but as across the European Mediterranean, such preferential marriage practices are giving way to more individualistic choices.⁴

In addition to recognizable consanguinal and affinal networks, Gogofians have a number of other kinds of social networks that affect behavior, thought, and identity. The extent to which extrafamilial networks challenge kin networks is complicated and debatable. Magliveras' study of identity, agency, and structure in Gogofis suggests, unsurprisingly for anthropologists, that individuals actively manipulate available network structures. Therefore it is necessary not only to map the formal mechanisms for inclusion in and exclusion from various social networks but also to have some way of charting actual instances of social interaction. The social interaction must include kinship networks, in particular marriage bonds that unite households, but must also incorporate complex kin-like patron-client networks of a kind of adoption between adult Albanian men and Arvanite families. Kin ties, combined with these quasi-kin ties nominally based on a perception of shared ancestry, are critical to explanatory models of individual and social identity among Arvanites and Albanians in Gogofis.

Initially, Magliveras attempted to use BK to record and analyze these different types of networks. The software permitted enough of what he wanted that he pursued it despite its obvious limitations. In the end, he was forced to concede that the range of output reports that BK offered simply did not provide him with the kinds of graphical representations that enabled greater understanding of the interplay among consanguinal, affinal, adopted, and patronage social networks. The software cannot be said to be flawed because Magliveras was exceeding the package's parameters. He then painstakingly reentered the kinship data into the CSAC XML Kinship Editor, which makes no assumptions about the kinds of unions permitted or the relative importance of any given lineage or set of relationships. Although the XML Kinship Editor does not perform social network analyses like Pajek, it nevertheless permits the networks to be graphically mapped. Although this may sound a trivial ability, it can be remarkably powerful to produce a formal, graphical representation of complex human relationships, even without a computational analysis of the connections among nodes. Magliveras almost immediately identified aspects of Albanian social networking that challenged his intuitive understanding of the significance of the various support networks available in the village. Rather than large social networks assuming the most importance, Magliveras found a correlation among Albanian men who were at the hub of smaller networks being the most materially successful. Once recognized, this becomes straightforward to investigate, and the conclusions, although speculative at present, seem to suggest that the larger networks demand greater obligations of reciprocity and that kin reciprocity, in particular, may be sufficiently asymmetrical to where it is a positive disadvantage to have too much

Figure 1
Malik A and His Wife, Malika B, Are First Cousin
on Both Their Paternal and Maternal Sides



kin. What is exciting about this kind of observation is that it contradicts received wisdom in the village that kinship is vital for success. Magliveras' hypothesis suggests that some kin are critical to success, but as in a Greek tragedy, too much of a good thing leads to catastrophe.

Such a restricted finding does not allow us to speculate on the links between linguistic models and social models, as White and Houseman (2002) were able to do with the Pul Eliya data. However, sometimes just a simple result can spur additional research in fruitful ways.

Bhalot, Punjab, Pakistan

Lyon's previous work on patron-client networks, local politics (Lyon, 2004a), conflict negotiation (Lyon, 2004b), and cultural systems (Lyon, 2004a, 2004b, 2005a) mostly stops short of extensive use of software beyond the use of including formal metadescrptors for field notes, video and audio files, and still images.⁵ In the process of collating genealogical data to produce small pedigree charts to use in the field, however, he discovered something interesting about the timing of marital links in the village of Bhalot, Pakistan. When Lyon arrived in the village in early 1998, he was confronted with two branches of the same family who had extensive marital connections. His host proudly proclaimed that he was a first cousin to his wife on both his father's and his mother's side. His father had married his first cousin, who was sister to his wife's mother. His wife's mother had married her first cousin, who happened to be the brother of her husband's father (see Figure 1).

When Lyon entered genealogical data going back as far as the early 19th century, he discovered that for most of that time, the division between these branches of the landowning family was pronounced and characterized by a complete absence of marriage unions for nearly a century. The divisions between the two branches had been apparent before Lyon

examined them in the XML Kinship Editor, but the step-to feature made it apparent that the decision to reunite the two branches may have been a calculated one on the part of two influential leaders of the two branches in the 1940s. These two men systematically arranged marriages between the branch known as the Upper Maliks (those who live at the peak of the small mountain in the center of the village) and that known as the Lower Maliks (those who live at the base of the same mountain). The step-to feature progresses year by year for a period designated by the user. Abrupt changes in demographic patterns tend to jump out during the step-to run. It was in running the entire genealogy (for the entertainment of his informants more than anything else) that Lyon was struck by a social phenomena that required greater investigation.

