COMMENT ON DENHAM'S
BEYOND FICTIONS OF CLOSURE IN AUSTRALIAN ABORIGINAL KINSHIP

DWIGHT W. READ
DEPARTMENT OF MATHEMATICS AND
DEPARTMENT OF STATISTICS
UCLA
LOS ANGELES, CA 90095
DREAD@ANTHRO.UCLA.EDU

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Denham makes a careful, thorough, argument regarding the problems, distortions and misdirections introduced by modeling Australian hunter-gatherer societies as if they are isolated, endogamous, generationally closed systems with marriages conducted according to a formal model based on assuming all marriages are between biological first cross cousins. This assumption requires, he points out, spouses to be close in age, whereas in fact the average age difference between them is 14.6 years.[1] With about a 15 year age difference between spouses, he observes, the marriage pattern will be that of a helix (see Figure 1.3), suggesting that marriages extend outward and need not be endogamous to the society. Because the section system through which proper marriages may also be expressed is sociocentric, this and the structural similarity between section systems in different societies allows for what is a proper marriage in one society to be "translated" into a proper marriage in a neighboring society, he argues, thus facilitating the extension of an open marriage system across societal boundaries.

This has the important consequence, he argues, for neighboring social systems to be integrated through marriages that are, from the viewpoint of each set of participants, an extension of their own marriage system. Hence, he suggests, societally exogamous marriages were not just occasional, happenstance occurrences, but were part of an integrated and cooperative, system that incorporated neighboring societies, possibly with global implications for Australian hunter-gather societies. This kind of cooperation or collaboration may be seen, he points out, in practices such as controlled fires that were used to increase the natural production of food resources that they were dependent upon. The degree and extent of local cooperation would be affected by geographical differences in resource density, for in areas like the Western Desert one would expect frequent interaction between groups in different societies due to needing extensive areas over which resources were obtained and so neighboring societies were likely to have overlapping regions over which they searched for food resources.

Denham makes the request: "help me improve my argument" (p. 10). My comments address this request in two ways. Part 1 relates to what Denham refers to as the canonical Kariera

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[1] Denham refers to Birdsell's supposed "fiction of endogamy" (p. 8) and repeatedly treats Birdsell's reference to genetic isolates as if Birdsell considered Australia to be made up of isolated subpopulations even though the evidence shows that about 15% of marriages were society exogamous. This seems to be a misreading of what is meant by a genetic isolate. A *genetic isolate* is defined as a (sub)population with fewer matings outside of the population than would be expected under random mating. The definition does not mean that the population is *isolated*; rather, determining genetic isolates allows separating the effect of migration on allele frequencies from Hardy-Weinberg equilibrium frequencies due to random mating. Thus, as Birdsell comments, he modeled Australia as an "idealized distribution of genetic isolates *for use in gene flow models*" (1953: 206, emphasis added).

terminology and marriage system. In this part, I mainly add to Denham's discussion, which focuses on the level of practice, by filling out areas at the conceptual level regarding the organization and structure of the Kariera kinship system provided through their kinship terminology and rules of marriage. I clarify several aspects of their terminological and marriage system that he refers to as heretofore unsolved. Part 2 deals with the implications of inbreeding, birth spacing, rates of cousin marriage, and variable environmental conditions for both demography and social integration on more than a local level. In Part 2, I provide constructive clarification aimed at identifying which parts of Denham's argument need to be reconsidered or restructured.

Part 1: Structural Logic of Classificatory (Bifurcate Merging) Kinship Terminologies and Cousin Marriage Rules

Structure of the Kariera System of Kinship Terms

Denham observes that Figures 1.1 and 1.2, when read as (idealized) models for the actual pattern of marriages, imply (among other things) sister exchange marriages between spouses similar in age and taking place in "societies that are spatially closed within discrete territories…" (p. 7), all of which, he points out, is contradicted by the fact that actual marriages have an average age difference of about 15 years between spouses and about a 15% exogamy rate. Denham argues that this discrepancy stems from the idealization being based on simplistic assumptions such as generational closure for marriages and fixed generation length. Denham then provides Figure 1.3, in which the discrepancies between the assumed behavior displayed in Figures 1.1 and 1.2 and actual behavior are corrected, thereby leading to Figure 1.3 in which the highly skewed age differences between spouses leads to open, and not closed, generations, a helical pattern for marriages, and the like.

Denham's observations highlight problems that can arise when imposing models based on a priori theoretical constructs rather than abducting theoretical constructs from patterning observed in empirical observations (Leaf and Read 2012). In this case, the idealization of Figures 1.1 and 1.2 involves imposition of a presumed, prescriptive marriage rule that supposedly interfaces between the Kariera's and the Aranda's ideas about marriage and kinship relations and the facts of actual marriage decisions. For this reason, the discrepancies noted by Denham imply that we need to better understand the marriage rules, both with regard to the functionalities discussed by Denham that they bring to Australian societies -- such as the role of the section systems in working out society exogamous marriages -- and with regard to the way the marriage rules are conceptually a part of the structural logic of the Kariera and the Aranda kinship terminology systems. In this part of my comments, I will focus on the later as a way to complement the arguments Denham has made about the former.

For my purposes, I will temporarily set aside (but not ignore) the issues that Denham has raised regarding the implicit assumptions embedded in Figures 1.1 and 1.2 by not reading them as genealogical models of marriage systems, but for their information content regarding the

structure of the Kariera and Aranda kinship terminologies. To do this, I will read the triangles and circles as sex-marking for the kin term located at a circle or a triangle, rather than as standing for a person in a genealogical diagram. The horizontal lines, which depict sibling relations, will be read as showing how a kin term at one end of the horizontal line is connected to another kin term at the other end of the horizontal through the sibling term represented by the horizontal line. Similarly, the vertically slanted lines will be read as depicting how kin terms are connected through the 'parent' and 'child' kin terms. Thus I will read Figures 1.1 and 1.2 not as genealogical diagrams depicting idealized marriage patterns, but as diagrams showing connections among kin terms that makes use of the symbols that are part of genealogical diagrams. The connections express the kin term calculations made by the users of terminologies and noted by Radcliffe-Brown in his observation: "Let us suppose, as an example, that two men, A and B, meet each other for the first time. The man A has a relative C who is his *mama*. At the same time C is the *kaga* of B.   It immediately follows that A and B are *kumbali* to each other" (1913:150-151). We can read the computation depicted by Radcliffe-Brown in this quote as saying that the product of the kin terms *kaga* and *mama* is the kin term *kumabli*; that is, the kin term *mama* is connected to the kin term *kumbali* by the kin term *kaga*.

I will read the diagrams, then, as informing us how the kin terms are interconnected through kin term product calculations with the primary kin terms, where the primary terms are kaga ('son'), mama ('father'), and so on.   This leads us to reading Figure 1.1 as a data model (Read 2008) in the form of a kin term map (Read 1984) that expresses the cultural knowledge embedded in the kinship terminology and underlies the computation of kinship relations carried out in the manner indicated by Radcliffe-Brown in the above quote. (For this part of my comments, I will only consider Figure 1.1 and the Kariera terminology.)   A kin term map makes visually evident structural properties of the kinship terminology; in particular, for the Kariera terminology, it makes evident that the marriage relation between a man and a woman, expressed through kin terms, is integrated into the structural logic of the kinship terminology; that is, Figure 1.1, read as a kin term map, shows that a marriage should be between a man and a woman the man refers to by the kin term *ñuba*.

Once we have the kin term map for the kinship terminology, the next step is to determine whether there is a culturally grounded, generative logic for the structure expressed in the kin term map (analogous to a grammar underlying the structure of sentences in a language) and, if so, whether a theory model generated according to that generative logic is isomorphic to the kin term map (see Leaf and Read 2012 for a complete analysis of the Kariera terminology following this procedure).   One result obtained from working out the generative logic of the Kariera terminology in this manner is that the so-called cross-cousin marriage rule is an integral part of the structure of the terminology; that is, the marriage rule (and hence what we refer to as affinity) is not added to an already determined kinship terminology, but is logically part of the kinship terminology. The kinship terminology does not exist without the marriage rule (see Leaf and Read 2012 for the complete argument).

From this perspective, Figure 1.1 can be read as providing the information needed to form a data model (in the form of a kin term map) of the structure of the Kariera kinship terminology, whereas Figure 1.3 models the idealized marriage pattern stemming from highly biased age differences between the spouses; that is, under my reading the two figures differ between being a data model (Figure 1.1) through which an idealized theory model for marriages can be inferred (namely that marriage should be with a woman a man refers to as ñuba), and an idealized data model of actual or observed marriages (Figure 1.3). The theory model of marriage being with a woman a man refers to by the kin term ñuba does not determine the actual pattern of marriages. Factors other than those expressed through the theory model can affect actual marriage choices. The same disjunction occurs in the American society between a theory model (expressed through wedding vows stating that marriage is permanent until death and the cultural presumption that children are born only to married woman) implying that families have the structure of a nuclear family and the fact that in the US today about 1/2 of all families have single mothers. Under the interpretation of Figure 1.1 as a data model for the structure of the kinship terminology (that is, as a kin term map), the closure of the diagram reflects the conceptual closure of a kinship terminology (Leaf and Read 2012), not the closure of a society with respect to actual marriages as some have assumed incorrectly, as discussed by Denham.

