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Sided with Omaha but no Twist:

Three Logics of Alyawarra Kinship *

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Abstract

This paper derives from an experiment in quantitative fieldwork, conducted in Central Australia in 1971-72, that was designed explicitly to explore differences between what Aborigines actually did and what they said they did when anthropologists interviewed them. Here we use genealogical network analysis in relation to data collected in this experiment to examine descent, marriage and kinship, including which kinship terms were applied to which relatives for a large sample of informants. The rich cognitive and network ethnography of the Alyawarra offers a test of and counterargument to the proposition that for any given culture to operate coherently, only a single logic is possible. Here, three logics are operative. Examining relationships amongst these three logics at the level of practice shows that they form a coherent dynamical system oriented towards demographically and strategically inflected adaptation. A strictly normative approach to modeling Alyawarra kinship would be misleading as a theoretical paradigm. We argue for broader frameworks that take into account the interplay of multiple cultural logics as integral within a networked system of kinship practices.

In Logic1 the Alyawarra strictly adhere to marriage rules and 'normative' kinship terms that conform to marriage sections (cross-cutting exogamous sides) and unnamed endogamous matrimoieties that unify interleaved alternating generations. In Logic 2, the axiom of generational closure – that successive sibling-in-law links close into cycles in an endogamous group – does not apply because female age at marriage is significantly lower than that of males, as is common in Australian systems. The resulting extra-normative age bias yields recurrent patterns of marriage between patrilineages that are much more likely to be asymmetric (classificatory MMBDD marriages) than symmetric (as with sister exchange, for example). In addition, patterns of marriage among the deceased are quickly forgotten, and no longer cast their shadow as a constraint on future behaviors. Thus wife-givers and wife-takers may engage in exceptional marriages that

inflect Logic2 behaviors into new systemic patterns leading to lineage remapping of generations. This allows the "kinship system" to evolve dynamically across a class of network models influenced stochastically by age distributions at marriage. In Logic3, the unintended effect of demography (H>W age differences) is supplemented by widespread and intended use of extra-normative Omaha terminology as an exclusionary device that says, "don't marry here", but does so nonreciprocally.

Introduction

The rich cognitive and network ethnography of the Alyawarra offers a test of and counterargument to the proposition that for any given culture to operate coherently, only a single logic is possible. First, the Alyawarra strictly adhere to Logic1 in which 'normative' kinship terms conform to a marriage pattern of sidedness composed of binary supersets of named exogamous unilineal descent groups. There are both matri- and patri-sided exogamous bipartite supersets ('sides'), however, and they cross-cut one another to form doubly-sided sections. The four sections are named, but not the exogamous patri-sides, the exogamous matri-sides, or the alternating generations that form interleaved endogamous matrimoieties (the latter are not 'sided' because they are not exogamous). As with the neighboring Aranda, marriage occurs only between a delimited subset of those in the permitted pairs of sections, so there are effectively eight subsections (among the Northern Aranda, these are named. Spencer and Gillen 1927:320-322 describe how the various group leaders led meetings to legislate changes from four to eight-section marriage rules, for example). These are consistent with both the 'normative' kinship terms and rules that prohibit MBD marriage but permit MMBDD and FMBSD, as is common with subsection systems.

Second, because female age at marriage is significantly lower than that of males, the axiom of generational closure – successive sibling-in-law links that close into cycles – does not apply. The age bias yields Logic2 in which recurrent patterns of marriage between patrilineages are highly asymmetric, like classificatory MMBDD marriage, rather than symmetric, as in sister exchange. Marriage practices associated with Logic2 lie within the 'norms' of Logic1, although the conventional 'genealogical' diagram for Aranda-Alyawarra type of kinship terms created by Radclifffe-Brown (1930) shows equivalence classes in which sister exchanges and bilateral second cousin marriages are permitted. His model of the Aranda "system" is one of delayed direct exchange between classificatory patrilines, following the erroneous logic of his diagram. In fact, neither sister exchange nor bilateral second cousin marriages occur among the Aranda or Alyawarra. To remedy this defect – a problem in interpreting equivalence classes in classificatory kinship terminologies – of the conventional Radclifffe-Brown model of Aranda-type section systems, Denham et al. (1979) made two previous proposals. Firstly, they created an 'open format' model of directed wife-giving relationships in which women's generational time runs 50% faster than that of men. This is the model that we call Logic2. Secondly, they created a closed double helix version of these same equivalence classes in spiraling generations that close back on themselves cyclically (we call this a helical Logic2). They found that the open format model and double helix variant could account for both the 'normative' Aranda-Alyawarra kinship terms and the stated preferences in both cases for MMBDD marriage. What they could not explain, however, was why so very many classificatory kinship terms of the Alyawarra (23%) were non-reciprocal and why Omaha terms were often employed as an exceptional pattern outside the 'normative' pattern of kin-term usage.

In this study we use network analysis – and methods for the empirical study of equivalence classes with respect to actual behavioral patterns – to help resolve the problems still unsolved with the double helix model. A network analysis of equivalence sets, conforming to the fact that members of local patrilineages are observed to forget the matrilineal ties of departed ancestors, establishes that Logic2 is one of generations that have time intervals of different length for men and women, and are shallow, open-ended, flexible, and extensible so as to include alliances with neighboring groups. We argue that since patterns of marriage among cohorts that have departed are successively erased, these patterns fail to constrain the emergence of new patterns in cohorts where marriages are taking place more than four generations later. Thus the network pattern does not form a structure that closes on itself with a fixed algebraic kinship structure, like the double helix model, but is a limited and partial realization of that model. This finding is consistent with a dynamic of alternative marriage choices that, as their network locations and frequencies change within the possibilities offered by Logics 1 and 2, alter the very topology of the kinship and marriage network. Wife-giving and wife-taking choices of members of the named patrilineages may be realized as exceptional marriages that inflect behaviors generated by Logic2 into new systemic patterns that lead to lineage remapping of generations. This allows the kinship pattern to evolve dynamically across a class of network models (Tjon Sie Fat 1983) influenced stochastically by age distributions at marriage. This opens up the possibility of a new understanding of the evolution of social organization in Australian societies, where age differences between spouses, and classificatory terminologies consistent with section systems, are very common.

The unintended effect of the demography of H>W age differences resulting from a preference dynamic is supplemented by Logic3, the widespread and intended use of an extra-'normative' Omaha terminology. A detailed analysis shows this usage to correspond to an exclusionary device that says "don't marry here," but does so nonreciprocally.

Examining relationships amongst Logics 1-3 at the level of practice shows how they form a coherent dynamical system oriented towards demographically and strategically inflected adaptation. A strictly 'normative' approach to modeling Alyawarra kinship would be misleading as a theoretical paradigm. We argue for a broader framework that takes into account the interplay of multiple cultural logics as integral within a networked system of kinship practices.

Field Methods and Data Structures

Hiatt's (1996) *Arguments about Aborigines* is a history of Australian Aboriginal anthropology that skillfully and sympathetically demonstrates the nature and extent of the intellectual conservatism that has characterized his discipline since the 19th and early 20th centuries. Although the discipline has long been characterized by controversies over the roles of Aborigines in human cultural evolution, Hiatt demonstrates that the controversies have occurred largely within the narrow confines of the original parameters laid down by the discipline's founding fathers, and shows how the self-sealing, puncture proof nature of the original parameters has determined the kinds of questions, methods and answers that can be accepted as legitimate contributions toward resolving the arguments. The complete absence from Hiatt's book of references to mathematical anthropology accurately reflects the longstanding marginality or irrelevance of quantitative data and mathematical analysis to his discipline.

Against this background, this paper derives from an experiment in quantitatively oriented field-work conducted in Central Australia thirty years ago. The experiment was designed explicitly to explore differences between what Aborigines actually did and what they said they did when anthropologists interviewed them. The attempt to discover what they did rested on observing and recording their activities, then using computers to seek and extract patterns in numerically coded data that would not have appeared in traditional ethnographic data.

Denham designed the Alyawarra project in the late 1960s and conducted it in 1971-72. The project was designed explicitly to use methods that were being developed then to perform observational field studies of nonhuman primate behavior, and at the same time to capitalize on the advantages of working with a population whose members had human cognitive and linguistic capacities (Denham 1978).

The project was conducted with 264 Alyawarra speaking Aboriginal people living at MacDonald Downs and Derry Downs Stations (henceforth abbreviated as MD-DD) about 160 miles north-east of Alice Springs, Northern Territory. The White Australian family of Charles and Rose Chalmers who operated these and adjacent cattle stations were highly sympathetic to the Aboriginal people whom they had known intimately since 1923, and served as a buffer between them and the harsh realities of the alien White world that was encroaching rapidly.

The research population lived in four semi-permanent camps spread over a distance of 54 road miles. The camp in which Denham lived and worked had a typical population of about 100 people and was by far the most remote and isolated of the four. The people were no longer nomadic in the traditional sense, but remained highly mobile among these four camps, as well as between this cluster of camps and other camps, cattle stations and towns in the southeastern quarter of the Northern Territory. They obtained most of their meat by hunting kangaroo, but received most of their flour, sugar, tea, bread, fruits, etc. from government rations. Under these conditions of semi-provisioning, they maintained much of their traditional lifestyle with little interference from Whites or "detribalized" Aborigines living at Alice Springs or Warrabri Settlement.

The project yielded the following data files, all of which are now available on the Alyawarra Archive CD and are becoming available on the web (Denham 2002; in prep.):

- File01 Genealogies and vital statistics - 377 records
- File02 Census data - 264 records
- File03-20 digitized maps of 17 Alyawarra camps
- File21 Meteorological records - 146 days
- File22 Kinship term applications - 104 egos x 225 alters = 23,400 applications
- File23 Sleeping Group Compositions - 162 records
- File24 Residential Group Compositions - 258 records
- File25 Task Group Compositions - 2490 records
- File26-27 Observation distribution records
- File28-78 Behavior Observations - 41,809 records of numerically coded data derived from 200 hours of observations spanning 86 days
- Documents - 500+ pages of field notes and historical letters

- Photographs - 217 portraits, 90 B+W prints, 230 color slides, 7 air photos
- Other graphics - 3 Alyawarra Territory Dreaming maps,17 camp maps, 12 residence plans, 30 sketches
- Genealogical diagrams containing all people belonging to the 17 countries represented in the research population
- Audio recordings - 14 hours raw, 77 minutes edited

In addition, the Alyawarra Archive CD includes approximately 2000 pages of documentation including relevant publications that preceded the fieldwork, all published and unpublished papers that derived from the fieldwork, and papers by others who have used or otherwise responded to the Alyawarra data. It also includes the Group Compositions in Band Societies Data Base which contains numerically coded genealogical censuses from the Alyawarra and comparable genealogical censuses from 40 other hunter-gatherer societies from around the world with a total of 9000+ people spanning the period 1775 - 1975.

The Alyawarra project was designed from the outset to yield this Archive. Consequently each step in the research has presupposed the prior existence or the development of appropriate methods to generate the archive.

The field research emphasized what people actually did in their day to day lives. That focus never precluded more traditional ethnographic data collection, but the emphasis at all times was primarily on what they did and secondarily on what they said they did. Likewise, the research emphasized quantitative or numerically coded data collection that was compatible from the very outset with computer assisted data analysis. Finally each component of the data collection process was done as systematically and exhaustively as possible within the time constraints of the project, but some components required various kinds of sampling.

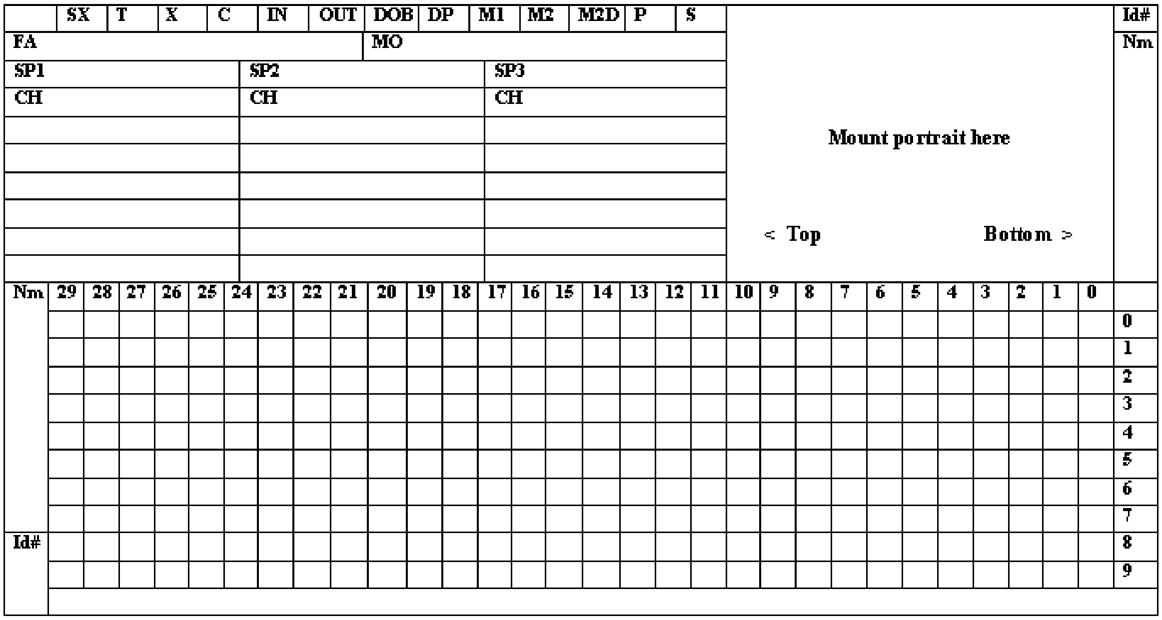
Since the body of this paper deals specifically with genealogical, demographic and kinship data, the remainder of this section deals exclusively with field methods used to generate those datasets. A detailed discussion of the full range of methods used in the Alyawarra project appears in Denham (1978).