As with Magliveras' correlation between network size and material success, Lyon was left with a puzzle rather than an answer, but often a clearly identified puzzle is worth far more than a straightforward answer. An answer to a question is satisfying because it means something is reasonably well understood, but ideally it should flag areas of ignorance as well. The pursuit of the puzzle leads to more systematic and powerful descriptions and explanations. Rieber (1989) wrote of Bateson that he understood that to develop new ways of conceptualizing phenomena one must ask impertinent questions, questions that defy the "hand-me-down Cartesian epistemology that nineteenth-century materialism had bequeathed to twentieth-century social science" (p. 1). But this is far more difficult than one imagines it to be at the outset of field research. The baggage of implicit assumptions about the ways societies are is profound and has weakened more than one ethnography in the brief history of anthropology. We do not vainly claim to have resolved this dilemma through the use of the XML Kinship Editor, but we argue that in some way this software enabled Lyon to impertinently ask new questions of data he thought he knew rather well.

Was Valley, Southern Highlands, Papua New Guinea⁶

The final example we present here does not represent a successful use of a kinship package. In fact, it has made us come face to face with the limitations of any standalone software package. Since 2004, Lyon and Sillitoe (of Durham University) have worked with Fischer and Zeitlyn (of the University of Kent) on an ambitious e-social science pilot project. Working with different data types collected by Sillitoe since the 1970s, they have been attempting to resolve the problems of interrogating rich, disparate data sets from multiple user entry points. Anthropologists familiar with genealogical pedigrees have the option of using the genealogy to query individuals who are then linked to census data from different years, geospatial data about the residence of particular people, gardens, and crops, and other data about how people used the forest resources around them. Moreover, they want to use this data in conjunction with satellite images and meteorological data to contribute something usable and productive in developing conservation policy at regional levels and, more important, to enable local people to make informed decisions about how they chose to utilize their own resources. The Was Valley, in the Southern Highlands of Papua New Guinea, is remote and difficult to access at the best of times. When the political climate of the Highlands becomes actively violent, as it has during the past decade, it becomes practically unfeasible for outside researchers to carry out ground-proofing surveys necessary to make sense of remote aerial and satellite images. Consequently, the e-social science project seeks to devise ways not only of coordinating disparate data types (including genealogical data) but of doing so across net-

works distributed spatially and temporally. To add to the difficulties, the tools must accommodate a gross divergence of computational power, ranging from simple handheld machines to state-of-the-art multiprocessor servers, and they should perform these tasks as seamlessly as possible so that the computationally intensive tasks can be distributed to high-performance computers, whereas the less performant machines provided other functions. Obviously the asynchronous nature of this project renders it substantially different from the standard perception of e-science as high performance, pervasive computing (often characterized as being grid based). We suggest that this project provides a glimpse of what kinship packages must cope with in the very near future.

E-Science Tools, Distributed Processes, and Disparate Goals

One of our demands of genealogical software packages to be used in anthropological research is that the data be easily exportable and usable elsewhere. We identified XML as a preferable format because we see it as likely to be one of the persistently supported formats in the next few years, and there are a lot of existing open source packages that can be used to store, retrieve, and transform data in XML format. We now add to that what looks set to be a demand of the future. Not only should the data be exportable, but the package itself should be modular and integrable with other packages that do things other than those nominally related to genealogies or kinship. For this reason, we suggest that the approach of GEDCOM utilities may be a viable way for the future when generalized. The CSAC XML Kinship Editor follows this ethos of modularity and object orientation. The software tools are task oriented, and as the tasks become more complex, so too can the software be bent to perform different functions. Pajek, with its power for social networks analysis, offers functionality that would be a welcome addition to the XML Kinship Editor, but integration between the two packages could be improved (e.g., an XML transformation can be made to Pajek format). This would then simplify research such as that being carried out by Magliveras that demands the incorporation of different kinds of networks. Similarly, it may be advantageous to combine genealogical analysis with terminological analysis, bringing together the XML Kinship Editor with the KAES (Read & Behrens, 1990; see this issue). Fischer, Lyon, and Read (2005) suggest that anthropology has much to offer to e-science and much to gain. The organization of culture and knowledge demonstrated by human populations is quite simply staggering in the ways in which potential chaos is rendered meaningful and ordered in real time. Such a transformation could not take place if every person had to define the orders and the meanings from scratch, but, nevertheless, every person is confronted with absolutely new situations that must be made meaningful. Kinship is clearly one of the mechanisms for establishing relationships (or order) among people (or nodes or categories), and this is apparently done using remarkably time- and energy-efficient means and processes that can be described (or modeled) by algebras in every human population. Such information processing systems can be studied, described, and modeled. Kinship is such a system, but there are others that also require such scrutiny. Our hope is that these disparate information processing systems (operating on possibly contradictory or independent logics) will be integrated in our models to reflect the ways in which they are integrated in human culture.