Logical Embedding of a Marriage Rule in a Kinship Terminology

The Kariera terminology highlights ambiguity in the literature surrounding what constitutes a marriage rule and its relationship (if any) to a kinship terminology system. The Kariera are often said to have a prescriptive marriage rule specifying marriage with one's cross cousin. While it may be easier for English readers to read the English expression "cross cousin" in place of the Kariera kin term *ñuba,* the use of the English expression leaves the impression that the marriage rule refers to biological cross cousins, which then requires clarification that the rule is about so-called classificatory cross cousins, not just biological cross cousins. The clarification still assumes that biological relatives are, nonetheless, the "real" relatives, despite ethnographic observations such as, for the Papuans of New Guinea, that 'real relatives' need not refer to biological relatives: "relatives or pseudo relatives, [are] referred to as 'real brother' and 'real sisters' without bothering about the genealogical connections. … Only the manifest behavior with respect to these 'siblings' is of interest to them. They are *not able or are not willing* to trace the actual or putative … connecting links" (Pouwer 1966: 278, emphasis added).

Further complicating the matter is the fact, as discussed above, that the Kariera marriage rule is integrally embedded in the generative logic underlying the structure of their kinship terminology, hence is a "rule" only in the sense of specifying what behavior would be required for an actual marriage to be consistent with the logic of their terminology. In this sense, calling it a rule is like saying English speakers have a rule stipulating that the husband of one's aunt is called uncle, rather than uncle-in-law since the marriage relation that is involved is "suppressed" by the term used for 'spouse of aunt' not including the "-in-law" suffix normally used to mark relations through marriage for English speakers. However, no emic rule, *per se*, is involved, just the fact that for English speakers, using *uncle-in-law* for the kin term product *spouse* of *aunt* would violate the non-

conscious, underlying logic of the English kinship terminology (Read 1984, 2007; Read and Behrens 1990; Leaf and Read 2012), hence, by using the kin term *uncle* in this situation, English speakers are simply being consistent with the underlying logic of their terminology. Should we say that English speakers have a rule specifying that 'spouse of aunt is uncle' (even though such a rule has never been elicited), or that English speakers are just being consistent with the logic of the terminology that *requires* the kin term product equation 'spouse of aunt is uncle'? The latter is the more parsimonious conclusion. The same kind of reasoning applies to the Kariera: Should we say that they have a prescriptive rule stipulating marriage with cross cousin, or that the logic of their terminology requires that the outcome of the kin term product *'wife'* of *male self* must be *ñuba*? The latter defers to the logic of the terminology, just as using *uncle* for *spouse* of *aunt* defers to the logic of the English terminology. This suggests that the "rule" is just a stipulation regarding the kind of marriage that is consistent with the logic of the terminology. When a man marries a woman who is his *ñuba*, he will then refer to his wife as *ñuba,* consistent with the logic of the terminology. Which female he marries, among those he refers to as *ñuba* is not specified, though, by the logic of the terminology and that choice may invoke other criteria; more specifically, it may invoke the criteria that lead to the extreme age difference between a man and his wife discussed by Denham. In the same manner, while the terminology does not distinguish between a maternal *ñuba* and a paternal *ñuba*, hence marriage with either kind of *ñuba* is equally consistent with the logic of the terminology, there is no terminological reason why marriages, in fact, cannot be biased towards one kind of *ñuba* versus the other kind of *ñuba*, as Denham points out is necessarily the case due to the difference in ages between spouses.

Relationship Between Egocentric Kinship Terminology and Sociocentric Section System

Denham goes on to comment, regarding the kinship terminology, which is egocentric, and the four-section system, which is sociocentric: "Whether they are independent inventions that have converged or coordinate parsings of the same conceptual universe remains unclear" (p. 70).

The origin of sections and subsections has not been fully resolved. One hypothetical argument places something like a section system as a precursor to all kinship terminologies by proposing that kinship terminologies are all derived from an assumed, four-part sociocentric division which is then transformed into an egocentric terminology (Allen 2008) -- an argument reminiscent of Morgan's (1871) ill-fated attempt to account for the classificatory terminologies through an assumed, prior practice of group marriage. Unambiguous historical evidence regarding the first appearance of the section and subsection systems is not yet available for helping resolve the matter. McConvell, in his Comment, refers to historical linguistic analyses that imply the subsection systems originated in Northern Australia and the section systems in Eastern Australia. I suggest, following Denham's comments, that the section systems and the terminologies are "coordinate parsings of the same conceptual universe" since, at least for the Kariera terminology, coordination derives from the structure of the section systems emerging through marriages consistent with the structural logic of the terminology. The argument is as follows.

The way the structure of the four-section system emerges from marriages consistent with the logic of the kinship terminology can be derived from the formal analysis of the Kariera terminology (Leaf and Read 2012) -- itself based on a general theory of kinship terminology structures (discussed in Read 2007; Bennardo and Read 2007; Leaf and Read 2012, among other references) -- in two steps. The first step shows how an *egocentric* four-section system may be derived directly from the kinship terminology by partitioning the kin terms, from ego's perspective, vertically into odd versus even generation kin terms (where the definition of generation is derived from the properties of the kinship terminology without needing to refer to genealogical generations), and horizontally into lines of male terms versus lines of female terms, with the terms in a line of male terms linked to a term in the line of female terms by the embedded "marriage rule." By itself, this step does not determine a sociocentric, four-section system as the division of the population according to an egocentric four-section system need not be the same from one person to another. The second step involves mathematically proving that the egocentric four-section system is, in fact, a sociocentric four-section system (see Leaf and Read 2012 for the proof), meaning that the egocentric four section system is the same, regardless of the choice of the reference person. This suggests that the four-section system is not so much an invention as identifying and naming the parts of an emergent structure (what Houseman and White [1998] refer to as sidedness) -- namely the sections and how they are interrelated by marriage and filiation -- that is the result of marriages made in accordance with the logic of the terminology.

Structural Differences Distinguishing the Australian, Dravidian and Polynesian Classificatory Kinship Terminologies

The formal representation of the structural logic of a kinship terminology also bears on Denham's comment: "I cannot solve the myriad of intricate problems associated with definitions of classificatory kinship or the nuances of Iroquois, Dravidian and Kariera terminologies (Morgan 1871, Trautmann 1981), all of which have taxed the patience of experts for more than a century and lie beyond the scope of this paper" (p. 71). Here I will indicate the way that these problems have now been solved.

