The Evolutionary Lattice of Avoidances as Respect

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Abstract: Stereotyped kinship behaviors are unrecognized as significant to the evolution of human cooperation. Joking relations reinforce cooperation through links with existing or close relatives (cross cousins, sibling's spouses, spouse's siblings). Avoidances reach out to connect non-relatives through marriage: parents-in-law and distant in-laws such as WiBrWi. The latter behaviors enhance cooperation in more extensive networks of in-laws and a variety of more distant kin. Low population densities, in a sample of 34 forager societies, show Joking dyads that are very frequent. They help to integrate societies of smaller scale and density, facilitating close marriages (e.g., wife's sister). Avoidance relationships become more common at higher densities that require nucleation into localized communities of larger scale and integrate kinship networks at these larger scales. Study of kinship-behavior dyads and other coded variables in the SCCS reinforce the view that Avoidance is density dependent: as population density increases, along with higher jurisdictional levels, the commonality of parent-in-law Avoidances among larger-scale foragers and more complex societies peaks, declines, and eventually disappears. These relationships are shown here by a Network of Variable Analysis (NoVA) of SCCS societies using Dow-Eff software that corrects for autocorrelation and missing data. See Appendix 1: Murdock Kin Behavior Data Summary.

A world sample of kinship-behavior dyads in 250 societies coded by Murdock (1971 and n.d.) shows 23 types of avoidances that fall into two categories: Parent-in-law (4 types) and another set of 19 other in-laws that forms an odd assortment of affinal and blood relatives (e.g., Br/Si, FaSi, MoBr, cross-sex cousins, HuSiHu, HuBrSo), of which WiBrWi, although scantily reported, forms the most generic superset. A formal concept lattice, carried out by Darmstadt mathematicians for the Birkoff festschrift (Baker, Birkoff and Wille 2007), identifies every superset, subset and intersection of types of avoidance and identifies all these intertwined subsets for subgroups of societies in this sample, and describes details of networks of avoidances for individual societies.

Avoidances

For Murdock (1971:433, 440-441), the choice of what to publish regarding Avoidance behaviors in kinship networks was partly based on the assumption that joking and avoidance are manifestations of sex taboos (e.g., avoidance of WiMo as an extension of maternal incest taboos and associated with matrilocal residence) and local rules prohibiting certain types of marriages. None of the theorists who speculated about avoidances, either anthropologists (Tylor, Lowie, Radcliffe-Brown, Eggan, and Driver) or psychologists (Dollard, Clark, Hull, Miller, Zinn and others), thought to explicate theories about the structure of kinship networks or the evolutionary importance of kinds of stereotyped kinship behaviors that might

facilitate cooperation in local or extended kin groups. Rather, they assigned causes of avoidances to different kinds of (1) connection to specific incest taboos or post-partum sex taboos, (2) the presence of different types of marriage. The more coherent "main kinship theory" of chained effects was initially spelled out by Murdock thus: "When any social system which has attained equilibrium begins to change, such change regularly begins with modification of the rule of residence. Alteration in residence rules is followed by development or change in form of descent consistent with residence rules. Finally adaptive changes in kinship terminology follow (Murdock 1949:221-222). Driver's (1956, 1966) rearticulated "main theory" posited kinship adjustments that "followed a regular and predictable sequence", forward or backward, of how "changes in the division of labor by sex triggered changes in land tenure practice and subsequently, changes in descent reckoning, kinship terminologies, and in-law avoidance customs" (Jorgensen 1980:174; Naroll 1970:1241). The last step in this chain remains to be investigated.[1]