Ballonoff (2000) argues that anthropology should be a hard science. However to do that, anthropologists must generate a mathematics of culture. Producing a means of mathematical description for some aspects of social interaction and culture have been done (notably kinship and language), and it is imaginable that others could be produced with relatively little effort, but Ballonoff proposes more far-reaching mathematical anthropological theories akin to the theory of thermodynamics. The result, we think, will be far more complex than are the rules that describe the behavior of heat exchange, nevertheless we endorse Ballonoff's goal and suggest that an important step in this direction is a more distributed approach to data management. In other words, an e-science approach has the potential to provide the data necessary to satisfy Ballonoff's call for a mathematical theory of culture. Lyon (2004b, 2005a) has argued elsewhere, in agreement with Leaf (1972, 2004, 2005), that it is operationally most useful to suppose that culture is not a unified monolithic system but rather a system of systems (kinship system, faction system, religious system, etc.). We know that knowledge, motivation, and capacity are not evenly distributed across individuals, and we know that this does not appear to impede people's abilities to create common cultural patterns that conform to some rules or systematic principles. Thus we believe that a mathematics of culture should not imply a monolithic reductionist mathematics to describe some contorted version of a norm from a particular part of a cultural group (nor does Ballonoff, 2000, for that matter) but that instead distinct mathematical systems that describe and predict options, contexts, behaviors, and attitudes within discreet cultural systems must still surely conform to some principles of global cultural mathematics. Chit Hlaing (2005) argues that contradictory systemic rules need not exclude the existence of global structure and cites as an example the coexistence of different laws of physics for different levels of phenomena in the universe (Newtonian and Einsteinian). One set of rules works in one context but not the other. That does not mean that the different contexts exist in different universes but rather that the higher level structure must be generic in kind and accommodate contradictory subsystems.

Conclusion

We suggest that kinship is one of a set of critical cultural systems in humans. Substantial work has been done on different aspects of terminologies and genealogies and the links among kinship and other cultural systems, so this broad topic provides a useful way to move forward toward a more systematic science of anthropology. In this article, we have suggested that not all of the software anthropologists use needs to necessarily be complicated or powerful, nor does it need to address high level theoretical issues. Sometimes the simplest tools may be the most appropriate. We have suggested that the commercial display packages for family trees, despite their limitations, may indeed provide some utility in the right circumstances, though with the caveat that such packages easily reach the breaking point when dealing with non-Western European kinship systems. We summarized the possibilities of more complex analysis and how social network analysis software can enhance the analysis of genealogical data and in particular marital alliances. We then provided two brief examples of where our research was stimulated not by complicated software that analyzed large numbers of connections among genealogical nodes but by simple features of a graphical representative package (albeit one that makes no assumptions about family or union composition). Finally, we argue that the ideology underpinning e-science provides a powerful set of concepts for enhancing the way anthropologists work with data. We suggest that distributed pro-

cesses and data require modularity, compatibility, and data about the data for computational processes to occur and that our choice of a software tool reflects this desire to see a more rigorous and expansive e-science approach as a legitimate and valued theme in anthropology.

Notes

1. Rarity notwithstanding, even among ohmiGene's target audience, the legitimization of same sex unions is currently undergoing reexamination in Western Europe and North America, particularly in Spain and Canada and with the Anglican Church in the United States, and increasingly same sex couples are permitted to adopt.
2. This is where the bride and groom reside in the groom's family home.
3. This section describes part of Magliveras' doctoral research.
4. Individual choice may be a misleading way to characterize current spouse selection patterns. As with the marital patterns of Pul Eliya, distributed local choices may still result in global patterns, suggesting something other than total individual freewill is certainly involved.
5. This section is based on Lyon's ongoing investigations of patron-client networks and local politics in Pakistan and among Pakistani diaspora (see Lyon 2004a, 2004b, 2005a, 2005b).
6. This section is from Fischer, Sillitoe, Zeitlyn, and Lyon's Economic and Social Research Council-funded collaborative project building on Sillitoe's (1988, 1996, 2000) extended longitudinal study of the Wola peoples of the Was Valley.

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