First, a culturally grounded, formal definition of what Morgan referred to as classificatory terminologies (which is what I think Denham means by "classificatory kinship") has been available since 1990 when Read and Behrens (1990) showed that the structural logic of classificatory terminologies (often referred to as "bifurcate merging" and expressed, even if inadequately, by the genealogical equations $fb = f \neq mb$ and $ms = m \neq fs$) derives from the sibling relation being conceptualized as a primary and not a derived kinship relation, such as *brother* is *son* of *parent* and *sister* is *daughter* of *parent* for English speakers (see Read 2007, 2010, 2012; Bennardo and Read 2007, Leaf and Read 2012 for a detailed demonstration). Ethnographies based on regions where local populations have classificatory terminologies repeatedly refer to the central importance of the brother-sister relationship (e.g., chapters in Marshall 1983), even to the point that some groups virtually exclude the vertical parent-child relation as having importance (e.g., Burridge 1959/60; see also Witowski 1972 and Dziebel 2007, who each
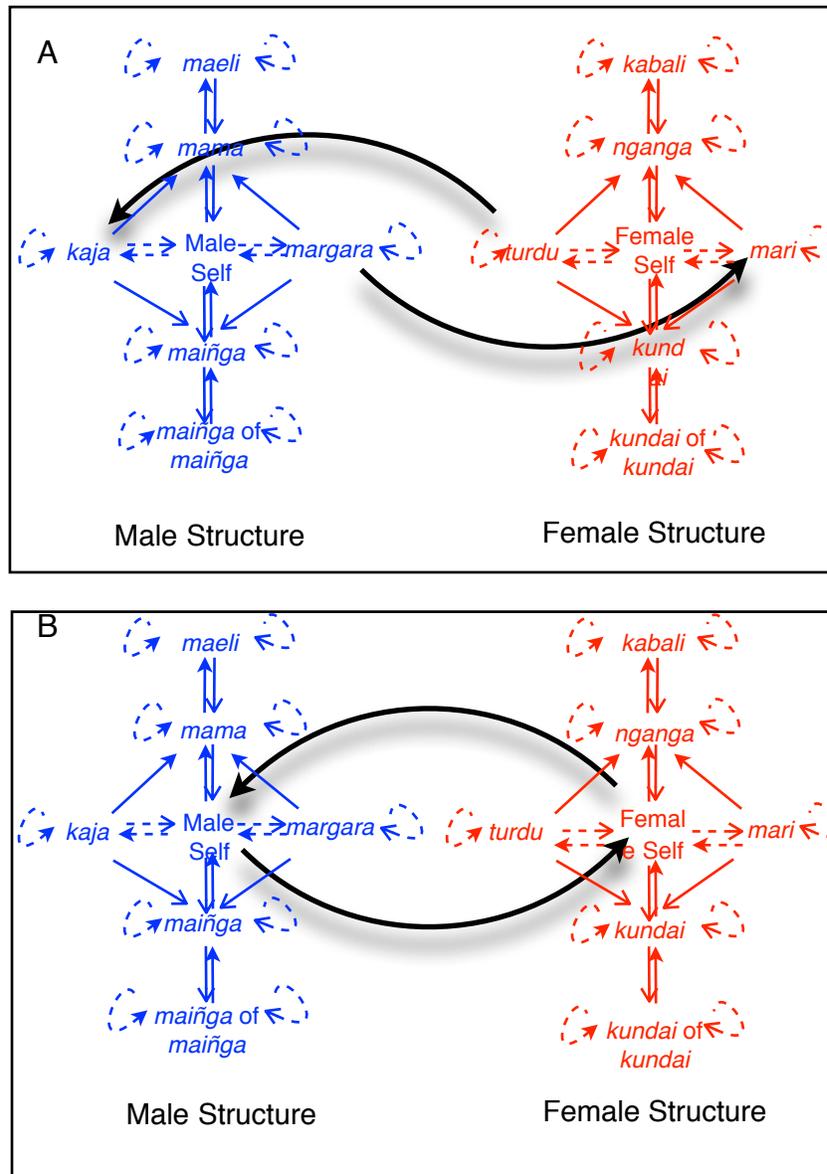
Figure 1: Core structures illustrated with terms from the Kariera terminology. (A) The disjoint structures are linked through the *kaja*/*turdu* and the *margara*/*mari* positions. For speaker located at Male Self or Female Self, the sibling positions become *kaja*, *margara*, *turdu*, and *mari* (glossed as 'older brother,' 'younger brother,' 'older sister,' and 'younger sister,' respectively). (B) Other classificatory terminologies such as the Trobriand and the Tongan terminologies link the disjoint structures through the Male Self and Female Self positions labeled as sibling terms and illustrated here using the Kariera kin terms. For speaker located at Male Self, the Female Self position would be labeled 'sister' and for ego located at Female Self, the Male Self position would be labeled 'brother.' The sibling positions for a male ego would thus be *kaja* and *margara* (glossed as 'older brother' and 'younger brother') and 'sister.' The sibling positions for a female ego would be *turdu* and *mari* (glossed as 'older sister' and 'younger sister') and 'brother.' Thus in the Trobriand and Tongan terminologies -- but not the Kariera terminology -- ego has same-sex 'older and younger sibling' terms and an opposite-sex sibling term without an 'older'/'younger' distinction (modified from Leaf and Read 2012, Figure 8-10).

independently found it necessary to use this distinction between the two ways of conceptualizing siblings in their respective analyses of kinship terminologies).

We can distinguish these two ways of conceptualizing siblings by whether (a) a sibling is conceptualized as a child of a parent, other than oneself, hence is a derived kinship relation, which leads to Morgan's descriptive terminologies, or (b) siblings share the same parents, hence is a primary kinship relation, which leads to Morgan's classificatory terminologies. The latter (but not the former) implies that the sibling relation, when represented as a mathematical relation, is an equivalence relation, which, in turn, formally expresses Radcliffe-Brown's notion of the Unity of the Sibling Group and justifies his claim that the Unity of the Sibling Group can account for the use of the same kin term for parent and parent's same sex sibling, though it does not account for the "elder"/"younger" distinction in the sibling kin terms (Read and Lehman forthcoming). Both of these are accounted for, though, when *sibling* is considered to be a primary kinship relation.

Second, the fundamental, structural differences between the Kariera terminology and the terminologies of the Dravidian language speakers of India have been worked out. The generative, structural logic of the Kariera terminology has been presented, in detail, in Leaf and Read (2012) and the same has been done for the Nanjilnattu Vellalar (India) terminology (Trautmann's [1981] canonical example of a Dravidian terminology) in Read (2010). We can also add to this comparison the differences between the Polynesian and Oceanic terminologies and the Kariera and the Dravidian terminologies by referring to the structure of the Trobriand terminology worked out in Read and Behrens (1990) and the structure of the Tongan terminology worked out in Bennardo and Read (2007). Briefly, the differences among these terminologies arise from the way a core structure of male terms centered around a *male self* position (left structures in blue in Figure 1) and an isomorphic, core structure of female terms centered around a *female self* position (right structures in red in Figure 1) are joined to form a single structure of male and female terms.

The Kariera terminology joins the two structures by linking the 'elder brother'/'younger brother' positions in the structure of male terms with the 'elder sister'/'younger sister' position in the structure of female terms (see black arrows in Figure 1A), where the 'elder'/'younger' distinction is, itself, a consequence of the logic of generating a classificatory terminology (Read 2007; Read and Behrens 1990; Bennardo and Read 2007; Leaf and Read 2012).

The Polynesian and Oceanic terminologies join the two structures in a different manner through the *male self* and the *female self* position by mapping these two positions to genealogical brother and genealogical sister (see black arrows in Figure 1B), respectively (see Read and Behrens 1990; Bennardo and Read 2007, for details), a structural option reflected in the observation that for the Gilbert Islanders, brothers and sisters are alter egos.

The generation of the Dravidian terminology proceeds in yet another way by first joining the male structure to the female structure by forming a (neutral) *self* position composed of the *male*

self and the *female self* positions in the structure of male terms and the structure of female terms, respectively, to form a *self structure* (structure on left in Figure 2). Next, a *spouse structure* of affinal terms isomorphic to this structure of male terms and female terms is formed (structure on right in Figure 2), and lastly the *self structure* of male and female terms and the *spouse structure* of affinal terms are linked in the 0 generation through the spouse kin term and in the +1 and -1 generations through the sibling terms (see Figure 2). This generative logic is the basis for the marriage opposition structure described by Dumont (1953) and accounts emically for the cross/parallel distinction defined etically through genealogical calculations.

Thus we now have a culturally grounded, formal account of the structural differences among the Kariera (as an exemplar of Australian terminologies), the Dravidian, and the Oceanic/Polynesian terminologies that makes evident both the underlying logic of classificatory terminologies, in general, and the specific, structural differences among these three groups of classificatory terminologies.
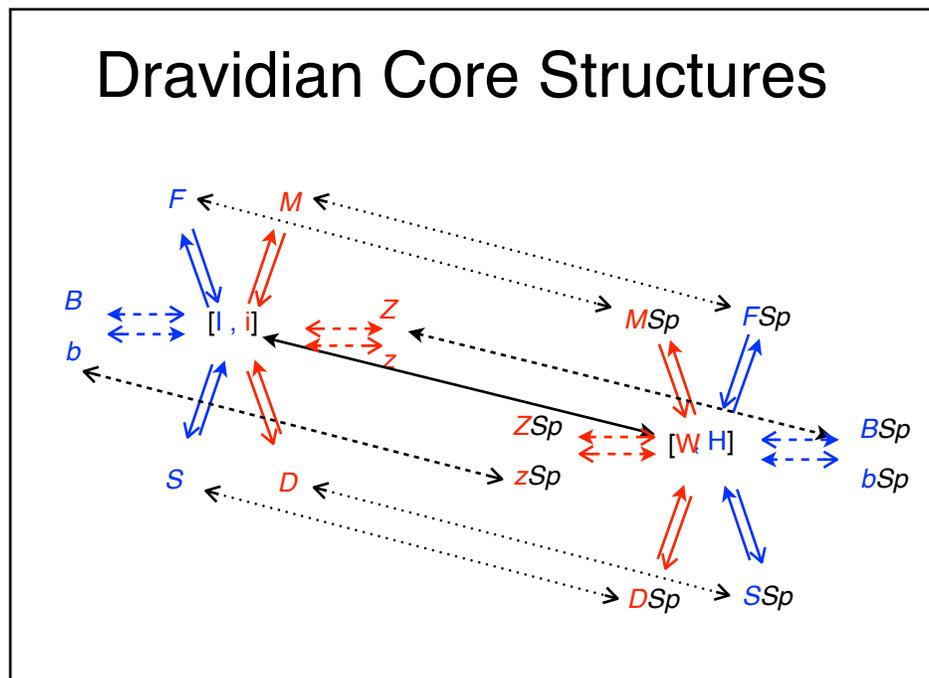
Figure 2: The *self* structure for a Dravidian terminology is on the left side of the diagram and the *spouse* structure is on the right side. The two structures are linked by spouse terms for the generation 0 terms(solid and dashed arrows in center of diagram) and by sibling links (double headed dotted arrows at top and bottom of diagram) for the +1 and -1 generation terms (from Read 2010:Figure 10).