In contrast, a major problem with the first two theories is that they are too particularistic: An Avoidance of a certain type of relative is supposedly associated with the presence of a certain kind or kinds of marriage. If there are very many types of avoidance, and of marriage, the possibilities of accounting for which is connected with or affecting which becomes almost insurmountable.[2] It seems unlikely that this diversity represents a widespread extension of specialized versions of the Oedipus Complex to many different types of marriage or of dyadic kinship relations. Stephens and D'Andrade (1962:134,173-174 sample of n=59), (cited in Naroll 1970:1241), argued that the severity of kin avoidance was correlated with the duration of the post-partum sex taboo. In tests with a new sample (SCCS variable v34=134 of 186) the significance values are WiMo p=0.25 n=47, WiFa p=.08 n=30, HuFa p=0.86 n=36 and HuMo p=0.34 n=24, WiBiW p=0.39 n=12, hardly impressive evidence. For a similar variable v107 (SCCS n=134 of 186): WiMo p=0.18 n=46, WiFa p=.30 n=27, HuFa p=0.84 n=32, HuMo p=0.84 n=20, WiBiW p=0.96 n=10, all non-significant. Their claims that certain licentious Joking behaviors (SCCS v1226-v1228, categories 5 and 6) are correlated with WiMo, HuFa, and Br/Si Avoidance are unsupported by SCCS data.

More current literature on kinship and incest taboos is reviewed by Read (2014), who argues that rather than biological *contrasted* to cultural theories, "a more complete argument may be obtained by recognizing that the evolutionary transition from an essentially biological foundation for societal systems to a mainly cultural foundation has the trappings of a phase shift." We will argue that stereotyped Joking and Avoidance behaviors represent part of a phase shift within that larger phase shift. The stereotyped Avoidance roles, as part of emergent networks in social structure, represent phases in evolutionary adaption to selection toward cooperative communities at relatively small scales, which are then displaced

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[1] See footnote 3 and 7: five out of six WiBrWi Avoidance kin terms shared with other kin types are societies with Crow-Omaha kin-term systems which Driver finds to be among the four proto-systems for Avoidances in North America.

[2] *Of the 55 reciprocal kinship dyads in a subset of the 12 by 12 matrix, 24 or 44% had 1 or more avoidances, and 10/55 or 18% have 5 or more instances. There are 56 cases of parent-in-law avoidance and 76 cases for 20 other types of dyads (126 dyadic cases total).*

with the emergence of hierarchical political organization between communities. Ethnographic descriptions of communities represent this diversity and comparative research has the potential to elucidate this transformation in specific evolutionary sequences.

Reviewing Turner and Maryansky, Read summarizes, "Development of culturally expressed incest taboos involves the consequences of the transition from the weak social ties of the early hominins to the strong social ties associated with the nuclear family", that "emerged, no doubt, as a way to increase social solidarity and ensure fitness of offspring" (TM, p. 158). In contrast, what the study of Avoidances may teach us is that it is not simply the nucleus of the family engendering deep emotions but the far reach of extensions of the family, engendering Avoidance links of trust with remote affines, such as WiBrWi/HuSiHu, that may increase social solidarity and ensure fitness of offspring. Our case study of forager canoe trade among the Tenino illustrates in-law networks essential to trust, that reflects a specific pattern found worldwide, evidenced by comparative data. What appeared to Westermarck (1891), and possibly Wolf (1980, 1995) or Wolf and Durham (2004) as avoidance *aversions* can be viewed in an alternate light as socially sanctioned roles that are more strategic than aversive. It is not that WiBrWi is an aversive *persona* but a role in *facilitating* positive role relationships well beyond that particular dyad., *empathetic* linkages rather than emotionally aversive ones.

Our present study gives much support to the likelihood that Westermarck's and subsequent theories of aversive taboos are wrong. They might be considered as part of an exaggerated 19th century hysteria in interpreting exotic behaviors as psychologically primitive. Our study also raises questions about the five frameworks for defining kinship or genealogy discussed in Read's review: Schneider's "relations determined through parenthood defined by biological birth" the constructivist view that kinship "structure derives in real time from practice divorces from biology;" the biological assumption "that cultural phenomena derive through practice grounded in biology;" River's kinship represents "indigenous knowledge about reproduction;" or Read's "evolutionary development of kinship systems as being like a phase shift that disconnects the evolved system of kinship concepts from their biological precursors (Read 2012)." Read asserts, however, that "There is no society in which kin terms cannot be given categorical (even if incomplete) definition using genealogical relations and a genealogical tree of cultural genealogical relations can be computed using the same recursive logic by which a biological pedigree is constructed by geneticists" (Read 2014:22), which is a small but important stretch. WiBrWi is outside both the genealogical tree and the co-parent relation. Geneticists recognize the co-parent relation as biological (with its cultural analogy to marriage) in producing a child but while the SCCS data suggest that WiBrWi kin terms *are* kin terms they do not refer to biological pedigrees. [3]