Photodeck Denham recorded all vital statistics, genealogies, and kinship data on specially printed 6 x 8 inch cards, one card per person. The sample photodeck card in Figure 1 is basically the same as the cards used in the field, but it embodies several minor improvements that resulted from the field experience. It can be modified in a great many ways to fit diverse requirements. See Rose (1960) for a similar design.

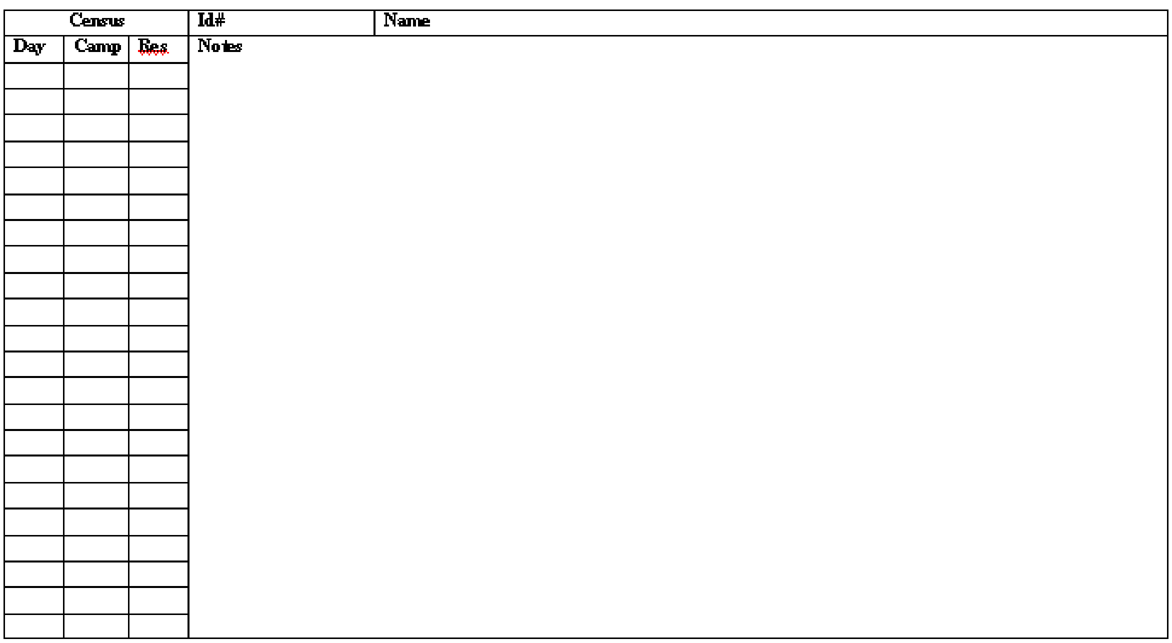
On the front, the upper right corner holds a Polaroid portrait of the person to whom the card is assigned, the upper left corner holds vital statistics and genealogical data, and the lower half contains a form for recording kinship terms used by the person in the photograph. The back of the card holds census data, the results of sortings discussed below, and miscellaneous notes about the person.

During the early weeks of the project, Denham made two portraits of each of 225 Aboriginal people at MD-DD, mounted one on the card assigned to the person, and gave the other to the person for his or her own use.

Figure 1: Photodeck Card



Front



Back

Vital Statistics When Denham photographed a person, or when a person officially joined the population without being photographed, Denham assigned a unique Personal Identification Number (ID) to the person and entered that number in designated spaces on each side of the card. At that time or as soon as possible thereafter he entered the following data on the person's card:

- Required: European name, sex (SX), date of birth (DB), current marital status (M1), patrilineage or clan (C) and section (S) membership; names of his or her father (FA), mother (MO), spouse(s) (SP1,SP2,SP3), and all known children (Ch); day on which the person was known to have joined the population (IN).
- As needed: date of puberty (DP), date of change in marital status (M2,M2D); date of death of parent (P), spouse (S), or self (OUT); date the person moved out of the research population (OUT).

Data quality control has been a central feature of the project. There are no known errors in Personal Identification Number, sex, and section (hence, partimoiety as well). We believe all data on current marital status is correct, but it is possible that a very few people who appear in the data as never having been married may, in fact, have been widowed or permanently separated (i.e., divorced) prior to the beginning of the project. Because of the distances separating the four camps, Denham often failed to learn immediately when someone joined or left the population by in- or out-migration, so some data bearing on these events have an accuracy no better than + 10 days. Dates of all births that occurred during the fieldwork are accurate to +2 days, death dates are correct, and dates of puberty and marriage, both of which mark fairly conspicuous changes in one's residence, probably are accurate to ±10 days.

Determining ages of people born before Denham arrived was somewhat more difficult. The Chalmers family, during their half-century at MD-DD, had compiled and maintained birth records for the Aboriginal people who were born at MD-DD, but their records did not cover everyone in the research population. From these records, which served as the primary source of most age data, Denham extracted dates of birth - with a probable accuracy of ±10 days for most of the people under twenty years old and ±1 year for older people - and computed the age of each person there (age =1972 - year of birth). Ages of people who did not appear in the Chalmers' records were determined with the Chalmers' assistance while validating the primary age data. Denham used four independent procedures to verify the age data (see Denham 1978). Although we are virtually certain that undetected age errors remain, we believe they are rare enough and small enough to be disregarded safely. Where they exist, they almost certainly are confined to the upper end of the age spectrum.

The photodeck was a powerful instrument for eliciting additional vital statistics data, for completing the genealogies, and for eliciting all of the kinship data. The people learned to sort the cards according to their own criteria and criteria that Denham proposed, to order the cards on the basis of genealogical relations and to label the cards in accordance with their own kinship terminology. Sorting, ordering, and labeling were done frequently by almost everyone in the population, but no one ever became a "key informant" for this or any other purpose.

Their sorting of the cards on the basis of patrilineage membership confirmed exiting data and added much more that Denham was unable to obtain as he compiled the photodeck. Generally speaking, we are more confident of the accuracy of membership data for large descent groups than for small ones. Because of tight logical connections among moiety, section, and country affiliations, and parent-child and spouse relationships, most errors in these data were detected and corrected in the field.

Language Group Affiliations Denham had the people sort the cards in the photodeck to clarify as much as possible the question of linguistic affiliations. During the first month of the fieldwork, he was assured repeatedly that everyone in the population was Alyawarra, but as the work progressed, it became increasingly obvious that such purity was not to be found at MD-DD. Everyone could understand and speak the Alyawarra dialect, but some had learned it as a second language.

Near the end of the project, Denham asked four independent groups of people to sort 217 cards from the photodeck, indicating that he was interested in the topic of tribal affiliation, but with the meaning of the concept being unclear to him and unspecified to them. The groups, in the order in which they did the sorting, were composed of five men, five women, three women, and three men. The first two groups sorted the cards on a single afternoon at Gurlanda camp, and the last two sorted them on the following morning at Bendaijerem camp. There was no known contact between the two camps, or between members of the two groups in each camp, while these data were being collected. Each sorting group had to reach consensus before a card was placed in a final category. Each time the cards were sorted, Denham made an entry on each card to designate the linguistic group to which the photographed person was said to belong. The complete list of dialects named in conjunction with these sortings contained four entries: Alyawarra, Aranda, Anmitjira, and Warramunga.

There was unanimous agreement that 173 of the people were Alyawarra and that 13 were Aranda. Three out of four groups concluded that 12 of the remaining 31 people were Alyawarra and that one of them was Aranda. That left 18 people whose linguistic or tribal affiliations were unclear despite vigorous debates that surrounded some of the decisions. Although Anmitjira and Warramunga were mentioned several times each, no one was classified unambiguously as being a member of either group.

By examining genealogical data for 45 people whose portraits were not used in these sortings, Denham determined that, of the total population of 264 people, 220 were Alyawarra (100% or 75% agreement), 21 were Aranda (100% or 75% agreement), and 23 were of unclear linguistic affiliations. This approach to the question of tribal affiliations yielded the data on that topic which appear in the data base.

Although the research focused on the Alyawarra, the Aranda speakers and those with unclear linguistic affiliations were active members of the research population, and their genealogical networks and kinterm data are included in the database.

Genealogies Denham obtained much of the genealogical data by recording the identities of parents and spouses at the time each person officially joined the research population, but many people did not have living parents or spouses. Furthermore, the Alyawarra refuse to mention the names of the dead and are reluctant even to acknowledge the prior existence of deceased infants. For this reason, Denham did not attempt to obtain any information about deceased infants.

It was possible, however, to use the photodeck to reconstruct genealogies upwards through deceased ancestors without violating the injunction against directly mentioning the dead. By arranging portraits of living people to illustrate known parent-child, sibling, and spouse relationships, then extending the process upwards with blank cards representing deceased ancestors and their siblings, it was possible to obtain this information without encountering any resistance. To each deceased person identified this way, he assigned a unique personal identification number in a sequence separate from that of living people, and added that person to the vital statistics file. Since there were no restrictions on discussing lineage and section affiliations of those ancestors, he obtained and recorded this information as he constructed the genealogies. Without the photodeck doing this job would have been virtually impossible; with it, construction of the genealogies for all 264 members of the population was a straightforward though time-consuming process.

Kinship Data After Denham finished making the portraits and attaching them to the cards, he used the photos and known genealogical relations between selected, well-known and well-documented pairs of people to elicit kinship terms and their relational *significata* in strict accordance with Tax's (1937) six rules or principles that serve as structural features of kinship terminologies as presented elegantly by Scheffler (1982). In other words, Denham used Rivers' genealogical method to learn the Alyawarra kinship vocabulary, to define the normative kinship data relationally and ultimately to generate Logic1 below. He simply could not imagine any other thorough, systematic way to obtain an initial understanding of Alyawarra kinship.

Next, in a move that proved to be controversial, Denham recorded one and only one kinship term that each ego applied to each alter, and gave the Aboriginal speakers complete control over which term to use. The technique was to select a person whose portrait was in the deck, and to show to that person, one card at a time, all of the portraits in the deck, including his or her own. As each portrait appeared, the informant (ego) gave Denham one kinship term that he or she used to refer to the person in the portrait (alter). Denham entered a number corresponding to that term on ego's card in the cell corresponding to the personal identification number assigned to alter. The result was a list of 225 terms from each of 104 carefully selected and broadly representative egos, yielding a total of 23,400 kinship responses elicited under standardized conditions.

In addition to "typographical" errors that occurred in this and all other data sets, both in the field and in subsequent data processing, the kinship data were subject to errors of identification when informants were responding to the portraits. Denham attempted to handle this problem by giving most of the people a great deal of practice in using the photodeck before kinterm elicitation began, and by encouraging more than one person to be present when kinterms were being elicited.

Sometimes ego arrived at a single term for alter very easily, but at other times he or she engaged in lengthy debates with other people who participated in the elicitation sessions before deciding which term should be recorded. It was common to hear people say, "Tell him the proper Alyawarra way" as these discussions proceeded. And on a few occasions an informant came to Denham several days later, often with two or three other people, and corrected an earlier response based on continued discussions that had occurred after the elicitation session ended. We conclude that every attempt was made by everyone to provide the "best" term in all cases, and the last half of this paper represents various attempts to decide precisely what "best" means in this context.

As kinship data accumulated in the field, it was apparent that the dataset contained many nonuniform kinterm reciprocals; i.e., the pair of kinship terms that ego and alter used for each other often did not agree with the normative data described above. Denham was acutely aware that each pair of people could be related through no known geneapath, one and only one geneapath, or multiple nonredundant geneapaths of equal or unequal length. To deal with this fact, he assumed that *all* of the nonuniform kinterm reciprocals could have been resolved through further inquiry and that each resolution would have agreed with the reciprocal relations embedded in the terminology based on Tax's rules.