Structural Difference Between the Kariera and the Iroquois Kinship Terminologies

Third, the difference between the Iroquois and the Kariera terminology relates to a single structural difference in what is otherwise the same generative logic for the two terminologies. The Kariera terminology (see Figure 3) maps the kin term product *'child'* of *ñuba* ('female cross
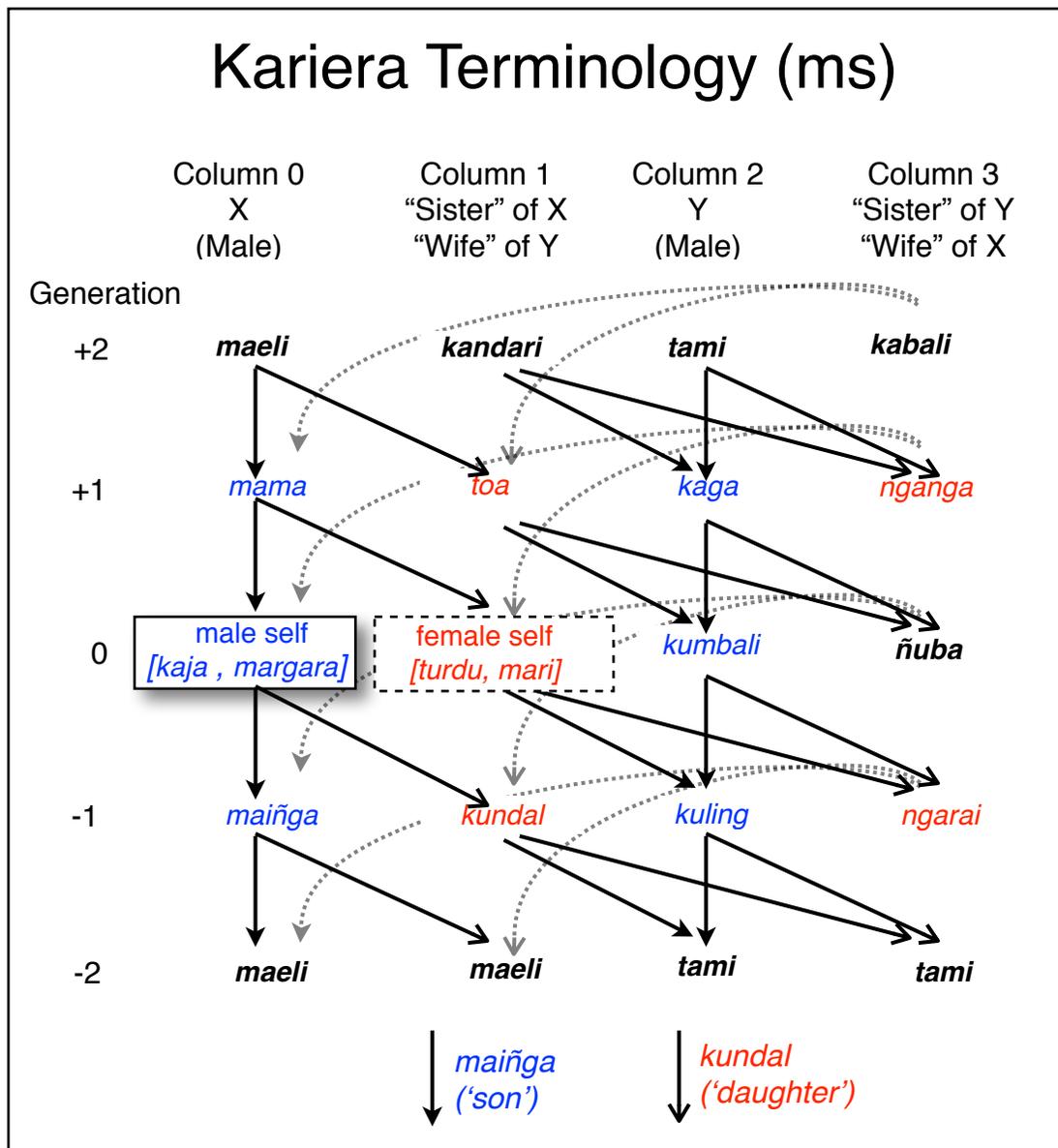
Figure 3: Kin terms for the Kariera terminology from the perspective of a male speaker. The columns are to be read as if they go around a cylinder so that Column 3 circles around, putting Column 0 to the right of Column 3. The dashed arrows show the arrows from Column 3 circling around to Column 0. Black: neutral-marked terms; blue: male-marked terms; red: female-marked terms. X and Y in the column headings refer to a kin term. (Modified from Leaf and Read 2012: Figure 8.11A.)

cousin, ms') to *maiñga* ('son') and *kundal* ('daughter') for *male speaker* (dashed curved arrows in Figure 3 starting from *ñuba*). The Kariera mapping for *ñuba*, along with four +2 generation terms and their -2 reciprocals, is necessary for the terminology to have four distinct "lines" of terms across all generations (see Figure 3). This, however, requires that, structurally, *'wife'* of *male self* is *ñuba*, hence the 'cross-cousin' marriage rule. The four lines give rise to a four section system as discussed above.

In contrast, the Iroquois terminology (see Figure 4) maps the kin term product *'child'* of *ah-gare-seh* ('female cross cousin, ms') to *ha-ya-wan-da* ('nephew') and *ka-ya-wan-da* ('niece') (straight arrows in Figure 4 starting from *ah-gare-seh*) and 'child' of *ah-gare-seh* ('male cross cousin, ms') is mapped to *ha-ah'wuk* ('son') and *ka-ah'wuk* ('daughter') for *male speaker* (curved, dashed arrows in Figure 4 starting from *ah-gare-seh*), rather than 'nephew' and 'niece' as in the Kariera terminology.[2]   It is this reversal of the mappings for 'male cross cousin' and 'female cross cousin' between the Kariera and the Iroquois terminologies that accounts for the differences in the two terminologies.

The Iroquois generative procedure of mapping *ah-gare-seh* to 'nephew' and 'niece' (for *male speaker*) negates the four distinct lines across all generations, hence the +2 and -2 generations need not be (and are not) represented by four 'grandparent' terms (see Figure 4), as is the case with Kariera terminology.   Structurally, the construction does not specify *'wife'* of *male self* within the terminology, hence the absence of a cross cousin marriage rule in the Iroquois terminologies and the use of separate *'husband'* and *'wife'* terms.   In addition, the structural difference also implies that a four-section system cannot be derived from the Iroquois terminology, which is consistent with the fact that section systems are not found as a correlate of Iroquois terminologies.

### Part 2: Local Population Structure and Global Consequences

Denham considers the implications of local group properties such as porous societal boundaries, exogamous marriages, section systems (skins), and the canonical Kariera model for global, pan-Australian integration in which a metapopulation of subpopulations is integrated continent-wide through these local properties and consists of "stable populations in a large space of continent-wide connections" (p. 60).   He comments: "The dynamics of survival in the metapopulation would have been fundamentally different from the dynamics of extinction in population isolates" and "all of those linked societies [would be] resistant to extinction from environmental, demographic and genetic stochasticity" (p. 28).   He contrasts this with the ensemble of isolated, "fragile Aboriginal societies continent-wide" (p. 59) implied by a literal reading of Figures 1.1 and 1.2 due to the degree of inbreeding depression that would arise from the extreme pattern of isolating, endogamous marriages depicted in these diagrams.   Denham thus contrasts a "possible scenario in which changes in habitats, subsistence strategies and social organization could have coalesced to insure the survival of Australian Aboriginal societies" (p. 55) with that of the extreme marriage pattern depicted in Figures 1.1 and 1.2 that depicts "conditions that ... could have extinguished the Aboriginal Australians long ago" (p. 60).

Denham suggests (p. 3) that "reproductive strategies or mating systems that systematically reduce societal closure while increasing societal complexity include marriage with tribal

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[2] The term ah-gare'seh (neutral) must be a covering term for (unlabeled) 'male cross cousin' and (unlabeled) 'female cross cousin' since each of these unlabeled terms is mapped to different kin terms when taking a kin term product with 'child'. For clarity, ah-gare'seh has been included in the diagram using both red and blue fonts to distinguish (unlabeled) 'male cross cousin' from (unlabeled) 'female cross cousin'.