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[3] *The kin terms used for WBW in cases of WBW Avoidance vary from descriptive (Manus; Crow-type terms generally), to WM (Dorobo, Crow; Omaha-type, Crow-type terms), HB and WF (Shilluk, Sudanese-type terms generally), to male-male (WBS; Thonga; Omaha-type terms), and cross-sex child (Marshallese). The WM for Dorobo and Crow and WF for Shilluk are also Avoided, and probably the WBS for the Thonga. The Marshallese have no other Avoidance relative, only WBW is Avoided. All others do have other Avoidance relatives.*

A previous PowerPoint presentation at the AAA Kinship Panel (White and Oztan 2012), on kin behavior among foragers, suggested that some of the variety in kinship behaviors could be subsumed under more general principles, such as demography, cooperativity in kinship networks, and how different stereotyped kin behaviors act to expand or contract the scales of inclusion, trust, and cohesion at different levels in kinship and social organization.[4] Those levels include concentric inclusion of nuclear, extended, and expanded subgroups linked within and extended to other communities. Above communities proper, jurisdictional hierarchies can be of very distinctive orders where our comparative analysis will show that stereotyped kin Avoidance behaviors fail to compete with as sources of cooperatively and lose their importance vis-à-vis supra-community institutions.

Forager Avoidances and Joking

Kinship behaviors – avoidance, joking, respect, informality, and sexual license – are reported for kinship dyads in nearly half of the world ethnographies that have been coded for kin behavior in the SCCS, especially in ethnographies from earlier time periods and for affinal relationships. Of the total dyads coded for presence/absence of avoidances in particular, in the SCCS, 26.5% have avoidances, and 48% of the dyads in societies coded for avoidance behavior have avoidances. Why are avoidances so prevalent, why do they occur in so many types of kinship dyads, and what kind of societies have or lack kin avoidances with specific kin dyads? To begin with, many of these societies are foragers, that is, hunters, fishers, and gatherers lacking agriculture and pastoralism.

Opening a new exploration of these questions concerning foragers (White and Oztan 2013), and drawing together data from Louis R. Binford's (2001) database and George P. Murdock's published (1971) and unpublished (n.d.) databases on kin-dyad behaviors, we demonstrated a critical relationship between the varying population density of forager bands – with a packing density threshold at 9.1 people/kmsq at which there is no longer unoccupied space into which mobile hunter-gatherers could move (Binford 2001) – and the number of Joking behaviors among relations in 24 societies (Figure 1).

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[4] *South American indigenous societies have an almost perfect split between 1) [formal link] relatives such as WiMo, SoWi or Brother-Sister) where Avoidance and Respect behaviors are present and 2) [informal link] same-generation relatives other than Sister where Joking or Joking-sexual license dyads may apply. The latter are probably the proto-kin behaviors. Avoidance or Respect are used for [formal links] dyads on all continents, and almost nowhere do [formal link] relatives have Joking or Sexual License (a variety of Joking) dyads, which are largely absent in the Circum-Mediterranean. Brother-Sister Avoidance dyad mostly occurs the Insular Pacific or North America. (is this footnote in the appropriate place?).*