In other words, following traditional anthropological practice Denham might have investigated what the people *could* have said if he had asked them to eliminate the many "discrepancies" in the data. Instead, he chose to investigate the relationship between what the people *could* have done (*viz*., use their kinship terms as uniform reciprocals in accordance with Tax's rules) and what they actually did under one specific set of standardized elicitation conditions (*viz*., apply the terms in such a way that the blooming, buzzing confusion of the real world prevailed over the sterility of the ivory tower).

Logic2 and Logic3 as introduced below represent attempts to reconcile the two different domains of kinship semantics and kinship pragmatics, using genealogical and demographic data to this end. To provide an accurate baseline for four-section kinship terminology, we also introduce Logic0. To introduce the analysis of logics in relation to how they are realized in actual behavior, the logics are listed in Table 1 by level of embedding, one logic in another, ordered from 0-3, the type of logic (formal or pragmatic), how the logic is operative, the level of operation, the operative rules, and the percentage fit to behavior. We explain the percentage fit to behavior as well as each of the other elements of this table, as we go along.

Table 1: Four Logics Operative in Alyawarra Kinship

Logic	Type	Operation	Operative Level	Operative Rules	Percentage Fit of Behavior
Logic0	**Formal**	Egocentric	Semantics	Tetradic Model	98%
		Sociocentric	Kin Terms	Kin Types: W,WB	84%
Logic1	**Formal**			Opposite patri-side	87%
				Same patri-side	67%
Logic2	**Pragmatic**	Emergent	Age Groupings	Network Positions	75% +/-
Logic3	**Pragmatic**	Signaling	Exclusion	Omaha Terms	W,WB 16%

A Logic0 Baseline for Sections

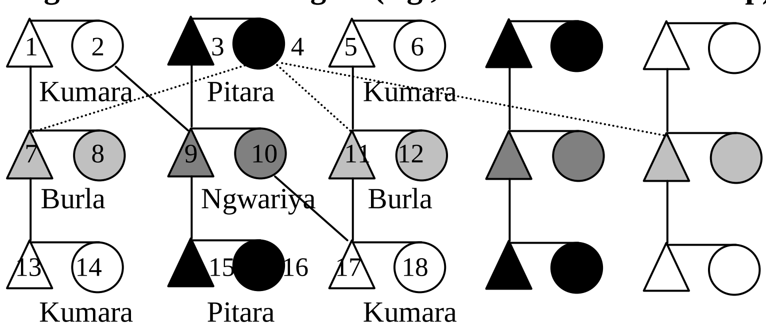
Logic0. Tetradic rules for (four-) section systems are constituted by three local principles of equivalence classes amongst relatives, plus a fourth proviso that these rules apply uniformly throughout the society:

1. Equivalence of siblings but nonequivalence of cross-cousins.
2. Equivalence of alternating generations in male and female lines.
3. Marriage cannot take place between those of the same equivalence class.

4. All rules apply uniformly, and uniformly to equivalence classes (if the brothers in an equivalence class marry into another such class, then so do the sisters, and vice versa).

In Figure 2, triangles and circles denote equivalence classes of males and females, respectively, and a horizontal line denotes that all the cross-sex siblings of one set are members of the other. A vertical or diagonal like denotes that all the children of the upper set are to be found in the lower sets (male or female). Given the equivalence class labeled 1, those of 3-18 are also determined locally, including the distinctness of the black nodes which follows from the uniformity of rule 2. This model makes no assumptions about marriageability except that a woman who belongs to the white circle class marries a man who belongs to black triangle class. Globally, however, since marriage does not take place between those of the same equivalence class, these rules imply a minimum of four exogamous equivalence classes. In this diagram, a male ego in equivalence set 1 (and siblings) is assumed to be a member of section K (Kumara), and the semantic rules for other sections apply to P (Pityara), B (Burla) and N (Ngwariya). The Aranda equivalents with the semantic rules of Figure 2 are K=Kumara P=Bultara B=Purula and N= Panunga.

Figure 2: Tetradic Logic0 (e.g., of Section Membership)



Logic0, as diagrammed in Figure 2, omits a full depiction of how classificatory marriages might be organized. Only certain couples in paired equivalence sets 2/3 and 10/11 are necessarily married, since they have children in common, as in sets 9/10 and 17/18. Further, alternate colums of sibling sets in this diagram may be either collapsed or further differentiated. One instantiation of this might have only two columns, another four, another six, and so forth. The five columns shown in Figure 2 are merely suggestive. How people from other sets other than 2/3 and 10/11 choose to marry, for example, with numbered sets potentially extending on ad infinitum, is underdetermined, as shown by the multiple sets of dotted lines from female 4: are her children in equivalence sets 7-8, assuming she marries into equivalence set 1, or in equivalence sets 11-12, assuming she marries into equivalence set 5? Logic0 is not required to make such an assignment. It is simply a semantic system (Scheffler 1978) for assigning equivalence class memberships according to rules of descent and affinity. If we "close" the semantics by a further equivalence logic by giving children in class 7-8 'mothers' in class 4 have and repeat this pattern in the next generation (to define 'parents' everywhere), we have a 'Kariera' type equivalence class logic, for example. If we give children in class 11-12 'mothers' in class 4, give children in class 15-16 'mothers' in class 8, and so forth until we define 'parents' everywhere by symmetric rules, we have defined an 'Aranda' type equivalence class logic. We could, however, add any number of further generations and extend the rules of affinity and descent to make any number of additional columns in such a diagram. The children of female 3 need only be located in one of the Burla equivalence classes. This possibility suggests that there are more ways to organize classificatory marriages here than simply the Aranda and Kariera logics.

Anthropological Fictions and Generalizations. A common inference made by anthropologists is that section systems imply marriage rules. The Tetradic Logic in Figure 2 implies only one such rule: a man and a woman who have a child (e.g., a man and woman in positions 2 and 3 who have a son and daughter in positions 9 and 10) are assumed to be members of a pair of sections that are allowed to marry. Many of the other "readings" of the logic of classificatory systems, as we explain below, are category errors and overgeneralizations on the part of anthropologists, ones that are highly distrusted, for example, by Hiatt (1996).

The Logic0 formulation in Figure 2 does correspond to the Tetradic Model proposed by Allen (1986, 1989a,b) but is sufficiently general that there is no need to decide *a priori* or require agreement among informants as to whether to interpret these four equivalence classes as sections, pairings of eight subsections, two intersecting exogamous moieties, one hereditary through males, the other through females, or an endogamous generational moiety intersecting with an exogamous patrimoiety, to name a few of the possibilities. Among these, the Alyawarra have named sections but no named patrimoieties nor matrimoieties nor named subsections. But any and all of these formulations might be consistent with the Tetradic Model, whether or not they exist in the minds or linguistic usage of informants.

Earlier Alyawarra Kinship Analysis

Exploratory analysis of the rich body of numerically coded demographic, genealogical and kinship data that emerged from the Alyawarra project demonstrated that Alyawarra kinship was in many ways consistent with traditional models of Central Australian systems, but in other ways displayed significant anomalies (Denham, McDaniel and Atkins, 1979).

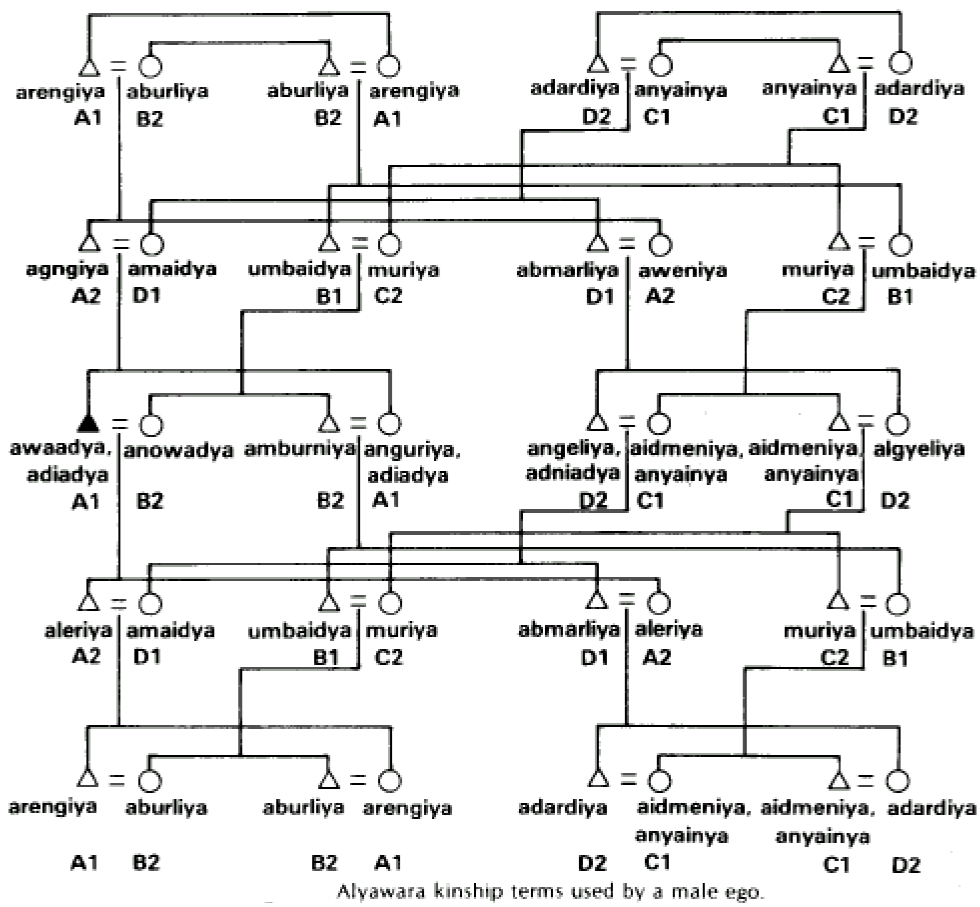
Since the research population consisted of Alyawarra (83%), Aranda (8%) and others (9%) all of whom lived within what was traditionally Alyawarra Territory, this analysis of descent, marriage and kinship focuses on the Alyawarra but includes data from Aranda and others as well. The Alyawarra are eastern neighbors of the Aranda. Their kinship system resembles that of the Eastern Aranda who use a 4-section system, but differs in this regard from the Aranda further west who use 8-subsection systems. Nevertheless Alyawarra kinship terms very closely resemble those reported by Spencer and Gillen (1927) for Aranda in the Alice Springs area at the beginning of the 20th century, and the normative structure that underlies those terms closely resembles that built into the Kariera model used by Radcliffe-Brown (1930) and his intellectual heirs.

Figures 2-4 below take same-sex sibling sets as the units of analysis and seek patterns in the ways they are related to each other. Although the formats of the diagrams in Figures 3-4 are unconventional, all of these Figures employ conventional genealogical and kinship symbols.

The remainder of this section contains an overview of two rather different ways to approach the Alyawarra data from the perspective of same-sex sibling sets, and introduces the problems that stimulated us to develop a third approach. It summarizes then goes beyond the findings reported in Denham et al. (1979).

Logic1 Radcliffe-Brownian Model Logic1 is a model in the manner of Radcliffe-Brown (1930) that focuses exclusively on language, rules and normative data and incorporates ideal genealogical relationships as well as kinship and section terms. It rests squarely on Tax's (1937) rules as elucidated by Scheffler (1982), and it accurately represents what the Alyawarra say they do. As a purely normative model, its merits have enabled it to persist with reference to various Aboriginal societies since the 1930s. We might think of this as a "default option" for trying to make sense of kinship in Central Australian section systems. For Denham et al. (1979) it was the first model tested against the Alyawarra data. The model has one nice feature, which is that it

Figure 3. Logic1 Radcliffe-Brownian model.



generates a set of genealogically-based kinship "positions" that appear to correspond to each of the Alyawarra (and, in a similar vein, Aranda) kinship terms. No doubt this was its appeal to Radcliffe-Brown. These "positions" are in reality, however, equivalence classes that categorize genealogical relatives, and not actual genealogical relatives. This "model" seems to assert, in the first instance, that all marriages are sister exchanges, and in the second instance, that all marriages are bilateral second cousins. As we shall see, these are mistaken inferences.

When Denham et al. moved beyond kinship terminology and rules and began to examine genealogical relationships and kinship term applications among the people to whom the terminology and rules purportedly applied, they discovered that the rules often were not very effective at explaining or predicting behavior. As a closed logical system insulated from the day to day behavior of the Alyawarra this version of Logic1 (and of Logic0) made plenty of sense, but as a guide to action it was of limited utility.