(classificatory) kin instead of proper kin, alternate generation-level marriage, Omaha kin term skewing, a broad spectrum of systematic changes in skin terms, circulating connubia, endogamous (perhaps helical) generations and exogamous horizontal and vertical marriage asymmetry."   Together, he argues, these would form an integrating complex activated by
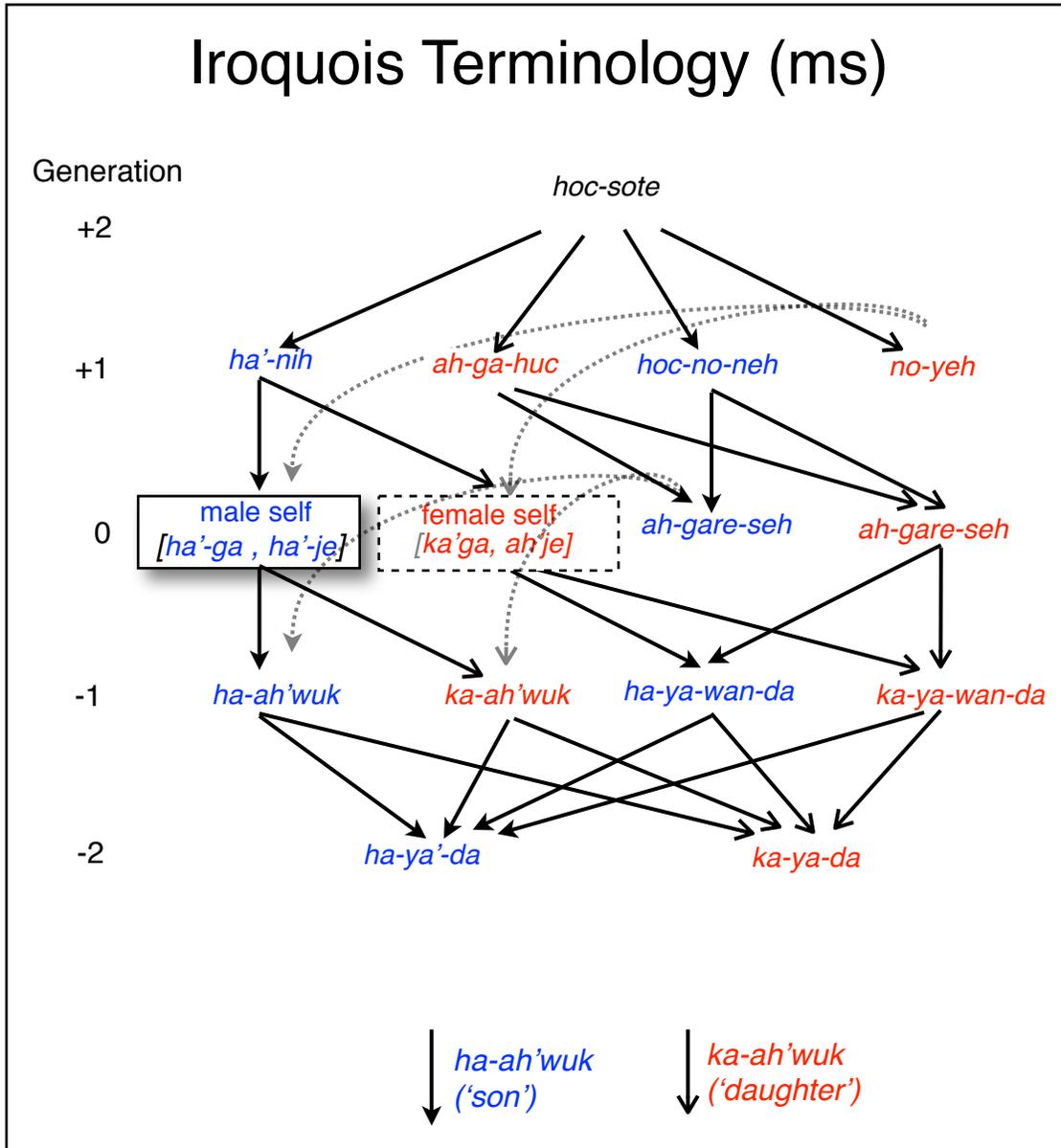
Figure 4: Kin terms for the Iroquois terminology from the perspective of a male speaker. A cross-cousin marriage rule is not necessary since none of 'son' of *ah-gare-seh* = *ha-ya-wan-da* and 'daughter' of *ah-gare-seh* = *ka-ya-wan-da*, or 'son' of *ah-gare-seh* = *ha-ah'wuk* and 'daughter' of *ah-gare-seh* = *ka-ah'wuk* requires a marriage rule for logical consistency. Compare these four products to the analogous products in the Kariera terminology; the differences in these products determine the differences in the two terminologies.

changing conditions at a local, regional, and continent-wide scale.   Under stress conditions, this complex, he suggests, would serve to reduce the population size by making it more difficult to find spouses endogamously, hence marriage exogamy would increase, thereby leading to a reduction in inbreeding depression, hence to reduced mortality, and so the population size would increase and recover from earlier reduction due to stress conditions.   Conversely, under beneficial conditions, population sizes would increase, making it easier to marry endogamously, thus leading to an increase in the inbreeding depression.

In my reading of this part of Denham's article, I see him as making two separate arguments. One argument compares the metapopulation he has defined with the ensemble of isolated, endogamous, highly inbred populations implied by Figures 1.1 and 1.2 when the latter are read as idealized data models of actual or observed marriages. The other argument builds off of the first by considering whether the integrative practices that are part of the metapopulation would vary with changing conditions in a manner that integrates the demographic trajectories of local populations with changes in the degree of inbreeding in local populations. For both arguments, inbreeding depression plays a central role, but in different ways.   In the first argument, inbreeding depression is driven to high levels in small populations that could lead to their extinction.   In the second argument, reproductive strategies or mating systems have the effect of modifying inbreeding depression by the factors integrating populations into a metapopulation. Let us examine these two arguments in turn, keeping in mind that whether it is inbreeding depression or some other mechanism integrated with the inter-societal dynamics is not critical to the overall thrust of his argument.

(1) Metapopulations and Isolated Populations

Denham's first argument requires more than a comparison of the demographic   consequences arising from the structural difference between a metapopulation and a collection of isolated populations, for if these two structures have the same demographic parameters, the ensemble of isolated populations will differ demographically from the metapopulation mainly by turnover in subpopulations, assuming the likelihood of a subpopulation fissioning increases with the size of the subpopulation, not by the risk of the total population going extinct.   Even though the magnitude of stochastic changes in birth and death rates are more pronounced in small subpopulations, thus potentially making it more likely that they might die out for stochastic reasons, stochastic effects like this are overridden even with a few hundred individuals due to the high, potential fecundity of 10 - 12 births over a woman's reproductive period, making it possible for even a small population to respond quickly to stochastic reductions in the population size (Read and LeBlanc 2003).   Central to this part of his argument, then, is the degree of inbreeding that can arise in a small, isolated population when marriages take place between genetically, closely related individuals in comparison to a large population in which marriage links are dispersed throughout the population.

Denham notes that the inbreeding coefficient will increase to around $f = 0.50$ under the marriage of biological double cross cousins shown in Figures 1.1 and 1.2. (The usual inbreeding coefficient for double first cousins of $f = 0.125$ assumes no prior inbreeding in the population; with an assumed population size of 500 persons and repeated double first cousin marriages, the parental generation is increasingly inbred, hence the increase in the inbreeding coefficient beyond what is contributed by double first cousin marriages alone.) His suggestion that this extreme of an inbreeding rate would lead to population extinction is borne out by data on the mortality cost of inbreeding in human populations. For first cousins, with $f = 0.0625$, the mortality cost of inbreeding is around 4.4% (Bittles and Neel 1994), hence the mortality cost would be 8 times higher for $f = 0.50$, or around 35% if all marriages matched the pattern shown in Figures 1.1 and 1.2. That, coupled with a mortality rate of about 50% between birth and adulthood in hunter-gather populations, would imply a mortality rate of about 85% before adulthood, which would require an impossible, average fecundity rate of around 16-17 births per female over her reproductive period, allowing for a low mortality rate during the early to middle adult years and the fact that some women are biologically infertile, merely to avoid population decline. Thus each of the isolated populations would go extinct.

Denham goes on to suggest that the Minimum Viable Population (MVP), defined as the species size required for a 99% likelihood of a species surviving for 1000 years (which corresponds to a 60% likelihood of surviving for 50,000 years, the upper bound for the time since Homo sapiens first reached Australia), taking into account stochastic effects, inbreeding depression due to finite population size, and natural catastrophes (Shaffer 1981), provides yet another measure for assessing whether an isolated population, as is assumed in Figures 1.1 and 1.2 and matching Birdsell's modal size of $n = 500$ persons for a hunter-gatherer society, would go extinct over the 50,000 years since Australia was first populated. For 145 mammalian species, the 20% trimmed mean, based on $\log_e(\text{MVP})$, for the standardized MVP values is $n = 1453$ individuals, implying that a single, isolated society composed of $n = 500$ individuals would likely go extinct over the 50,000 years since Australia was first populated.[3, 4]

Applying the MVP risk factor to hunter-gatherers needs to be done with caution, though, as the 20% trimmed mean, based on $\log_e(\text{MVP})$, for the MVP values is computed over a disparate collection of mammalian species and may not be representative of MVP values for hunter-gather population, as suggested by the fact that the trimmed means for the MVP values are smaller when the comparison group is phylogenetically closer to *Homo sapiens*: the 20% trimmed mean for MVP, based on $\log_e(\text{MVP})$, is $n = 944$ individuals for the 17 anthropoid species and $n = 1163$ for the 5 great ape species in the database used by Traill *et al*. 2007. For a single estimate based on chimpanzees, the MVP drops to 99 individuals. In order to compare these trimmed means

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[3] All MVP values were standardized by Traill *et al*. 2007 to correct for the various methodologies used by different authors for computing MVP values.