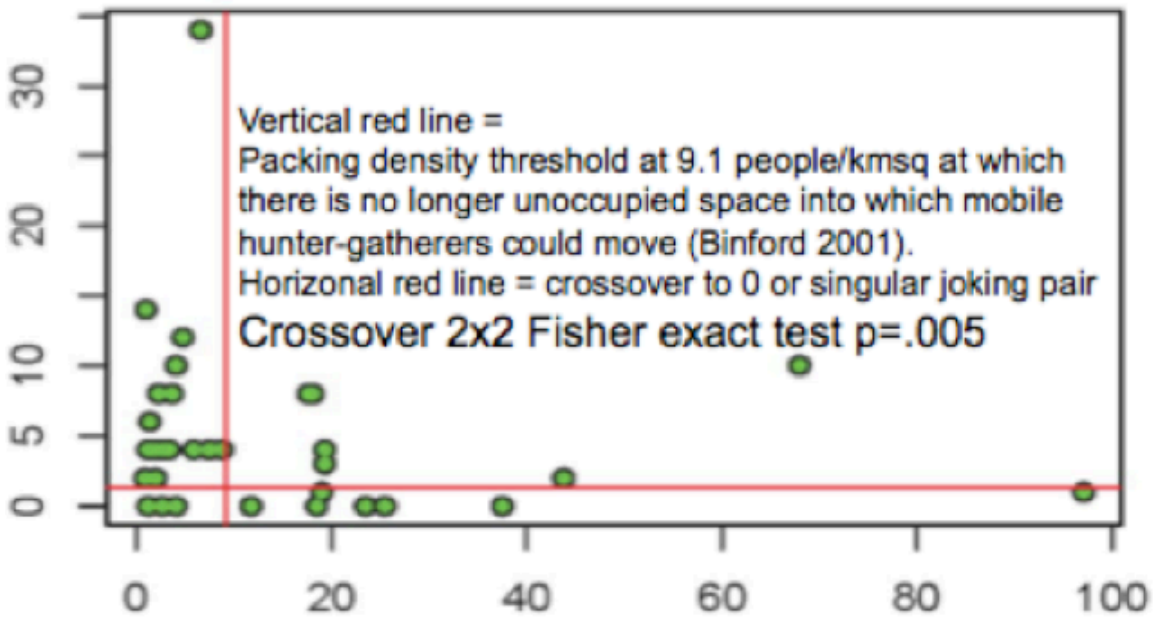

Figure 1: Forager Population Density and Log of Frequency of Joking. The packing density threshold is 9.1 persons per square kilometer (Binford's 2001), shown as the red vertical line. below population density packing threshold, there are many more foragers with in-law Joking behaviors and with more types of in-law Joking. The !Kung, upper left, are an extreme outlier. The probability of randomness is p=.005.

Given these results, we argued that the occurrence of Joking in 85% of the foragers below the packing threshold and half that (46%) above the threshold (for fewer kin types) is also a probable indication of the ubiquity of Joking relations in much earlier time periods in which band societies operated at very low densities. Joking links potential marriage partners and opposite sex sibling's spouses/ spouse's siblings and cross cousins in an explicit means of cooperation within that can also lead to marriages within generations .

Population density rises with larger population (R^2=0.374, p=.0006) and implies many more non-kin pairs of people in the local population. Thus a greater proportion of Avoidance than Joking behaviors will develop as non-kin persons marry. Joking will continue between cross-kin of the same generation in a more limited network. That is, while Avoidances will occur with the broadening of social networks, Joking is more often expressed among those of the same generation connected by parental and grandparental ties. Avoidances do not replace Joking within particular dyads (the dyads in which they occur differ) as population density increases but do increase in frequency in forager societies as Joking declines. To the extent that they each extend potentials for cooperation and conflict resolution Avoidances do so on a more extended scale and Joking on a smaller scale.

Figure 2 shows a comparison, for the same 34 band societies as in Figure 1, between the distribution of Joking and Avoidance behaviors. Avoidance does not cluster above the density packing threshold but tends to occur at significantly higher densities than do stereotyped Joking behaviors, as expected.