Some have argued that such a logical system or model constitutes only part of what determines people's behavior and cannot be tested legitimately by examining the extent to which behavior complies with it. But it goes without saying in the sciences that the most effective way to evaluate a model is to test it with data that were not used to construct the model in the first place; i.e., model building and model testing should not be tautological.

If there were no discernable relationship between Alyawarra rules and Alyawarra behavior we might be sympathetic to the argument that rules and behavior lie in different domains. But such is not the case here. In some ways Alyawarra rules and actions display very close fits, in other ways actions fit the rules moderately but imperfectly, and in still other ways actions are entirely systematic but are so far removed from the rules as to suggest the operation of another set of rules radically different from those embedded in Logic1.

Logic2 Age Biased Model Logic2 reflects the first attempt of Denham et al. (1979) to understand widespread and systematic differences between what the Alyawarra did and what they said they did. The objective here was to retain as much of Logic1 as possible because of its good fit with practices in some areas and to modify it as needed to accommodate incompatible practices.

McDaniel's quantitative analysis of the Alyawarra data in 1976 used FORTRAN, SPSS and SOCSIM software to extract 240,000 nonredundant genealogical paths connecting discrete pairs of individuals, to group together ego-alter pairs according to the nature of their linkages, to attach kinship term applications and demographic data to the pairs, and to print the results to facilitate a manual search for deeper patterns underlying the surface patterns that the computer detected.

This analytical process revealed that the single greatest problem with Logic1 was that it was based on the “hoary old anthropological assumption" that Atkins (1981:390) called the “axiom of generational closure"; i.e., “the tacit but widely accepted supposition that any ‘normal’ kinship system - or at least every proper model of such a system - must entail an infinite or open series of successive genealogical generations each of which is not only discrete but also closed.”

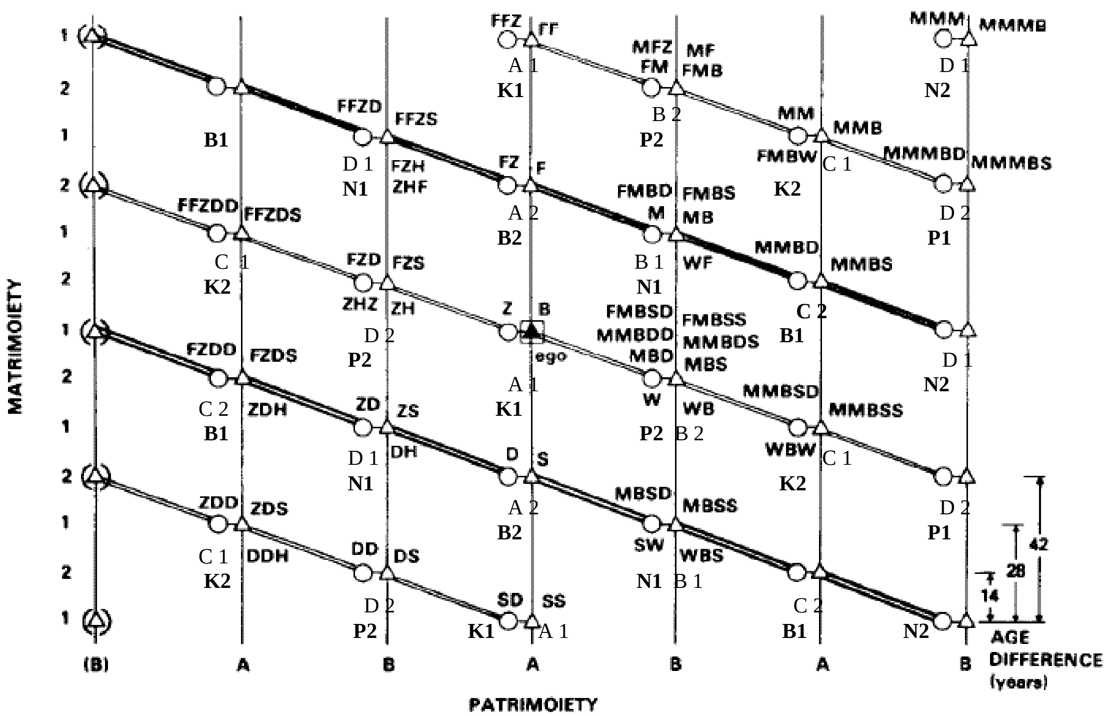
A model of Central Australian kinship that incorporates the axiom of generational closure by its very nature has no place to accommodate often large mean differences between the ages of husbands and wives among Aborigines. Yet the Alyawarra data revealed a 14-year F>M or H>W age disparity that cannot be dismissed as atypical for Australian systems, and certainly is too large to be neglected by kinship theorists. Specifically the systematic F>M mean age difference of 14 years precluded brother-sister exchange, [1]while at the same time it biased marriages by male egos in favor of real or classificatory MBD and MMBDD and against FZD (Hammel 1976). These and other profound effects of the age bias, including a strong tendency towards asymmetric exchange between patrilineages, were observed to ramify throughout the structure and operation of the system.

By failing to accommodate the age bias, a vital extra-normative variable, Logic1 was insulated from the real lives of real people whose behavior complied to some extent with the normative model but deviated from it both systematically and extensively. In other words, we concluded that a model of Alyawarra kinship, marriage and descent that deals with what people actually do rather than confining itself to what they say they do must incorporate demographic realities.

An alternative to the axiom of generational closure is to redefine the concept of "generation" in a less ethnocentric manner. Bell (1993:19) says that Alyawarra women at Warrabri Settlement in the 1970s often spoke *"of their siblings, cousins, grandparents and grandchildren as belonging to the same generation level",* and remarks that her own anthropological training was a hindrance to her understanding and their attempts to clarify created confusion. The italicized line from Bell's brief report, prepared by someone who apparently knew noting of our work, is a capsule description of our Logic2.

Figure 4 represents Atkins' open format Logic2 diagram for an arrangement of Alyawarra classificatory lineages that accommodates (1) age differences between spouses, (2) an asymmetric order of classificatory patrilines that move from left to right in terms of wife-giving (leftmost in an adjacent pair) and wife-taking (rightmost in an adjacent pair), and (3) distinct kinship positions

Figure 4. Alyawarra Logic2 (open format)



Key: Assuming that ego is in section K, then **K,P,B,N** are section designations and **K1,K2**, through **N1,N2** are implicit 8-subsection designations. A 1, A 2, B 1, B 2, C 1, C 2, D 1 and D 2 are distinct kin terms consistent with 8 implicit subsections.

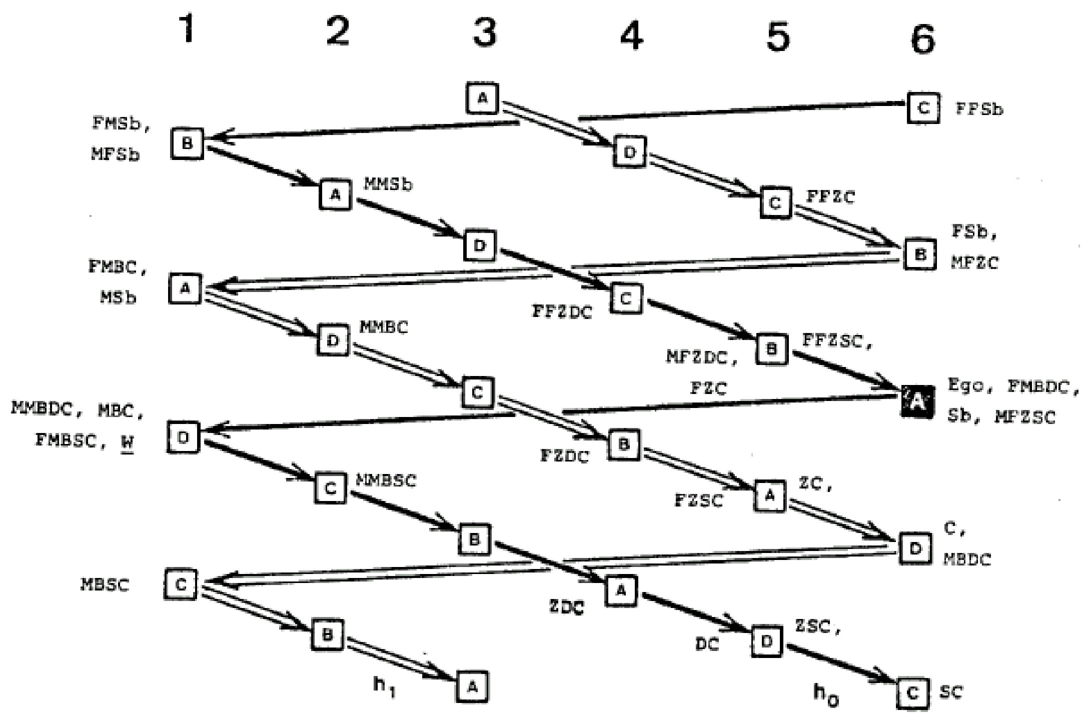
in the classificatory array that correspond to distinctive kinship terms. Note that while Denham et al. (1979) labeled this an "age-biased *Kariera*-type system" it does incorporate the kin-term distinctions consistent with the eight sub-section divisions (A 1, A 2, B 1, B 2, C 1, C 2, D 1, D 2 as we have labeled them in the diagram. These designations for eight-sub-section equivalence classes for the Alyawarra kinship terms (each of which contains several distinctive kinship terms) are precisely those employed by Denham et al. (1979:7). This is the model that we will refer to as "Logic2."

Atkins' double helix model of Alyawarra kinship goes further to derive a helical Logic2 (a special version of Logic2) that also incorporates the strengths of Logic1 but rests on a finite set of open generations rather than an infinite set of closed generations.

> "It is a 6-patriline, 4-matriline representation in which the generations are discrete, unclosed, and just two (2) in number. Each of the latter winds helically and endlessly down through genealogical time, in direct reflection of the large Alyawarra parental and marital age biases. In this type of model, an intra-generational chain of connections of the form WBWB... does not cycle back to close at ego; instead, it is part of an open, eternal helix that includes ego's FFFF and FF before it reaches ego, and which again returns to ego's patriline at the positions SS, SSSS, etc. A second, complementary helical generation, separate and distinct from ego's own, includes ego's FFF, F, S, and SSS." (Atkins 1981:390)

The resulting model, shown in Figure 5 as depicted by Tjon Sie Fat (1983), embodies the Alyawarra conception of generations as subsequently and independently reported by Bell. It functions such that spouse giving and spouse taking happen asymmetrically, ego's sisters going to men who are on average 14 years older than ego and ego's wives coming from men who are on

Figure 5. Helical Logic2: an age biased model with a double helix 'twist'



Helical exchange structure $H(N_{pq}, 6, 3; r, .667)$. Alyawara-Wikmunkan type with direct exchange of FZDD.

average 14 years younger than ego. Thus brother-sister exchange is extremely unlikely if the sisters to be “exchanged” are on average 14 years younger than their brothers. Furthermore, a male ego’s MBD or MMBDD may be a potential spouse while his FZD is not. With a small number of patrilineages engaging in such exchanges in a four section system, the two generations pass through each lineage in turn and spiral around each other in a manner that can be best depicted, if carried on for a sufficient number of generations, as a double helix. The kinship terms that are used in this context are identical with those used in Logic1, but they work radically differently as can be seen by comparing the models of Logic1 and Logic2.

Tjon Sie Fat (1983) took the specific age biased model that Atkins designed for the Alyawarra as a starting point for developing a generalized age biased model that accommodates Logic1 and Helical Logic2 as described here, and goes beyond both of them to accommodate other extra-normative variables as well, including number of patrilines and matrilines, number of generations and H-W age differences. His generalization also accommodates McConnel’s (1939-40, 1950) age biased model of Wik Munkan kinship which fell on deaf ears when she published it.

Most importantly Tjon Sie Fat's work demonstrates that the generationally closed Logic1 is only one instantiation of a much more general model. If a society to which Logic1 applies has no systematic difference in spouses’ ages (i.e., H=W), Logic1 may be sufficient, in some sense, to represent the kinship system; i.e., the default option is acceptable. But if the society is characterized by a systematic H-W age difference, then the axiom of generational closure fails, the default option fails, and an age biased model *must* be invoked if there is to be any meaningful relationship between what the people do and what they say they do. The precise nature of the resulting age biased system is determined by the values of the variables in Tjon Sie Fat's model (also see Atkins 1982, Atkins and Denham 1981, Tjon Sie Fat 1981).