[4] Because the MVP values have a skewed distribution, a robust measure of central tendency in which 20% of the tails of the distribution are trimmed before computing the mean has been used (see Ercet-Hurn *et al*. 2013). In addition, due to the extreme skewness of the data, the trimmed means have been computed using $\log_e(\text{MVP})$.

with the hypothesized size of $n = 500$ hunter-gathers, though, we need to return to unstandardized population sizes. The 20% trimmed mean for unstandardized MVP values, based on $\log_e(MVP)$, for the 17 anthropoid species is $n = 671$ individuals; for the 5 great ape species it is $n = 433$ individuals, and the single chimpanzee unstandardized MVP estimate is $n = 25$. The population size of $n = 500$ hunter-gatherers is within the range of these MVP values.

We can complement these data with examples of small hunter-gatherer groups surviving over 100s of years. The Polar Eskimo, who numbered about 300 individuals when encountered by Europeans in the 1800s, apparently had been completely isolated for about 400 years. Also, the East Greenland inuit who numbered 489 individuals in a census taken in the mid 1800s (see references in Read 2012) and were sufficiently isolated so that they remained genetically distinct as a subpopulation, were able to survive for at least the 400 years from when the Thule Inuit migrated into Greenland. These data suggest that even isolated hunter-gatherer groups of around 500 persons were viable over centuries, if not a millennia.

Altogether, these data suggest that 500 persons is within the range of (unstandardizd) MVP values for hunter-gatherer populations. If so, a single population had a 60% probability of surviving 50,000 years, then there is only a 1% chance that as many as 5 populations would go extinct over this time period. Hence most of the groups in a cohort of several hundred, isolated, hunter-gatherer populations distributed over Australia would survive 50,000 years. Given the uncertainties involved in estimating MVP values for hunter-gatherer populations, though, we should cannot rule out the possibility that isolated populations of 500 individuals would have been less viable over a 50,000 year time period than the above data suggest.

Even if the MVP data are assumed to imply that most of the populations in a cohort of small, isolated hunter-gatherer groups would survive over a 50,000 year time period, it still is the case that small, isolated hunter-gatherer groups following the highly constrained marriage patterns of Figure 1.1 and 1.2 would be at risk of extinction from inbreeding depression, as argued by Denham.

Now consider the actual marriage patterns with substantial deviation from the pattern depicted in these diagrams, as Denham discusses in detail. The large age difference between spouses "opens up" marriages in the manner he depicts in Figure 1.3, and the regular occurrence of exogamous marriages, he points out, substantially reduces the inbreeding coefficient from what is implied by these diagrams. He also suggests that one way groups could respond to environmental stress conditions was through increase in exogamous marriages, then with marriages becoming more endogamous under more plentiful conditions. The change in exogamous marriages in response to environmental stress opens the possibility that there was a feedback loop formed by groups responding to environmental stress conditions through increase in exogamous marriages, and then marriages becoming more endogamous under more plentiful conditions, thereby changing

the inbreeding coefficient accordingly, hence acting as a regulator on the population size.[5] Though Denham does not make this argument, I will show that the inbreeding depression is not sufficiently large, under actual actual marriage patterns, to stabilize the population size under this feedback loop. I then discuss an alternative means by which the population size may have been stabilized, as a supplement to his discussion (pp. 5-10, 31-51) of factors affecting the population size of local groups.

(2) Inbreeding Depression as a Regulator of Population Size

To evaluate whether inbreeding depression could be the means through which population sizes were stabilized, we first need a measure for the degree of inbreeding and inbreeding depression due to the actual marriage patterns.

Genetic Homozygosity and Degree of Inbreeding

The degree of inbreeding can be determined from genealogical records when available, but the results may not be generalizable (spatially or temporally) beyond the society for which the records were obtained. Alternatively, and more robustly, increase in genetic homozygosity beyond what would occur under random mating -- the latter being the marker of inbreeding -- can be measured using genetic traits over large and disperse populations. A recent genetic study of Aboriginal populations conducted in this manner found that increased homozygosity does not characterize the indigenous "tribal populations" (Walsh *et al*. 2007) for Australia as a whole. Homozygosity measures varied across "tribes," ranging from f = -0.1 (outbred) to f = 0.1 (inbred), with an average inbreeding of f = 0.0. There were some regional patterns, such as four regions in the northern part of Australia with more than 1/2 of the "tribes" having increased homozygosity (to be discussed in more detail below). Thus the historical marriage pattern measured by genetic pattern has not led, on average, to inbred Australian populations. This is not to say that no group is inbred; rather, some groups may be inbred, but at the same time other groups are outbred.

Inbreeding Depression: Mortality Risk Due to First Cousin Matings

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[5] Denham relates difficulty in finding endogamous spouses to scarcity: "hard times of scarcity would yield more open boundaries that would facilitate exogamous marriages *when endogamous marriage partners might be scarce*" (p. 54, emphasis added). Thus, he assumes that endogamous spouses are rarer, hence harder to find in small, than large, populations. However, the likelihood of finding a marriageable person of the opposite sex in one's group (subject to local constraints on eligible marriage partners) is a function of the sex ratio, not the population size. Let us ignore drift effects for the moment. If the population size is reduced by a factor of two without changing the sex ratio, then there are 1/2 as many potential spouses, but there are also 1/2 as many individuals searching for spouses, hence the likelihood of finding a marriageable person of the opposite sex has not changed. Drift effects can change the sex ratio, but with 100's of persons, drift effects on the magnitude of the sex ratio are negligible. Hence there is no demographic reason to assume that endogamous marriage rates rates vary with environmental stress.

The consequences of inbreeding at a local level can be measured directly through data on the risk factors associated with a group's rate of cousin marriages. For first cousin marriages, the increased risk of "late miscarriage, still-birth or early death" is about 4 - 5% (Bittles and Neel 1994:120). The 20% rate of first cousin marriages Denham reports for the Alyawarra (which is not large in comparison to the Middle East where first cousin marriage rates vary from 18 - 41% [Joseph 2007 and references therein]), would add 0.2 x 5% = 1% to the mortality rate, which only slightly increases the 25% risk of a newborn in a (traditional) hunter-gatherer society not surviving the first two years and the overall 50% mortality rate before adulthood. Given the potential fecundity rate of human females, the increased mortality rate for a group due to first cousin marriages could easily be compensated for by an extra birth. In addition, for the same rate of inbreeding, inbreeding depression will decrease through time as recessive, deleterious alleles are removed from the population: "consanguineous marriages … are from the standpoint of population genetics not undesirable" (Bittles and Neel 1994:120). Substantially more marriages between close, biological kin would be required before inbreeding depression would act as a deterrent on population growth.

Effective Population Size and Inbreeding Depression

Another way the consequences of inbreeding depression can be measured is through the effective population size needed to avoid inbreeding depression. An effective population size around N_e = 50 suffices to counterbalance inbreeding depression due to small group size (Franklin 1980) and corresponds roughly to a census population size of about 200 individuals for hunter-gatherer groups.[6] However, this also assumes the population size does not increase, which is unrealistic for hunter-gatherer groups. Assume, for example, that a society of 500 individuals is suddenly reduced to 25 individuals due to a catastrophic event. With the drastically reduced population density, a new fecundity rate of 8 births/reproductive period in response to the decrease in the population density is not unreasonable and, assuming a 50% mortality rate, the population will double in size in one reproductive generation, hence will have 800 persons after 5 generations. Birdsell (1953) provides a number of examples of small human populations doubling in size each generation for several generations.

Migration and Inbreeding Depression

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[6] Franklin (1980) also discusses an effective population size of N_e = 500 as being needed to maintain sufficient genetic diversity within a species to cope with environmental variability. This, however, does not apply to hunter-gatherer groups due to the extensive ability of Homo sapiens to engage in niche construction through cultural means. Hunter-gatherers adapt to variation in environmental conditions through culturally, rather than biologically, mediated behaviors. The variability of concern for at least one subpopulation to survive is between group, not within group variability, as the former measures the likelihood that at least one group in a collection of small hunter-gatherer groups will survive in the face of environmental stress. Between group cultural variability will vary directly with the number of groups, hence tends to vary inversely with size of groups, keeping the total population size fixed. In addition, horizontal, phenotypic transmission tends to take place over shorter time scales and greater distances than is the case with genetic transmission. Hence the effective population size required to maintain genetic diversity does not apply, unmodified, to hunter-gatherer groups.

Migration between groups due to exogamous marriages will also attenuate the inbreeding depression effect. A migration rate of about 7%, corresponding to an exogamous mating rate of 15%, suffices to replace about 50% of the original alleles in a population with alleles from neighboring populations after about 200 years (Cavalli-Sforza *et al*. 1994:Table 1.17.1). This implies that possible deleterious effects of inbreeding will be overridden over time scales of 100's of years by the diluting effect of the inflow of alleles from surrounding groups through reproduction associated with exogamous marriages.