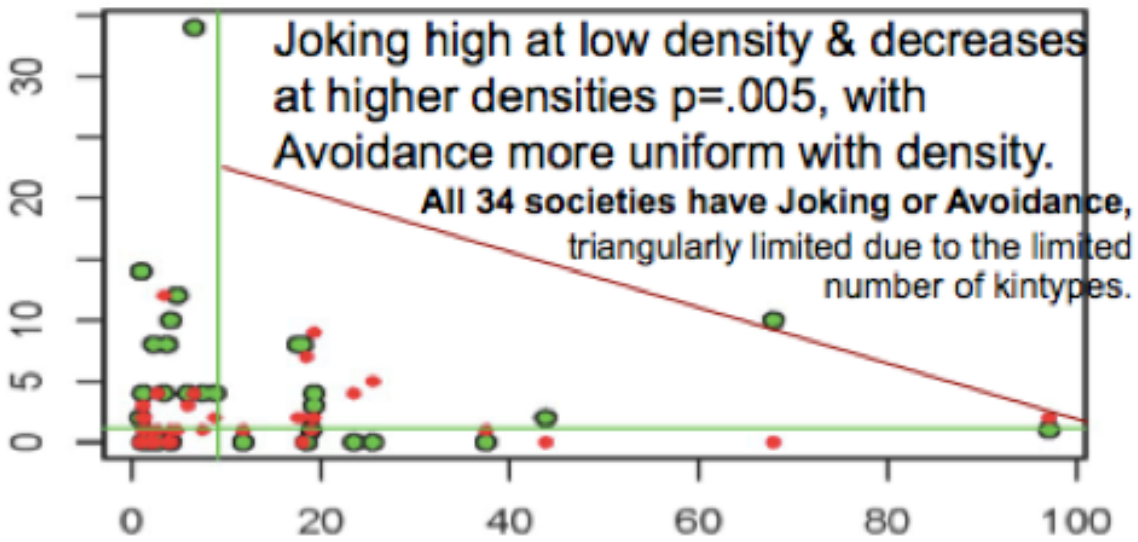

Figure 2: The distribution of Joking relations versus Avoidances relative to the 9.1 people/kmsq population density packing threshold , the green vertical line. The green horizontal line identifies a dichotomy for number of Joking (green dot) and Avoidance (red dot) relationships for the 34 forager societies. Joking relations tend to occur under the packing threshold. The difference in distributions is significant at pvalue=.005.

Figure 3 shows, along the x axis, the 34 foragers in the sample, summing negative values for Joking frequencies and positive values for Avoidance frequencies, as against, on the y axis, percentage of fishing and gathering contributions to subsistence.

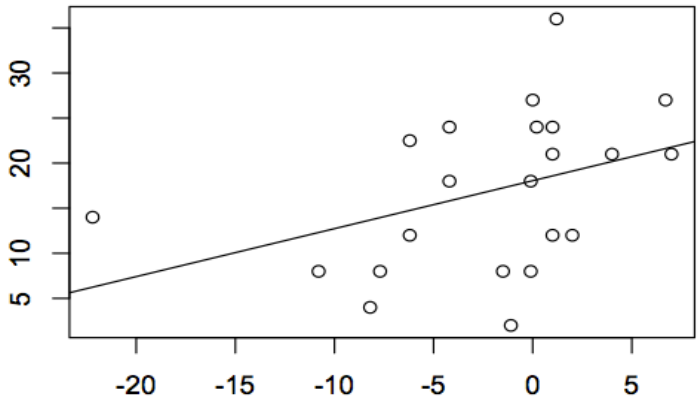

Figure 3: Linear regression of a subsistence densification measure with both Joking and Avoidance; nearly significant without removal of the leftmost !Kung outlier: p=.07 n=22, R2=.23. With adjustment of the outlier (to -5 not -22), p=.02, R2=.23. The y axis is fishing plus gathering times density in units of 9; another way of showing 3-dimensionality of Joking vs. Avoidances.[5]

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[5] ***Notes***: *Like Br/Si Avoidance, regression of Excess (+) Avoidances over (-)Joking is also predicted by Fishing (SCCS v7, p=.09). There is also mutual exclusion of Kin Avoidances (>1 in Table 1) & Joking Relations (>4 in Table 1) significant at p<0.05 (2 tailed)*
Entailments: Lo density Hi Hunting --> 9 more Joking>Avoid p<.01 Fisher exact
More Avoidances>Joking --> 7 Hi density NonHunting p<.01 (same by definition)