Logic1 became fossilized in the anthropological literature early in the 20th century due in part to anthropologists' ethnocentric conception of generations and in part to their failure or refusal to consider extra-normative data (in this case demographic data) that could have helped them to better understand what the Aboriginal Australians were actually doing in this domain. Since it did allow the preference for MMBDD marriage that Spencer and Gillen (1927:49) reported for the Aranda, this model remained stubbornly obdurate to the inconsistencies with the ethnographic facts. If MMBDD marriage were practiced consistently, for example, patterns of wife-giving and wife-taking between lineages would be asymmetric, whereas Radcliffe-Brown’s model is consistent with symmetric patterns of bilateral second cousin and sister exchanges.[2]

Remaining Problems Logic2 and its helical version accommodate Alyawarra normative data just as Logic1 does, and it accommodates the demographic realities much better than Logic1 does. But some problems remain.

First, the age biased model we published in 1979 was an ideal or abstract model, in that sense not unlike the Logic1 model. In designing Logic2 and its helical version we took into consideration quantitative field data concerning age relations and marriage practices, but we did not generate the model computationally and we had no technology with which to determine the precise fit between the Logic2 models and the Alyawarra data. So we left the work to be tested later or by others.

Second, while analyzing the numerical data upon which Logic2 rests, we discovered that about 23% of 3,200 kinterm applications displayed an anomalous "Omaha" pattern that was deeply imbedded in the so-called alternating generation pattern in Logic1 that typifies Central Australian kinship. The key to this anomaly is that a male ego applies the kinterm that normally glosses as "mother" to his own mother, to his mother's brother's daughter, and to his mother's brother's son's daughter. A systematic deviation of this magnitude from the standard alternating generation pattern could not be dismissed as random noise, but after making every feasible attempt to determine where the Omaha pattern came from and what it was doing there, we were unable to understand it in the context of either Logic1 or Logic2. So we left it as an unsolved problem and described it as such in the 1979 paper.

Now a quarter century later we have resumed work on the Alyawarra data. The remainder of this paper deals specifically with the quantitative fit between the data and the model, and with the Omaha problem.

Alyawarra Network Analysis

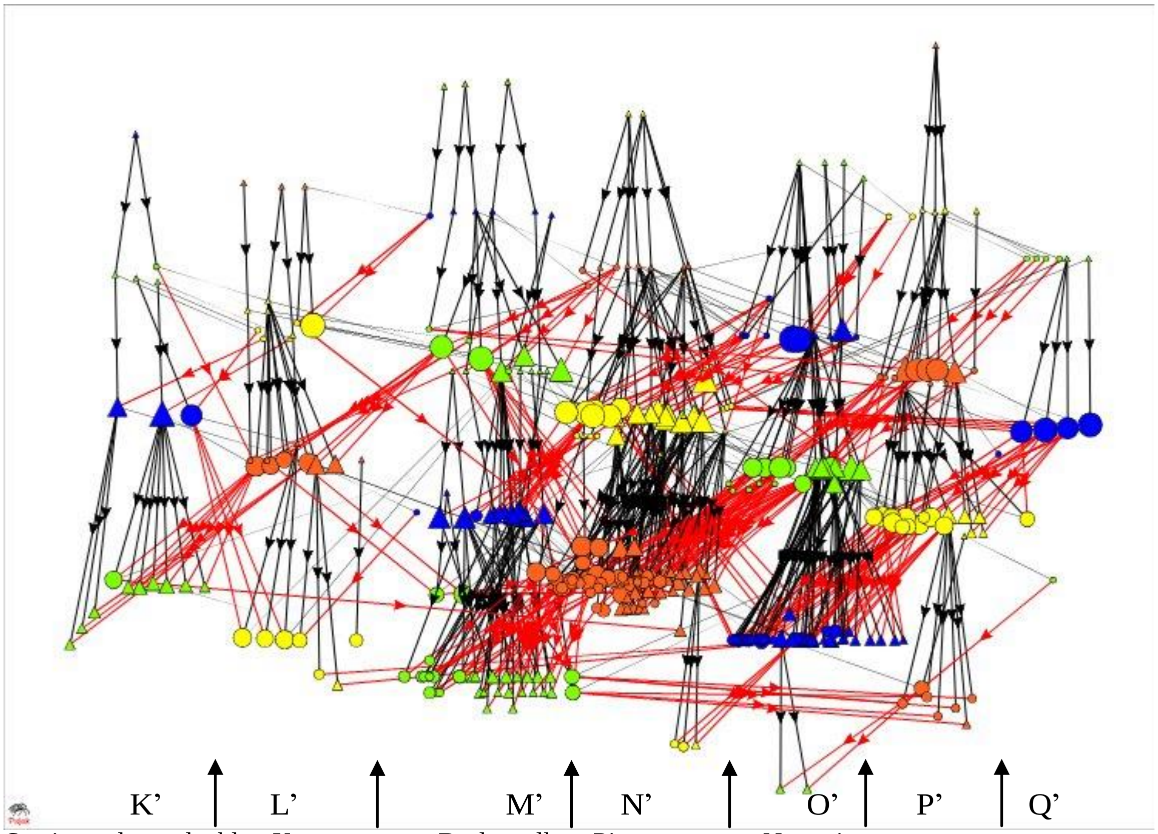
Introduction To this point the story has been more or less linear. Denham designed the field methods, collected the data and used the normative data to construct Logic1. McDaniel performed various computer based exploratory data analyses to determine exactly where and how the data failed to fit Logic1. Atkins constructed helical Logic2 to better accommodate certain aspects of the Alyawarra data. All of this work took same-sex sibling sets as the units of analysis and sought patterns in the ways they were related to each other.

From this point onward, we use an entirely different approach to the Alyawarra data. D.R. White joins the cast of characters bringing with him long experience with computer-based analysis of genealogical networks (Brudner and White 1997, White 1997, Houseman and White 1998, 2002, White and Schweizer 1998) and the use of Pajek software designed and developed by V. Batagelj and A. Mrvar (1998). Pajek, like White's earlier Pgraph software (White and Jorion 1992, 1996), is designed for the analysis and visual display of very large networks of any kind, including genealogical and marriage networks (de Nooy, Batagelj and Mrvar 2002).

Figure 6 uses circles for females and triangles for males as in Figures 2-4; but here two married individuals are connected to each other by a light blue line, each mother is connected to her children by red lines and each father to his children by black lines. The circles and triangles are colored according to known membership in one of the four sections. This graph of the genealogical and marriage network contains all 377 individuals in the Alyawarra database (198 males and 179 females), all 114 of the known marriages, all 323 links from children to their fathers and all 275 links from children to their mothers. The size of the nodes, except for the very smallest that represent missing data, is proportional to age of each individual, in 5-year age cohorts , e.g., 0-4, 5-9, up to 90-94.

Figure 6 is organized into classificatory patrilines determined by a simple algorithm for matching genealogical and inter-lineage marriage relationships to Logic2. The algorithm begins by taking the pair of lineages with the greatest number of intermarriages, and placing the lineage that predominates as wife-takers to the left of the one that predominates as wife-givers. The vertical

Figure 6. Fit between Alyawarra behavior and the Logic2 model: by Section



Section color code: blue-Kamara, green-Burla, yellow-Pityara, orange-Ngwariya

alignment of individuals in each generational cohort is then arranged so that the age-cohorts match across lineages. This alignment is usually not horizontal, as will be seen, but staggered. Let us call these two seed lineages M and N, out of a total of 54 lineages defined by patrilineal descent from a common (known) apical ancestor. Next, all other lineages that are predominantly wife-givers to M are added to a superclass of lineages that contains N, and now designated as a classificatory patriline, N'. Next, all other lineages that are predominantly wife-takers from lineages in N' are added to a new classificatory patriline, M', that contains M. This process is now repeated to identify potential classificatory patrilines. To the right of N' are added successive wife-givers O', P', Q', etc., until no more can be added. To the left of M' are added successive wife-takers L', K', J', etc., until no more can be added. At each stage the relative age cohorts are adjusted so that they are uniform across the diagram in the sense that the average age of each cohort for each classificatory patriline follows a regular progression. The arrows at the bottom of the figure show the dividing points between the classificatory patrilines derived by this procedure.

Alternating patrilineages K', M', O' and Q' belong to the Kamara and Burla sections, while L', N', and P' belong to Pityara and Ngwariya. Marriages are perfectly sided in the sense they all occur between two distinct sets of patrilines, and these sets correspond to the Kamara-Burla versus the Pityara-Ngwariya classificatory patrilines. The degree of sidedness in Australian societies, including the Alyawarra, is examined in Houseman (1997). Since Pityara and Ngwariya are in the same patrilines, their side of the bipartite marriage system forms an unnamed patrimoiety that intermarries with Kamara and Burla. In addition, however, the distinct sets of matrilines that belong to the Ngwariya-Burla pair of sections are on opposite sides of the bipartite marriage system as opposed to those that belong to Pityara and Kamara. These are standard features of Australian Logic1. Houseman and White's (1998) treatment of sidedness and 'doubly sided' marriage systems in the Amazonian context applies equally well in this context, although marriage choices in the Alyawarra context, as in many other Australian societies, has a much closer fit to double-sidedness (Houseman 1997).

Fit between Section Membership and Logic1. Actual marriages are in 98-100% agreement with the Logic1 section memberships,[3] as we have verified from a detailed examination of the data displayed in Figure 6:

- Yellow section A men marry green section B women and their children are red section C.
- Green section B men marry yellow section A women and their children are blue section D.
- Blue section D men marry red section women and their children are green section B.
- Red section C men marry blue section women and their children are yellow section A.

The network diagram in Figure 6, however, is not an abstraction as are the diagrams in Figures 2-4. Instead, by displaying real relationships among all of the real people in the Alyawarra database, it invites us to measure things that are not measurable in Figures 2-5. For example, in Figure 6 there are seven classificatory patrilines K' through Q'. This is an empirical determination based on the algorithm; there is no *a priori* cutoff for how many classificatory patrilines there should be. The algorithm that grouped lineages into classificatory patrilines, as described above, uses a well-established analytical algorithm based on regular equivalence (White and Reitz 1983, Reitz and White 1989; see also Hanneman 1998).

The central concept that each of Figures 2-6 have in common is "regular equivalence," although for Figure 2 (Logic1 of sections) the context is semantic (how section memberships are defined), while for Figures 3-5 the context is an equivalence-class model of kinship terminology. In Figure 6, the regular-equivalence principle is the grouping of actors in a social network of actual genealogical relationships of parents, children, siblings and spouses according to similarities in actor positions relative to other actors. Two actors are regularly equivalent if they are equally related to equivalent others (White and Reitz 1983; Borgatti, Everett, and Freeman, 1996: 128). In each of these applications, regular equivalence sets are composed of nodes (words, kin terms, actors) in a network that have similar relations to members of other regular equivalence sets. Historically, social scientists used attributes of actors to define social roles and to understand how they give rise to patterns of interaction. Regular equivalence analysis takes the opposite approach. It seeks to identify social roles by identifying regularities in patterns of network ties whether or not the occupants of the roles have names for their positions. Thus actual patterns of interaction are the regularities out of which roles emerge. In the case of the Alyawarra data, after applying the algorithm iteratively to its conclusion, regular-equivalent lineages are those that are wife-givers to regular-equivalent others as well as wife-takers from a different set of regular-equivalent others.

Fit between Marriage Behavior and Logic2 Diagrams such as Figure 6 lend themselves to evaluating the fit of detailed marriage behavior with section memberships and classificatory patrilines based on overall patterns of marriage behavior.

First, the predominant pattern of regular-equivalence among lineages in terms of asymmetric wife-giving and wife-taking is consistent with Logic2. About 74% of the marriages are consistent with this logic. But also the regular equivalence algorithm that generated Figure 6 reveals two marriage patterns that are exceptional to Logic2 and occur with lesser frequency than the main pattern of Logic2.

In the second pattern, groups L', M', N', O' have wife-givers one group to the left while groups K', L', M', N' have wife-takers, reciprocally, one group to the right. It tends to occur with husbands who are much older than their wives.

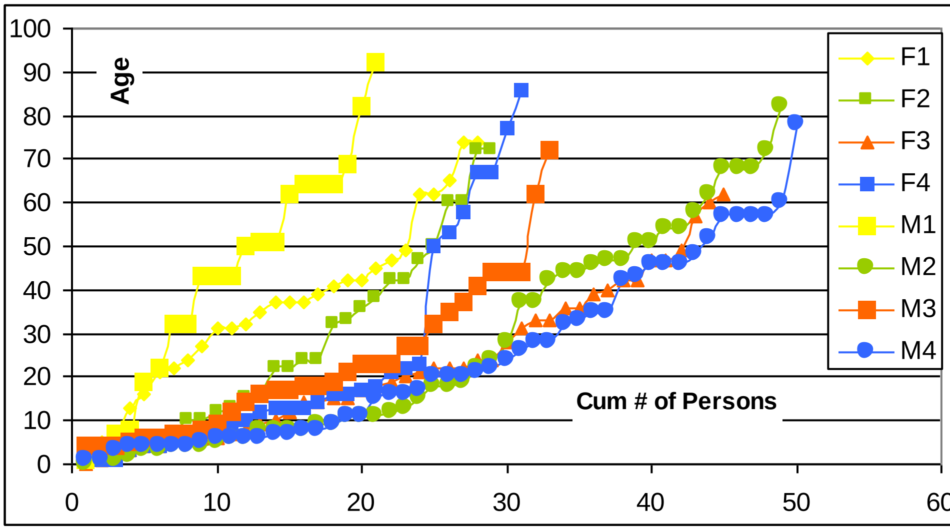
Third, another marriage pattern that is exceptional to Logic2 is that groups K', M' and O' have wife-takers three groups to the right while groups N', P' and Q' have wife-givers three groups to the left.