In sum, the population sizes of Australian hunter-gatherer groups were not stabilized by a feedback process that depended solely or primarily on inbreeding depression. That the population sizes were stabilized is not in doubt. We now consider (in addition to the comments Denham makes about factors affecting population sizes) a general model for the stabilization of population sizes in hunter-gatherer groups based on a women making decisions affecting her fecundity based on what she perceives is in the interest of the well-being of her family.

Stabilization of Population Size in Hunter-Gatherer Groups

Fecundity rates in human societies are culturally mediated, both at a group level through cultural practices such as age of marriage (assuming reproduction only begins after marriage), *post partum* sexual taboos, and the like, and individual practices, especially the number of years that a newborn is nursed (Read and LeBlanc 2003).[7]   The latter relates to the fact that for hunter-gatherers, a woman has (at least) two main demands on her time: parenting and foraging. Of these two demands, only the first is under her direct control and one way, but not the only way, it can be modified is by changing the spacing of offspring through the length of the time she nurses an offspring (Read and Leblanc 2003 and references therein). Assuming women have a desire for a healthy family, when foraging costs are high and her time is limited, she may defer becoming pregnant when she perceives that she currently does not have sufficient time to properly care for a new infant and, conversely, she can decrease the birth interval when foraging costs are low, assuming women have a desire for many children. The translation of the demands on her time into the spacing of her offspring, in both directions, leads to a stabilized population size for a group.

The birth spacing model, then, both increases and decreases the population size without deliberateness on anyone's part, other than assuming women want healthy families and they want children. This does not mean that groups never affect their population size, just that one need not assume group awareness of the population size and the consequences of an indefinitely growing population in order for the population size to be bounded below the carrying capacity. In the reverse direction of a population size reduced for reasons other than a decrease in resource density, the birth spacing model implies that the birth rate will increase because foraging costs

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[7] The diagram showing a population going extinct after overshooting the carrying capacity is valid only if it is assume that, as the population shrinks in size, it continues to overexploit its resource base. If, however, rapid and high mortality drives the population size to a density below over-exploitation of its resource base, then it will not be driven to extinction.

will have been reduced, and so women will space births more closely under the assumption that women want children, subject to having a healthy family.

Realized Carrying Capacity

Because woman can modify their fecundity rates, we need to distinguish between the *realized carrying capacity*, K*, that takes into account cultural factors affecting her fecundity such as the number of years an infant is nursed, and the *absolute carrying capacity*, K, which is environmentally determined (keeping hunter-gatherer technology fixed).   Under the same environmental conditions (i.e., the same value for K), K* will be stabilized at a value less than K when a woman varies the nursing period in accordance with foraging demands on her time (Read and LeBlanc 2003); how much less will depend on the value women place on parenting time. For the same foraging time costs (that is for the same number of woman foraging for the same resources), K* will be lower when women place higher value on parenting because women are thereby reducing fecundity rates sooner in response to foraging cost increases arising from increase in population density than would be the case if women placed less value on parenting (see Read and LeBlanc 2003 for details).   In other words, whereas K is environmentally determined, K* is culturally determined. In brief, if hunter-gatherer women balance parenting time and foraging time by spacing of births, this suffices to stabilize population sizes, even with very large, potential fecundity rates for human females.

Relationship Between the Realized Carrying Capacity and the Absolute Carrying Capacity

In addition, when comparing environments with a high density of resources to environments with a low density of resources, the foraging time increases at more than a linear rate with the change in resource density due (at least) to the increased travel time required to reach the larger area over which foraging must be done to obtain the same quantity of resources in regions with a low density of resources.   The net effect is for K* to follow a C-shaped curve in comparison to K when comparing regions with different resource densities.   At the two extremes of very small K and very large K, K* will be close to K and in the middle range K* will be substantially below K, hence the C-shape for the way K* varies with K.   For the extreme of very low resource density, K* will be close to K due to the absolute shortage of resources. With very high resource density, the low cost of obtaining resources implies that foraging cost will have little effect on spacing of births until the population density is close to the carrying capacity, K. For the middle range, the increased cost of foraging will cause K* to be substantially below K. Empirically, we find precisely this predicted C-shaped curve for Australian hunter-gatherer groups (see Figure 5).

The implication of the C curve is that groups in relatively moderate resource density regions, where K* is substantially below K, are buffered more against stochastic variation in resource availability than groups in regions with high resource density, where K* is close to or equal to K,
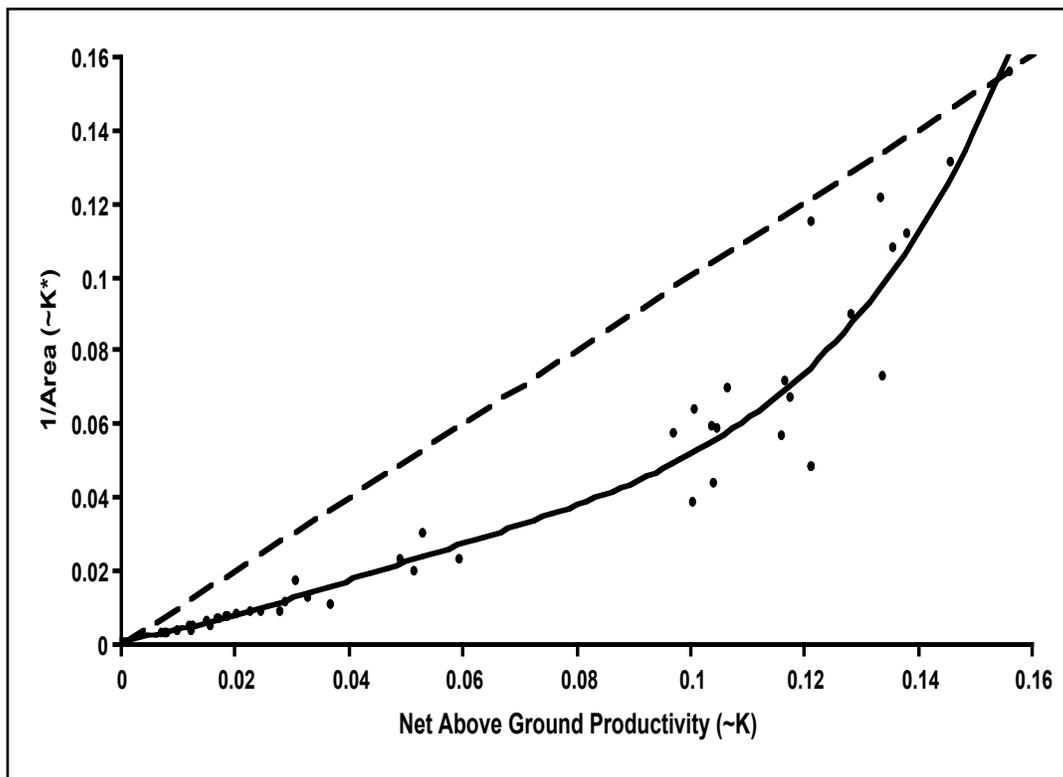
Figure 5: Observed data for Australian hunter-gatherer groups. K* (vertical axis) is proportional to 1/area, where area is the total region used by a group, since population size has a modal size among hunter-gatherer groups and so K* varies inversely with area. K (horizontal axis) is proportional to net above ground productivity. The curve is a best fitting 2nd degree polynomial. Data are from Binford (2001).

implying that we should find more instances of conditions that might lead to food stress in region s of high resource density than in regions with low density of resources.[8] How groups respond to food stress is not fixed, but relates to aspects of a group's culture that affects the decisions made at a group level regarding possible responses to stress conditions. Denham points out how, for example, the Dream Time provided Australian groups with an ideology that enables food stress experienced by one group to be ameliorated through cooperative access to resources by different groups.

According to the model developed by Read and LeBlanc (2003), high resource density implies most groups are close to K, given the rapid rate with which human populations can increase in size. If the environmental conditions worsen over a spatial scale substantially larger than the area habitually used by a single group for obtaining resources, then an extreme condition may arise in which neighboring groups are all at, or exceed carrying capacity simultaneously, hence all groups are simultaneously under high stress for survival. Extreme and unusual conditions

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[8] In regions with very low density of resources, the dispersal of families and the sheer lack of resources imply that violence against neighboring groups is not a strategy that increases resource availability for the warring group.

like this may have led to groups opting for violence rather than accepting starvation, which might account for fact that Arnhem Land, the northern, resource rich area occupied by the Murngin, conflict is depicted in rock art, suggesting episodes of conflict between groups (Taçon and Chippindale 1994), with the conflict scenes depicted in the rock art correlating with a general increase in resource availability: "… climatic changes rendered Arnhem Land more ecologically plentiful 4,000 to 6,000 years ago… [rock] art style during this period exhibits a much greater incidence of collective armed conflict ..." (Knauft 1996: 86). It is also in these regions where we find ethnographic reports of warfare: "[W. Lloyd] Warner found multiple types of Murngin conflict … much of this lethal violence occurred in collective battles and raids between rival groups … *they inhabited a rich ecological environment*" (Knauft 1996: 85, emphasis added). Contrariwise, the Western Desert lacks evidence of inter-group conflict and has had little change in stone artifact forms for 10,000 years (Gould *et al*. 1971), suggesting a population size stabilized below carrying capacity, perhaps due (in part) to spacing of births as assumed in the model given in Read and LeBlanc (2003).