Table 1 shows the raw data for the correlation between the relative frequencies of Joking and Avoidance behaviors in the 24 foraging societies in Tables 2 and 3.[6] Because Joking dyad frequencies (Column 3) are more than those of Avoidances (Column 1), Joking frequencies are divided by 1.3 before computing their Adjusted Joking/Avoidance ratio (Column 2). Column 4, Density rank order, lists societies by the packing density threshold of 2X in Binford's (2001) measure of population density, with 3 and 4 being above the threshold. The foragers with higher Joking/Avoidance ratios ("Joking ratio higher") tend to be those with lower on density and high on hunting, D(10-H) labeling (10-Hunting) X Density (with low values for hunt-enabled. An intermediate group of foragers, are more intermediate in Joking/Avoidance ratios, population densities, and often lower Joking/Avoidance ratios. A third group tends to be low in Joking/Avoidance ratios, high in population densities, and not hunt-enabled but have high population density and more fishing and gathering.

Table 1: Ranking from more frequent Joking than Avoidance kin behavior for the initial smaller sample of 24 foragers. *Joking is correlated to low density and high dependence on hunting. Avoidance is correlated to higher density and lower hunting*. Data sources Binford (2001) 7 Murdock (1971; unpublished kinship codes). The frequency of Joking dyads here is divided by 1.3 to equalize comparison ratios to Avoidances. 2X is defined by Binford as below the packing threshold.

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Forager  Avoidances         Joking   Density                D(10-H)=Lo Density times NonHunting (Gather and/or Fish) N (coded) =22
             Adj.JokingRel           Packorder      Hunting              Data#   J:Joking&L:License v. A:Avoidance
Teton        2        3.1        4          2X         9          2          #12 J D(10-F)=LoDPack    Avoid  Joking/L (- Missing data)
Cheyenne     1        9.2        12         2X         8          4          # 9 J LoDPack&LoHunt  <14   0 |  7     2   p<0.00005 1-tailed
Kaska        0        1.5        2 [1]      2X         6          8          # 1 J HiDPack&LoHunt  >13 ---------------  p<0.00005 2-tailed
Wind River   0        3.0        4 [1]      2X         6          8          # 3 - LoDPack*LoHunt 14<19  0 |  5     0   Fisher Exact Tests
Aweikoma     0        7.7        10         2X         6          8          # 5 L                      ---------------
Slave        0        10.8       14         2X         6          8          # 2 J LoDPack*LoHunt  >19   7 |  0     1   are below
Rainy River  3        3.1        4          2X         6          8          #13 J HiDPackLoHunt    9    5    2     0
Attawapiskat 1        4.3        6          2          5-4-3M     12-14      #11 J Na7 N03c Murdock 1971 EA: hunting: 4 (36-45%) 3 or 5
Kaibab       0        6.2        8          2X         4          12         # 4 J - - - - - - - - - - License an extreme form of Joking
Arenda (N)   1        3.1        0 4L       2X         4          12         # 8 L 4L Murdock 1971
           ------------------------------------------------------------------------------ Joking ratio higher (dominant)
!Kung        4        26.2       34         2X         3          14         #15 J Anomalously high levels of joking
Eyak         3        3.1        4 [1]      2X         1          18         #14 J P<0.009 (one tailed) p<0.01  (two tailed)  2;10;7;2
Atsugewei    2        6.2        8          3          4          18         #20 J P=0.005 (one tailed) p<0.005 (two tailed)       2x3 test
Murngin      2 [1]    1.5        4 [1]      3          3          21         #16 L 4L Murdock 1971
Diegueno     0        6.2        8          3          2.5        22.5       # 6 J D>18 (packorder Binford 2001:122#147)__ Cutpoint
Guahibo      2        6.2        8          3          2          24         #19 J
Luiseno      0        0.0        0          3          1          27         #18 - - - - No J No A
           ------------------------------------------------------------------------------Below: A D>18 Theory: Avoidance fits here: beyond packing density
Chiricahua   2        0.0        0          2X         4          12         #10 A ___________________________________________ Cutpoint
Maidu (Mtn)  4        0.0        0          3          3          21         #21 A Avoidances replace Joking as suppression of conflict
Vedda        7        0.0        0 ok       3          3          21         #22 A (Packing density 3+ is a threshold to the following:
Kutenai      1        1.3        2 [1]      4X         4          24         #24 A                 1. Not everyone is kin
Tenino       1        0.8        1? [1] 4L  3          2          24         #17 A of Sister, WBW? 2. Conflicts more likely Murdock 1980 Ethnology
Gilyak       9        2.3        3 ok       3          1          27         #23 A                 3. Competing claims over wife's sisters
Haida        2        0.8        1?         4          1          36         #25 A                 4. Avoidance restrains conflict
           ------------------------------------------------------------------------------ Avoidance ratio higher (dominant)
                  /1.3 reduction ratio     [1] Murdock (1971)
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Standard Cross-Cultural Data: Logistic and Autocorrelation Regression