Overall, Figure 6 shows a frequency ordering of marriage patterns, described from a male perspective, to marry wives in age cohorts of the appropriate section that correspond to: (1) the average age difference consistent with Logic2 (H>W = 14 years), (2) a much younger cohort of wives (H>W ≅28 years), and (3) a same age cohort of wives (H>W ≅0 years). Variant2 approximately doubles the standard Logic2 age difference, while variant3 is what we would expect to see associated with Logic1. Thus a system such as this can have Logic1 and several variants of Logic2 operating concurrently but with different frequencies of occurrence, If the mean H-W age difference were to change, we would expect to see changes in those frequencies; if the mean were to drop to zero, the system would revert to "pure" Logic1. The co-occurrence of multiple variants in a single system is compatible with Tjon Sie Fat's (1983) model even though he does not mention the possibility.

The patterns of marriage that are both consistent with and exceptional to Logic2 correspond very closely with the demographic distribution of age differences between spouses, and with the numbers and age distributions of potential spouses available in each section. Table 2 shows that sections sA-sD differ in terms of total numbers of members in order sD>sC>sB>sA and in average ages in order sC> sD>sB>sA. There is also a major demographic difference between patrimoiety 1 (sB and sD), having more males, and patrimoiety 2 (sA and sC), having more females. Since members of each section differ in these demographics, and there are different numbers of available spouses for each of the different social categories that are most likely to intermarry, marriage patterns alternative to Logic2 will necessarily be found, and their frequencies will vary with the differing demographic frequencies of available spouses. Table 2 shows how the age demographics vary by gender for members of the four sections.

The import of all this is that as the demographics vary, including age differences between spouses, so will (1) the average inflection of the blue (marriage) and red (mother to children) lines in diagrams like Figure 4 (Logic2), and (2) the frequencies of exceptional marriages that do not fit Logic2. In the period under study, the blue lines inflect to an average of 14 years age difference between spouses, while the red lines inflect to an average of 28 years age difference between mothers and children.

Table 2: Demographics for the Four Sections



Sections
sA Yellow
sB Green
sC Orange
sD Blue
Totals: sD>sC>sB>sA
Ages: sC>sD>sB>sA
Ratios of Male/Fem:
sA F>M P2
sB M>F P1
sC F>M P2
sD M>F P1

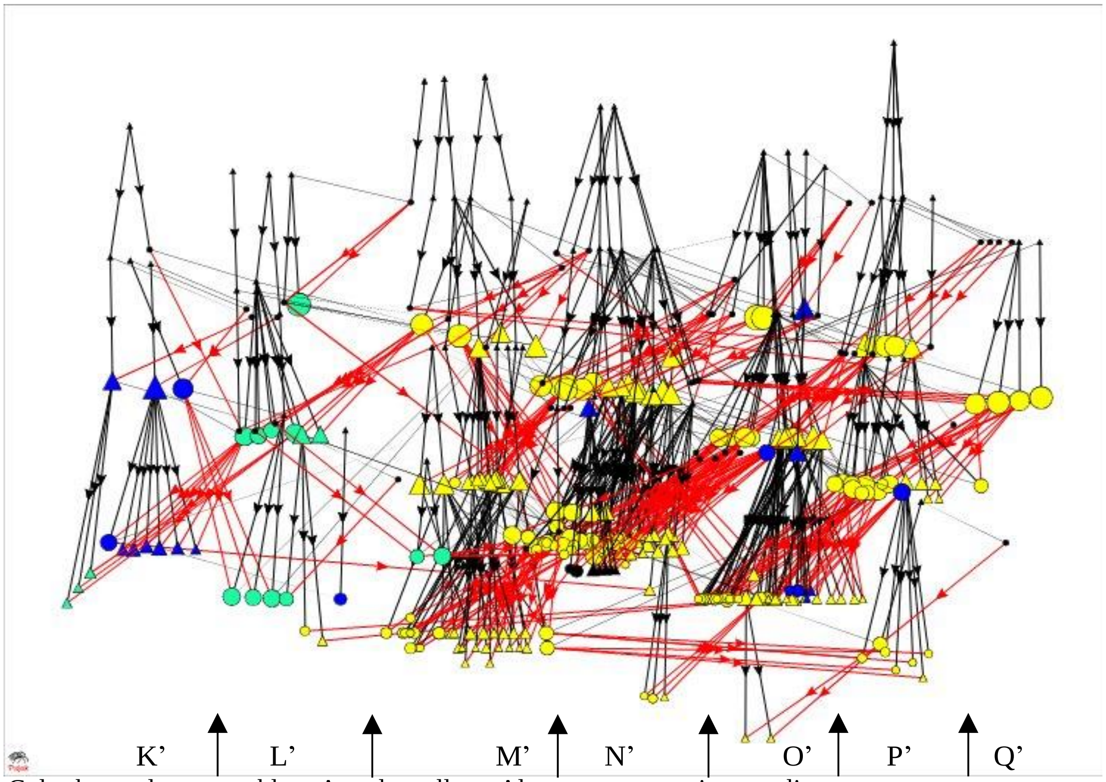
Thus, by constructing Figure 6 according to the logic of regular equivalence among categories of lineages and the categories of other lineages with whom they exchanged spouses, White was able to address one of the major unresolved questions about Logic2: To what extent does Alyawarra marriage behavior actually conform to the Logic2 model?

A further aspect of the answer to this question appears in Figure 7, in which Yellow nodes are Alyawarra speakers, Blue nodes are Aranda, and Green nodes are ambiguous as between Aranda and Alyawarra. There is also a fourth category, unknown, that corresponds to those for whom ages are lacking, most of whom are deceased. Figure 7 is identical with Figure 6 except that it takes into account the language spoken by each person.

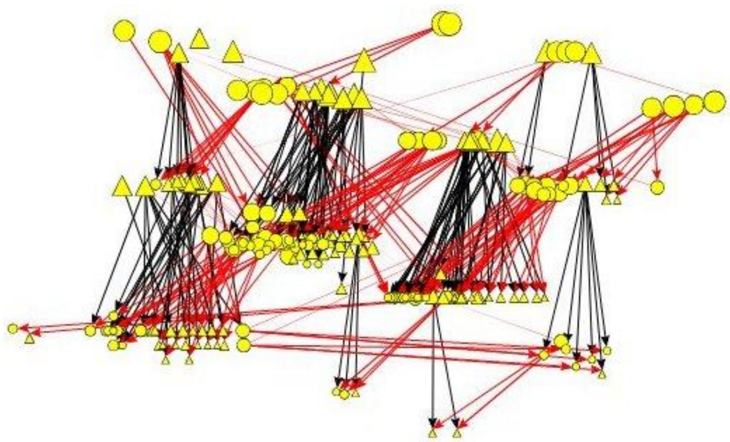
Figure 7 shows that among the Alyawarra speakers proper (the excised and reduplicated subgraph), there are five classificatory patrilines M' through Q' and five classificatory matrilines, mostly formed by the red lines running diagonally from sets of nodes at the upper right to other sets at the lower left, although the upper leftmost set of senior individuals do not follow this pattern. The asymmetric Logic2 marriage structure, however, extends beyond the Alyawarra proper: In the larger graph of all members of the study group, one of the matrilines runs far to the left to connect to children of patrilines of Aranda-Alyawarra and Aranda speakers who have intermarried with Alyawarra and intermarry in turn with Aranda patrilines.

In sum, red lines that follow a Logic2 pattern constitute 74% of the matrilineal links in the two Figures. They run in the continuous bands of red lines from sets of nodes at the upper right to other sets at the lower left. The remaining 26% constitute exceptions to the Logic2 pattern, and are easily identified since they run from nodes situated on the upper left of the children to whom they connect. They form part of the pattern of exceptions to the double helix model noted by Denham et al. (1979). As we have seen, these exceptions to Logic2 are expected from the fact that there is wide variance around the mean age difference between spouses.

Figure 7. Fit between Alyawarra behavior and the Logic2 model: by Language



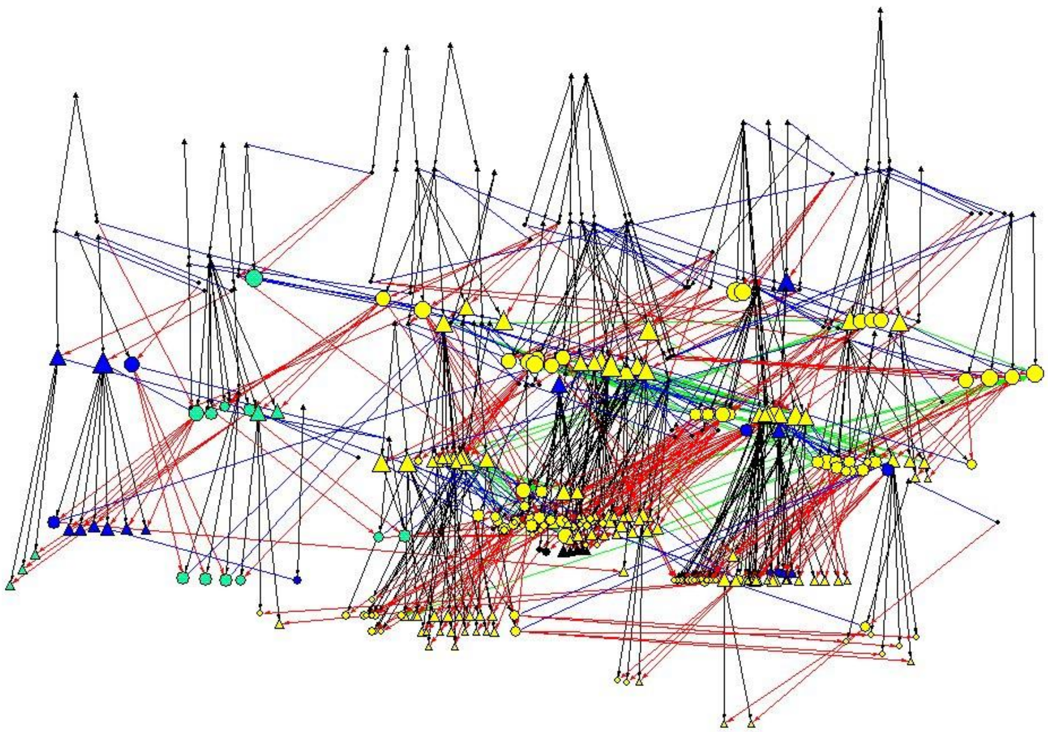
Color key to language: blue=Aranda, yellow=Alyawarra, green=intermediate



Kinship Term Consistency with Logic1 and Logic2 Alyawarra kinship terms (Denham, McDaniel, Atkins 1979: 7, 19), almost identical to Aranda terms, are consistent from grandparent down to grandchild with Logic0 and also with the finer distinctions of Logics1-2. At the level of terminology alone, without asking how the use of these terms is realized with respect to specific alters, there is little to distinguish Logics 1 and 2. None of the kin terms in Alyawarra or Aranda terminology distinguish to which of the two logics the terminology refers.

Logic3 The Omaha Problem Green lines in Figure 8, drawn for Alyawarra speakers only, link pairs of individuals who display non-reciprocal use of kinship terms such that ego classes alter as 'spouse' or 'sibling' while alter reciprocates with an Omaha term that classes ego as 'upper generation' and thus non-marriageable. None of these pairs actually marry, although the majority are in a marriageable class.

Figure 8. Omaha terms and the Logic2 model: by Language



In societies with frequent marriage between relatives linked by blood, marriage rules are often less ambiguous in their application even when there are multiple kinds of genealogical relationships between potential spouses. To assess whether this holds for the Alyawarra, we identified all blood marriages and children of blood marriages, and added all of their ancestors to form a network of relatives relinked by or the product of blood marriages. There were a total of 22 out of the total of 114 marriages (19%) that were between blood relatives. Of these, 17 had a single common ancestor, four had two distinct common ancestors and one had three distinct common ancestors. In four of the five cases with distinct common ancestors, the spouse's classificatory position was consistent with MMBDD marriage and in all but one case the wife was also a real MBD. The only exceptional case was a marriage of a man with a woman of the grandchild generation who was both a MBDDD and a FBDSD, neither of which fit Logic2.