Birth Spacing and Regional Patterns for Genetic Homogeneity

The birth spacing model also accounts for the increased genetic heterozygosity found within "tribal" groups in the northern regions of Australia, as well as the genetic homogeneity found among "tribal" groups in the Western Desert. The former suggests relative genetic isolation of groups in the northern areas, whereas the latter implies genetic flow among groups, which would occur with intergroup marriages.

As noted above, the Read and Leblanc model shows how, for the Western Desert, population sizes could have been stabilized below carrying capacity through birth spacing. This, coupled with the low density of resources that required extensive yearly migration in accord with local environmental conditions by very small groups such as a single family, suggests that families from different groups are likely to encounter one another and it would be beneficial for them to cooperate with regard to information about availability of resources and the like. Thus, families from different groups would find it in their interest to activate cultural means that facilitate cooperation, such as exogamous marriages through which kin connections between groups are established. Exogamous marriages, as discussed by Denham, are facilitated by reference to their respective section systems through which marriages can be arranged so as to be proper from the viewpoint of both groups. Under these conditions, exogamous marriages would be likely, thereby leading, to an increase in genetic homogeneity in the Western Desert.[9]

In the northern, resource richer regions, the higher density of resources translates into groups being at, or possibly exceeding, carrying capacity, which, under extreme conditions, may lead to inter-group violence. Under condition like this, cultural differences between groups may be

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[9] The pattern of marriages in the low resource density areas in comparison to high resource density areas is similar to the conclusions reached by Denham for these two regions, but for different reasons. The model presented here arrives at this pattern from the interest of women in balancing parenting against foraging costs; Denham attributes it to inbreeding depression -- but as has already been discussed, inbreeding depression does not account for the pattern.

emphasized, leading to reduced social interaction, hence to lower rates of group exogamous marriages than is the case in the Western Desert, and so there would be higher rates of inbreeding and greater genetic differentiation between groups, which is precisely what the genetic data indicate. Thus the model of women responding to increased costs of foraging by increasing spacing between children -- motivated by a woman's interest in ensuring adequate parenting time for her offspring -- implies stabilized population sizes (the realized carrying capacity K*), in a patterned way (a C curve) with respect to the carrying capacity, K. In turn, the predicted pattern would account for the inter-group homogeneity in genetic data for the groups in the Western Desert and the genetic distinctiveness of groups in the northern region, along with the lack of evidence of systematic inbreeding in the Western Desert and the evidence for more systematic inbreeding in the northern regions. In brief, the model for spacing of births in accordance with the demands on a woman's time would account for the aspects of interest to Denham, hence may be "a concept that is more robust than inbreeding avoidance [and] might have informed my argument better" (p. 67).

Implications of Spatial and Temporal Patchiness of Resources for Social Integration

The Read and LeBlanc (2003) model also deals with another aspect of the Australian continent of interest to Denham. Denham, following Sutton (1990), assumes a situation in which there is "alternating impoverishment and enrichment of neighboring habitats" (p. 54) and goes on to suggest that this might even be occurring on more than a regional basis. He uses this to argue for a pan-Australian, integrated social system. Let's examine this in more detail, beginning with the conditions identified by Sutton; that is, a situation where the scale for measuring patchiness of resources is comparable to the scale for the habitation area for a group. Read and LeBlanc (2003) modeled this situation in detail. Briefly, they note that, under this pattern for environmental conditions, if groups institute some means by which cooperation between groups in the use of resources is achieved, and if this leads to an increase in population density by virtue of groups with a resource surplus sharing their surplus with groups having a shortage of resources, then the increase in population density acts as a brake on any tendency towards devolvement to a prior, lack of cooperative interaction between the groups.[10] The prior form of social organization cannot maintain the increased population density -- otherwise, the population density would already have increased -- hence devolvement would entail high rates of mortality and so the individuals involved have a vested interest in maintaining whatever mode of social organization that makes possible the sharing of resources among the groups.

This is the situation that Denham posits for Australian groups with regard to the porosity of societal boundaries. He argues for increase in the porosity of group boundaries leading to an increase in exogamous marriages when one group may be facing resource shortages but another

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[10] This assumes more complex forms of social organization instituted for sharing of resources (such as institutionalized means for integrating together otherwise separate groups) have (at least) a maintenance cost, hence there is a tendency to devolve towards simpler forms of organization when possible. Examples of group fusion and fission processes have been widely noted in the literature.

group is not, and an increase in endogamous marriages in the opposite situation. Following Denham's argument, if we imagine that initially Australia had completely endogamous hunter-gatherer groups, then the maintainable population density would be less than what could be maintained with porous boundaries when some groups have a surplus of resources while others have scarcity. As argued by Read and LeBlanc (2003), if porous boundaries lead to increased population density, then we would expect the porous boundaries to be maintained since the increase in population density due to the porous boundaries can be sustained only with those porous boundaries, hence it would be in the interest of individuals to maintain the porous boundaries.

However, we also need to consider the time scale for tracking variability in resource patchiness. Resource densities vary with climatic time scales and one of the most important of these scales, for local spatial variability, is year-to-year climatic variability. Exogamous marriages, though, are on a time scale of generations, not years, and, as Denham discusses, only involve a few individuals. The implications of exogamous marriages for balancing population density against resource density is much less pronounced than when residence group numbers are balanced against resource density on a month-to-month basis through family movement between residence groups in the same society on the basis of kinship relationships. Hence the exogamous marriages probably had limited consequences for changes in population density, meaning that they would have had, at most, a limited demographic effect. Their social implications are, however, more complex, as discussed extensively by Denham.

Conclusion: Section Systems and Group Integration

That the section system apparently makes exogamous marriages easier to work out in a manner consistent with local ideologies about marriages is an intriguing aspect of the Australian kinship systems and may have led to a greater degree of interrelatedness between groups than is generally the case with hunter-gatherer groups in other continents who did not have kinship terminology systems structured in the same manner that allowed for a smooth change of reference from speaker (the kinship terminology) to society (the section system). Kinship systems like this would have provided a cultural overlay with intra- and inter-societal ramifications extending beyond what would be implied by a purely environmental/ecological account. How much greater ramifications is not clear, though Denham's idea that there was "a single integrated unit with 600 semi-autonomous nucleations embedded in it, thereby encouraging research on structures and processes spanning the entire field of Aboriginal societies that hosted the emergence of both subsection systems and firestick farming" (p. 66) may go beyond what the data justify. The section systems may play an important role in the interaction between neighboring groups, but it is not clear that this extends continent wide, except in an indirect sense.

That local interaction between groups may have led to continent-wide communication patterns is certainly possible; the homogeneity of material culture in the Arctic during Dorset times, for example, implies that while groups were relatively isolated (as indicated by the mosaic pattern of

the archaeological record), there was still enough intergroup contact to enable cultural ideas to be shared across the Arctic (see references in Read 2012). Ideas can spread widely and uniformly, even with limited migration, as long as the ideas are relatively stable and persist even without frequent reinforcement and/or realignment. The section systems are of this nature; they have a logic to them that prevents structural change through drift. As noted by Denham, the structure of the section system implies that structural changes between systems with an even number of sections will be through multiples of two: a two-section system can be changed into a four section system by introducing a generation moiety based on odd versus even generations, and a four section system can be changed into an 8-section system by introducing a criterion that divides each section into two parts. Contrariwise, we would not expect a four-section system to become a five-section system, then a six-section system, then a seven-section system, and finally an eight-section system.

Even if transmission of the idea of sections is just a one-step process (that is A transmits the idea of a section system to B; B transmits the idea of a section system to C, independently of A, and so on), we would still expect to find homogeneity in the structure of section systems over large areas, as Denham discusses, for structural reasons. In the same vein, Dousset's comment that the section systems and the kinship terminologies are "made for each other" (Dousset 2005:23, as quoted by Denham) follows from the demonstration by Leaf and Read (2012) that the Kariera sociocentric four-section system is the logical consequence of, and emergent from, the egocentric Kareira kinship terminology. But all of this need not add up to pan-regional, let alone a pan-Australian, "integrated unit." Pair-wise network connections do not, by themselves, imply an integrated, overarching structure. The latter must be demonstrated.

Nonetheless, I agree with the general thrust of Denham's argument; we need to look at the same data with new perspectives and allow ourselves more conjectural freedom, while ensuring that our arguments are in accord with what we know and understand about the operation of human systems; that is, the operation of human complex systems.

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