We have argued that Avoidances provide a stronger form or at least broader spread of kinship network bonding than Joking. Joking behavior tends to extend to a narrower circle of alliances. Radcliffe-Brown regarded Joking behaviors (Eggan 1955:516); as "special forms of alliance, comparable to those of gift-exchange, intermarriage, and ritual kinship. Murdock, on the other hand, is more concerned with avoidance relationships and offers and explanation based on psychoanalytic inferences as to [cross-sex] relations within the family." There was no need here,

[6] Variations in the sizes of this forager sample in this paper is dependent on missing data.

however, for Eggan to demure to Murdock. Eggan (1955:76-77), focusing on ethnographies, reported: "Among the Cheyenne and Arapaho (as elsewhere) respect relationships seem the more fundamental [than joking] and involve the members of the elementary family as well as parents-in-law…. [In] order that the affairs of the camp may run smoothly, the son-in-law and mother-in-law avoid each other completely, though manifesting the highest respect for each other. It is significant, in this connection, that the restrictions may be removed when a satisfactory adjustment has been reached by a public exchange of gifts."

Eggan, like Radcliffe-Brown, regarded Avoidance as a special form of Respect behaviors. Given their perspectives, as we noted above, managing the avoidance of conflict between affinals by the medium of one or more Avoidance behaviors has the potential of expanding ties between families that both enlarge the circle of alliances and avoid conflict with newly-established affinals.

Parent-in-law avoidances establish limits on communication between in-laws of different generations, at least for an initial period after a marriage. The most common hypothesis is that uxori-/matrilocal residence creates conditions for husband's avoidance of wife's parents and viri-/patrilocal residence for wife's avoidances of husband's parents. Murdock's cross-sex psychoanalytics (WiMo, HuFa) offer no explanation for same sex avoidances (WiFa, HuMo). Decisively, correlations vary randomly for cross- and same-sex avoidances for both the first (opposite sex) hypothesis (r=.03 and .12 for WiMo and p=.85 and .48 for WiFa avoidance). Similarly for the HuFa and HuMo pairs (r=-.02 and -.11 for HuFa and p=.88 and .56 for HuMo avoidance), all non-significant. For WiBrWi and residence rule (r=.03 and p=-.11 for uxori-/matrilocal) and similarly (p=.41 and .85 with viri-/patrilocal residence). Same-sex WiBr-SiHu (WiElBr or WiYoBr) are also potential avoidances but not same-sex, as are HuSi-BrWi, and HuElSi or HuYoSi and their reciprocals. Driver's (1973:356) review of Avoidances noted that correlation with culture area explained more of the variance than did any structure-functional variable.

If each of these avoidances act as a positive bond between in-laws, they do so irrespective of residence patterns, and similarly for matrilineages and patrilineages; and difference in generations. To test further our earlier findings on the relationship between population density and dyadic kin avoidances, we use both logistic and autocorrelation regression for Network of Variables Analysis model. Here we focus on five in-law avoidances in detail.