In Figures 5 and 6 some marital pairs are connected with each other by two or more paths through the network, while others are more tenuously connected to the network by a single path. If we delete the tenuously connected or peripheral pairs, we retain only core members who are interconnected by two or more paths. Relationships within the core determine the structure of the network. Most of the following analyses deal only with marriages in the network core, or with other subsets of the data that fit specific criteria required for investigating the Omaha problem.

Figure 9 shows the total subnetwork of 70 individuals who are relinked through the children of blood marriages. Overall, as shown in Table 3, 30% of the marriages and mothers in this subnetwork involve females in a category that is not consistent with Logic2. This rate of exceptions is considerably higher than for the genealogical subnetwork of purely affinal relationships with those relinked by blood marriages removed.

Figure 9. Known Kin Terms for those in blood relinkings

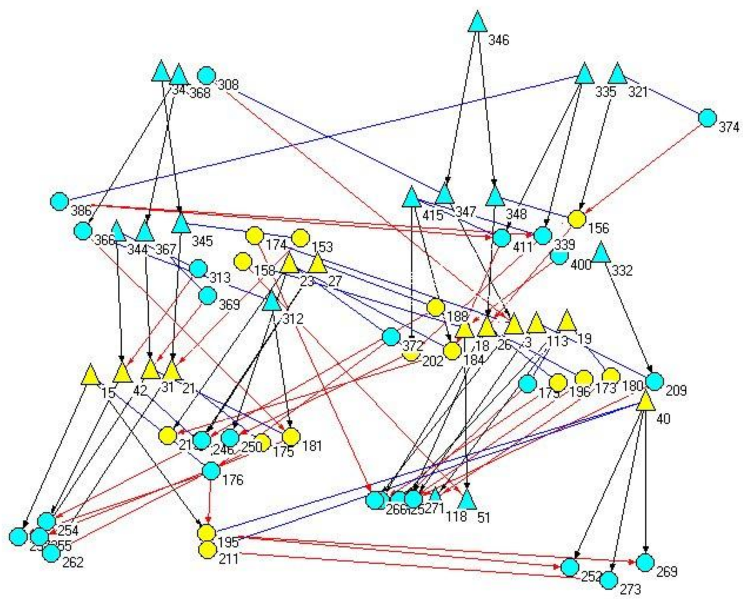


Table 3: Logic2 and Exceptional Marriage Patterns in Figure 9

	Logic2	Not Logic2
Mo-Child	21	9
Spouse	19	8
Total	40	17
Percent	70%	30%

Nine of the 22 blood marriages are with a MBD and another five with a classificatory MBD (actual MFBSD where FBS is classified as S). Four are with a MMBDD (2 cases) or classificatory MMBDD (actual MMFBSDD where FBS is classified as S). These marriage types constitute 82% of the blood marriages. Yet, Table 3 shows that in the subnetwork that contains these marriages there is a high rate of inconsistency with Logic2. Some other factor is at work in generating these inconsistencies.

In the blood marriage subnetwork as shown in Figure 9, some of the nodes are colored to show the individuals for whom Denham collected reciprocal kinship terms. Reciprocals do not, in general, follow Tax's (1937) "law of uniform reciprocals," at least not for the single terms elicited reciprocally from each ego with respect to an alter. The most common departure is where a term for potential spouse (terms 13,14) are used reciprocally (in a gender appropriate manner) with a term for a matrilineal relative (terms 8,9). One person is saying same generation "potential spouse" (classificatory MMBDD or MBD) and the other is saying "mother" or "mother's brother" (M=MBD, MB=MBS). These two most basic generation-merging equations of an Omaha type terminology "raise" the potential spouse to an unmarriageable category in the senior generation. Table 4 shows how the use of this terminology restricts the possibility of marriage.

Table 4. Omaha Terms Excluding Marriage (p=.05) for those in blood relinkings

Terminology used in Categories of Potential Spouse	Actually Married	Not Married
Omaha-Spouse	0	31
Spouse-Spouse Reciprocal	11	93

Of the 30 pairs of people using terms for Omaha and classificatory spouse or sibling-in-law reciprocally, about two thirds (19) are opposite-sex pairs, and one third (13) are same-sex pairs. Of the opposite-sex pairs, ten are cases where the husband is of the same age or younger than the potential or classificatory spouse, and five involve the wife or husband in grandchild blood marriage. Of the same-sex pairs, six are cases where the age difference is between 20-30 years (the difference from a randomized distribution of these ages is significant at p=.05). Hence, it would seem that Omaha terms are also used to signal "inappropriate" age differences or reclassifications that occur with marriages in the grandchild generation.

While people of both genders send such signals, as is evident from the same-sex pairs, men are more likely to (but rarely do) use an Omaha term if they are 30 or more years younger than a woman in a potential spouse category, or to use it towards a man who has married a classificatory daughter or towards the wife in such a marriage, while women are more likely to use an Omaha term if they are between 20 years older to 20 years younger than a man in a potential spouse category. Overall, women (17 cases) are only slightly more likely to use an Omaha term than men (13 cases) within this subnetwork.

There is clear evidence for asymmetric use of Omaha terminology in the fact that when ego and alter are in "potential spouse" genealogical positions, they never shift to a reciprocal use of Omaha terms: only one person shifts, not the other. That is, one person is made "senior," but the other is never made reciprocally "junior." Very rarely, one person is even made "senior" in the grandparent generation, but again this is not reciprocal. Hence, even if Denham had collected alternate terms (2nd or 3rd most preferred terms), there is no hint in the pattern of first-term responses that the use of Omaha terms would turn out to be reciprocal. No such instances occurred in the blood-marriage subnetwork data.

The most telling evidence of what is really being signaled in opposite-sex dyads by the use of (asymmetric) Omaha terms appears in 8 of the 11 cases in which a man is in a structurally junior position relative to the woman in terms of Logic2 (Figure 6). When their age difference is extreme he calls her 'mother'; otherwise she calls him "SWB" which matches her status as senior and is equivalent to and also used for MB. Two of the remaining cases would be proper Logic2 marriages in structural terms but the woman is only two years younger and hence not in the appropriate junior age category that would fit her structural position. In one of these cases he calls her 'mother' and in the other she calls him 'MB'. In only one case (where the wife is 20 years younger) the wife is in the proper age and structural position, yet he calls her 'mother.' In this case, however, the woman is his brother's wife. The use of Omaha terms, then, is highly structured.

In sum, ego's terms for "potential spouse" and "potential spouse's siblings" have two distinctly different reciprocals. On the one hand, alter may reciprocate with a term that agrees with the "potential spouse" designation in accordance with Tax's (1937) law of uniform reciprocals; on the other hand, alter may reciprocate with an equally legitimate term that designates ego as a member of "other generation" in terms of Logic2 thereby saying "don't marry here." Denham failed to grasp this distinction in the field at least in part because of his mistaken assumption that Tax's (1937) law of uniform reciprocals applied universally.

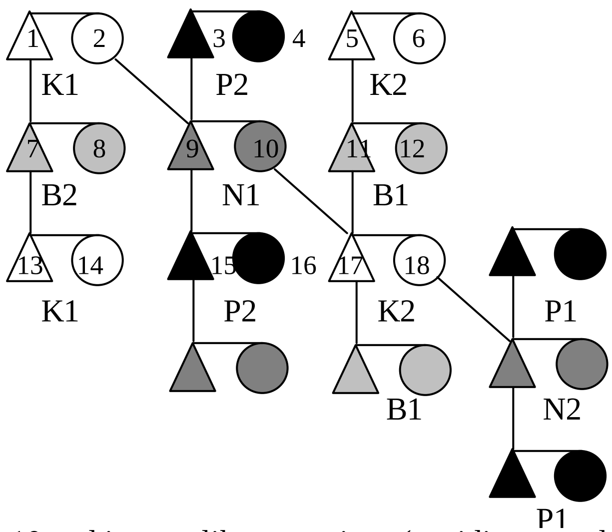
Hiatt (1996:55-56) describes a pattern of remapping among the Gidjingali that seems to resemble what we see here, but the nature of his data led him to conclude that he had discovered a personal or political usage that constituted a Gidjingali "joke". Perhaps he actually found a highly structured equivalent of our Logic3 but saw only the "tip of the iceberg" and failed to recognize it as such.

Levels and Dynamics

We have finally come to understand that Alyawarra Logic2 (open format), as in Figure 4 (but not the helical version in Figure 5), is a dynamic and open-ended system. Yet it is found with an implicit eight-subsection kinship "system," like that of the Northern Aranda, where the eight subsections are even named. We have also learned that distinguishing levels of analysis is essential to keep straight what kinds of equivalence classes we are talking about in classificatory kinship systems.

Having come to this point in our discoveries about Alyawarra kinship terminology, networks, and marriage practices, some other rather essential questions are raised that we need to answer. In Figure 2, from a single ego's point of view, we showed how the definitions of sections are instantiated to yield semantics that would define the section memberships of four section systems. What about eight-subsection systems? To generate a figure equivalent to Figure 2 that defines rules of membership in subsections, we have only to note that subsections rather than sections alternate in the patriline, but cycle in iterations of four subsections in the patriline, as in Figure 10, where the number of equivalence classes is doubled. Now we have only to note that the third and fourth column of siblings take subsection values opposite to those of columns one and two in Figure 2. Thus, to bring the coloring of sibling sets into line, we would only need to distinguish four new color sets in three columns 3-4. From Figure 4, however, we can see once again that at the semantic level, there are no specific marriage prescriptions as to whom you must marry, except that K1 sibling set equivalents marry those of P2, but only proscriptions that the other subsections are exogamous. Now we see that, within both matrilines and patrilines sections follow sequences of alternation between two subsections (rather than sections) such as K1 → N1 → K2 → N2 → K1 in the matriline. By the proviso that principles of Logic0 apply uniformly throughout the society, this implies for the preceding or following generation, another matriline might have the sequence P2 → B1 → P1 → B2 → P2, yet another B2 → K1 → B1 → K2 → B2, and so forth. Although lines for those sequences might be drawn on the diagram, we do not draw them on the same diagram, e.g., between 8 → 15-16 → 16's children, because that would exceed what is needed to define the *semantic* rules that define subsection memberships. Instead, to avoid the category error of confounding levels of abstraction that has plagued anthropological understanding of equivalence classes, we would draw a new diagram that is *isomorphic* to that in Figure 10, but move all the labels up one generation so that another matriline in the diagram would not correspond to B2 → P2 → B1 → P1 → P1.[4]

Figure 10: Egocentric Double-Tetradic (8 subsection) Logic



N.B.: subscripts 1,2 in this type of semantic diagram will vary from case to case: see Gould p.249 for Aranda subsections, p. 243 for Walbiri; the exact Alyawarra format has not yet been constructed.

Figure 10 and its tree-like extensions (avoiding any closed paths whatsoever) can be used as a template for evaluating all of Denham's kinterm usage data systematically, for each ego. This will be the subject of a separate article.[5] There we will do the detailed analysis of fit not only to the implicit eight-subsection groupings implied by informants' designations of their first choice in appropriate usage of kinship terms applied to specific alters, but also:

- Where and to what extent violations of subsection logic correspond to irregularities in the network patterns of Logic2 (as seen in Figure 7),
- Where precisely and exhaustively are Omaha terms employed, and
- To what extent usages are non-reciprocal systematically (i.e., not merely as a result of the elicitation methods) given both the network and subsection framing of Logic2.

Making the Switch from four to eight

If section and subsection systems are so hard for anthropologists to understand, how about the Aranda and the Alyawarra themselves? Would it be hard, for example, to make the switch from a four-section logic (e.g., Figure 2) to an eight-subsection logic (e.g., Figure 10)? Figures 2 and 10, however, are specifically drawn to show that this switch is not difficult. The nodes colored white, for example, in the extension of Figure 2 to that of Figure 10 are still within the same section. All that has been done is a division of sections into halves, one half now unmarriageable. This is exactly what Spencer and Gillen (1927:320-322) report from Aranda narratives about historical changes that took place in the 19th century, first to a four section marriage system, and then from four to eight:

> “[T]he marriage system was changed owing to the influence of certain Erlia [emu] people, with the result that Purula men might marry Panunga women, Bultara men Kumara women, and *vice versa*. Secondly, and at a later period, each of these sections was divided into two, so that, to a Panunga man, for example, only half of the Purula women were eligible as wives, the other half being *Unkulla* or forbidden to them.”[6]

The switchover within Logic0 from a Figure 2 system to a Figure 10 system is automatic and effortless.

Conclusions

Data and analyses introduced by Denham, McDaniel and Atkins (1979) raised serious questions concerning the commonly accepted “axiom of generational closure” which says that successive sibling-in-law links in endogamous groups must close into cycles. Their analysis led from a Logic1 common paradigm of Australian 4-section systems to a double helix model employing Logic2. The generational closure axiom is – mistakenly – built into Logic1 while its absence is consistent with Logic2 and the empirical data on marriage networks. Note however that at the level of kinship terms alone, Logic2 and its helical version are refinements consistent with Logic1, but at the level of practice it renders certain kinds of marriage – sister exchange or bilateral second cousin marriage, or more generally, direct or direct delayed exchanges between patrilineages – unlikely. The evidence of use of Omaha terms in a systematically nonreciprocal fashion also calls into question, if only at the level of kinship practice, the “axiom of universal reciprocity” (Tax 1937; Scheffler 1982). At the level of informant understanding of which terms are proper reciprocals within one or another of the logics in play pragmatically, however, the “axiom of universal reciprocity” of cultural models for kinship terms is not contradicted.

Data and analyses introduced here also raise serious questions concerning the “axiom of algebraic closure” on which the double helix model was based. It says that for any given culture to operate coherently, only a single logic is possible. Yet our investigation of relationships amongst Logics1-3 at the level of practice shows how they form a coherent dynamical system oriented towards demographically and strategically inflected adaptation. In other words, we are discovering here that the interplay of different logics can be a key to understanding system dynamics and evolutionary change. The “axiom of algebraic closure” is very widely used in modeling kinship “systems” as entirely self-contained and static. Our findings for the Alyawarra suggest that this axiom lacks general validity and its use should be very carefully circumscribed lest we assume out of existence the dynamical elements operating within the domains associated with kinship networks.

In the Alyawarra case the full double helix of helical Logic2 never exists at any one time. Rather it is a projection into an unknown future. The fact that variant practices are available and that their frequencies change over time allows (non-helical) Logic2 to be dynamic, not static as Logic1 or helical Logic2 suggest. For example, two generations hence, instead of completing a "double helix" future, there may be fewer patrilines and larger age differences, and the earlier two generations may no longer be remembered. Something like that was happening in 1971 when members of localized patrilineages no longer remembered the matrilineal ties of deceased ancestors. When that happens, the system may easily transform itself into a different age-skewed model (Tjon Sie Fat 1983) without abandoning the Logic0 of sections or that of subsections.

Finally we introduce evidence that makes sense of Logic3, i.e., the use of an Omaha terminology that Denham et al (1979) identified as inconsistent with both the Radcliffe-Brown Logic1 and helical Logic2. The use of Omaha terms provides a signaling ability to stop people from marrying into structurally appropriate Logic1 or 2 categories, and thereby shifting the relative frequencies of different behaviors. Thus quantitative changes in the various dimensions of the demographics and use of signaling devices such as the use of Omaha terms can alter the nature and operation of dynamic kinship network topology that never needs to become a closed, finished, or locked-in system with a single logic.

The quantitative changes introduced here are natural, internal changes in system parameters that are different from, but can have effects similar to, externally induced changes such as the spread of the section system (Dousset 2001). Some of the internal changes could be demographic (lineages die out or mean age differences change) while others might be personal or political or even aesthetic (increase or decrease in Omaha signaling, in marriage with blood kin, etc.). But regardless of what produces them, and without any necessary planning or even awareness on the part of the Alyawarra, their effects ramify throughout the system.

We do not know whether the processes outlined here could yield new kinship systems or simply yield variations on existing themes. Are kinship systems in societies with small populations more vulnerable to demographic change than those in societies with large populations? How can the kinds of factors introduced here contribute to our understanding of broad similarities and local differences among Aboriginal kinship systems? Answers to such questions might come from tying Logics1-3 to computer-based simulations of demographic change among the Alyawarra, running the simulations and watching what happens as the kinship system unfolds through genealogical time, as earlier links in the actual network fade, are forgotten with time, and no longer cast their shadow as a constraint on future behaviors.

Based on what has emerged from the data, we argue that a strictly normative approach to modeling Alyawarra kinship would be misleading and incomplete as a theoretical paradigm, and argue instead for broader frameworks that take into account the interplay of multiple cultural logics as integrated within a networked system of kinship practices.

The Alyawarra experiment in field methods yielded the Alyawarra Archive which contains not only the data utilized in this paper but also an enormous amount of numerically coded ethnographic data that has not yet been analyzed at all. The Alyawarra gave us 23,400 kinterm applications based on their own unknown criteria for selecting the “best” term in each case, they gave us genealogical and kinship data that embody exactly two generations that comply precisely with their own understanding of generations as reported to Bell, and they gave us data on an exclusionary principal in kinterm applications that ramifies throughout the system. Data analysis revealed three different but complementary logics of Alyawarra kinship that almost certainly would not have emerged from any other kind of data. Thus in these data we discovered a world of descent, marriage and kin relations that were previously unreported from Central Australia.

The fact that this work called into question the commonly used axioms of generational closure (as in Radcliffe-Brown’s Logic1) and of algebraic closure (as in Denham et al.’s helical Logic2) has broad implications for studies of human systems of descent, marriage and kinship, especially those that fall under the rubric of what Lewis Henry Morgan (1870) called classificatory kinship systems. Finally, the ability to employ network analysis on a societal scale in relation to how cultural models such as kinship terminologies and their logics are implemented has major implications for anthropological research and the testing of models. It is useful here to note the difference in levels of semantic and cognitive "logics," on the one hand, and the level of practice, where multiple logics may be deployed, leading to situations where logics may conflict, compete and contradict one another. At the level of the construction of single logic, principles such as the "law universal reciprocity" (Tax 1937; Scheffler 1982) may apply at the semantic level, but such principles obviously will not hold at the level of practice, as in kinship terms whose use is realized with concrete others in concrete situations.[7]

We cannot predict whether the experiment will overcome indifference or opposition from those who reject it for its failure to comply with currently accepted theory, dismiss it on methodological grounds, or argue that the Alyawarra were too far removed from their roots to yield acceptable data, for as Hiatt shows those are stratagems that make disciplines puncture proof.

Whatever happens, we are convinced that the Alyawarra truly are the experts on Alyawarra descent, marriage and kinship, and that attempts by anthropologists to impose their ethnocentrically or theoretically biased views of reality onto Aboriginal people are both disrespectful and counterproductive. We do not say this simply from a moral viewpoint but as a respectful observation of the fact that European categorical thinking, applied to Australian relational logics, has been demonstrably guilty of systematic errors in confusing levels of analysis and misunderstanding the equivalence classes of relational logics and their implications. Lewis Henry Morgan's "Classificatory Systems" is a very poor designator in the first place for the relational logics in which Australians are expert.

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Endnotes

[1] There are no cases of brother-sister exchange in the Alyawarra genealogies, but 11 cases of two brothers marrying two sisters, which is compatible with systematic age differences between spouses.

[2] This discrepancy seems to have been lost even on Lévi-Strauss (1967:180), who describes the Aranda 8-section system as one of restricted exchange. Elkin (1964:72-73), however, quoted by Gould (2000:212) mentions the importance of second-cousin wives such as MMBDD: “This example, however, is not selected at random from the possible marriages. It expresses a significant fact; for in very many tribes … which have [a] … kinship system [of Aranda type] the mother’s mother’s brother seems to be almost the most important relative a person possesses. He is mother’s “uncle”, and takes a leading part in arranging his niece’s son’s (ZDS’s] … marriage. In fact, he is the marriage authority for [a male] EGO’s matrilineal group of relations (EGO, Z, M, MB). It is his duty to find a wife or to see that a wife is found, for his “niece’s” son, and one way to do that is to arrange for his daughter’s daughter to marry [his ZDS].”

[3] One wrong marriage was reported by Denham et al. (1979:16): “only one marriage conflicts with the section relations expressed in Figure 1,” and this is what we find as well. This is an Alyawarra woman (274) who belongs to Section 2 (Pityara) and should be married to a man of Section 1 (Kamara). Instead, she brought home an Aranda man from Aranda section 4 (Ngwariya) which is a wrong section marriage. The children’s section is correct relative to their father, so Denham is confident that this is “wrong marriage,” although this Aranda husband was not a resident at the time when the study began, his photo was not taken, and his name is not yet transcribed from field notes to the data files. The couple and their children (128-131, 275-276; coded has belonging to the right section relative to the husband but not to the wife) are recorded as residing in the study region for a period of 30 days. The husband’s parents and native residential group is coded as unknown, but in any case his group of origin seems to be outside the study area. Denham (personal communication) adds the following comments:

> “This means that his Alyawarra section membership was computed on the basis of his Aranda subsection membership when he entered the Alyawarra population, perhaps when 274 married him. So he was a kind of wild card or free agent. I could have misidentified his moiety and/or section membership, but for reasons to be introduced below, I don’t think I made a mistake.” “It’s possible to fudge kinship terms because almost everybody is multiply related to almost everybody else, and everything is “relative” in the first place. But fudging section memberships is harder since they are “absolute”. If you were to change one of them (in this case to align 127 “properly”), 127 would no longer fit into the Aranda system when he went back to Alice Springs, and his kids wouldn’t fit anywhere unless he fiddled the kids’ sections too, and so on ad infinitum. And he couldn’t change his wife’s section membership since her whole network of relations among the Alyawarra presupposes that she is whoever she is. So, when all else failed, they just told the truth. I’m confident that 274 brought home a husband from the wrong section, but I’ll check further the next time I’m in New Hampshire.”
>
> “I understand that it would be nice if all of the marriages were “right”, but if the data indicated that ALL of them were right I would be suspicious of them, and would expect others to think I had cooked the books. In fact, one of the really remarkable things about the dataset is that it contains ONLY ONE wrong marriage. People who worked in Central Australia in the 1960s and 70s have good reason to expect to see a far higher per-

centage of wrong marriages, and this very low figure is indicative of the "purity" of the Alyawarra at MacDonald Downs."

[4] Similarly, for kinship terminology, the sequence in the matriline might be: A1 → D1 → C1 → B1 → A1. Again, by the proviso that principles of Logic0 apply uniformly throughout the society, this might yield a similar sequence such as A2 → D2 → C2 → B2 → A2 in another matriline, but we take care not to draw such additional lines on the same graph.

[5] We will not attempt here to complete our analysis of the use of Omaha terms outside the equivalence class of potential spouses and siblings-in-law, but as shown in Table 1, the lowest percentage consistency with Logics 1-2 is 67% for same patri-side relatives. This suggests that Omaha terms are used frequently not just for "affinal" relatives in the section system but also for those classified as unmarriageable or "consanguineal" relatives. This would be consistent with patterns of extended use of Omaha terminology, as in SS = FZDS, Z = MFZD, MM = MMBD and the like. We plan to finish with the network analysis of other categories in which Omaha is used before publication.

[6] Gould (2000:247) opines, based on Scheffler's (1978:455) access to Gillen's unpublished manuscripts, that the first change, in which the entire Aranda tribe adopted a four section system, occurred "probably about 1850, and this system was left unchanged in the southern half of the tribe. But beginning about 1880, the northern half changed over to the subsection system…, in imitation of their northern neighbors, the Walbiri. As in Walbiri, one of [each of] the two subsections goes by the same name as the original section."

[7] The following commentary by David Kronenfeld on this point is highly relevant:

I wonder if some analog of the old Saussurean distinction between Langue (and other langue-like systems) on the one hand and Parole on the other is maybe not useful. The other Langue-like systems included physiological breath constraints, socio-linguistic variation, short-cuts and elision, etc. These were each separate--logically independent systems (of greatly varying complexity)--that each came to bear on any given act of Parole (i.e., speech act). This is why the relationship between Langue and Parole was an intrinsically asymmetric one; Langue was one conceptual system that was realized in Parole, but at the same time other conceptual and physiological systems were also realized in the same speech act. Thus Langue, as a conceptual system, could/should be represented in a theory, while the only theory of Parole that one could have was a theory of how the diverse realized elements were combined into the single utterance.

I wonder whether we might want systematically to distinguish theories about how some set of cultural phenomena are organized from the process by which those abstractions are concretely expressed. And, in saying that, I am suggesting that there is something more interesting maybe to be said than is conveyed simply by speaking of different levels. We might then be able to make some interesting generalizations about the kinds of different systems involved, about differences between them, and about differences in their scope and effects on other things.

Essential to the Trubetzkoyian implementation of Saussure's paradigm was abstract quality of the separate analytic systems (in Trubetzkoy's case, particularly the phonemic system)--in which only elements essential to the given system's functioning are expressed in the theory of that (phonemic, aka phonological) system; this was why he then needed the concept of "realization" to explain how those abstractions related to concrete entities (in the case given, sounds).