The regression models for each of five most frequent types of Avoidance

The models in each of the tables below use new statistical tools designed for cross-cultural research by Dow and Eff. They cover: the prevalence of autocorrelation in cross-cultural data (Eff 2004, Dow and Eff 2008); how to incorporate multiple imputation and network lags to estimate cross-cultural models (Eff and Dow 2009; Dow and Eff 2009); substantive analysis employing the Dow-Eff functions (Dow and Eff 2013, Eff and Routon, 2011, Brown and Eff 2010); and data creation for the Standard Cross-Cultural Sample (Eff 2008, 2010, Eff and Maiti 2013). The current Dow-Eff functions (DEf) models combine all these aspects.

These models have been implemented as R gui software and in a Science Gateway for the field of Anthropology, the UCI Complex Social Science Gateway.[7] The instructional home page is the UCI http://intersci.ss.uci.edu/wiki, which contains a clickable visual manual and instructions for viewing and saving histories of models that have been computed.[8] This site is a collaboration between PI Douglas White, Anthon Eff, the SDSC, the Argonne labs, UCI, and UCSD as an NSF-sponsored XSEDE project providing research and instructional support. It supports an instructional results home page[9] and shared modeling histories[10] of the PI.

In each current DEf model below, each independent variable has a pvalue for significance, after factoring out autocorrelation and performing missing data imputation. The hpcval significance value is the heteroscedasticity-consistent pvalue (White 1980). Bootstrapping is another way to get a robust pvalue, and nowadays it would be the preferred way. The null hypothesis for these pvalues is that the true value of the coefficient is zero. Coefficients are positive and negative, with a leading * substituting for a negative coefficient together with reversed direction to the name of the variables.

The shared predictors across these models are: Low population density (all but WBW), Low population density squared (HF, HM), Jurisdictional Hierarchy of Local Community (WM, WF), and Beyond Community (WM, WBW), Low product of the two Jurisdictional Hierarchy variables (WM, possibly WBW), Low importance of Hunting (HF, WF, HM), Nuclear family (WM, WBW), and bio.2 Mean Diurnal Range (HF, HM). Other variables are predictive for only one type of Avoidance. Variables for types of residence and lineage organization are not shown because they are highly nonsignificant.

First we model the predictors of Wife's Mother Avoidance, in Table 2. The model removes network lag effects first, which are known to cause Galton's problem (Dow, Burton, and White 1982, Dow, Burton, White and Reitz 1984) and confound results, and then calculates predictors with wife's mother avoidance as the dependent variable. Removing distance and common language effects (i.e., cultural similarity) as autocorrelation effects, the <u>logistic regression</u> model tells us only that higher population density is a significant predictor of **decline** in WiMo Avoidance. The <u>autocorrelation regression</u> also shows a highly significant effect on **decline** of Avoidance for population density (v64) but also of the product of lower and upper - jurisdictional hierarchies (v236*v237).

WiMo Avoidances are significantly more common with higher jurisdictional hierarchy in the <u>local</u> community and less significantly (p=0.11) with jurisdictional hierarchy <u>above</u> the community level. Our prior hypothesis suggested that Avoidance that provides greater social integration that co-enables an increase in jurisdictional hierarchy of the local community (v236) and marginally for jurisdictional hierarchy above the community level (v237). However, the product of these two variables is a negative predictor of WiMo Avoidance. Finally, Low Family

[7] https://www.xsede.org/gateways-listing
[8] https://vimeo.com/79056519
[9] http://socscicompute.ss.uci.edu/history/list_published
[10] http://intersci.ss.uci.edu/wiki/index.php/DRW_Shared_Histories

size (Nuclear family) is one of the stronger predictors although this effect is curvilinear given nuclear families as a feature of complex societies.

Table 2: WiMo

Wife's Mother Avoidance [[Dd1197.6]] WiMo n=25/60 DEf01d Rsq=.346					
WiMoAvoid.eW.DEf01d.xlsx distance=0% language=65% ecology=35% Tables 2,4					
Logistic regression	**Coef**	**fst**	**df**	Hcpval	**star**
(Intercept)	1.830416	0.41	9	0.5402	
Network lag term	-1.091236	0.04	9	0.8550	
Low Population Density	*0.462670	5.50	9	0.0436	**
Autocorrelation regression	Variables	coef	stdcoef	Hcpval	Star
(Intercept)	(Intercept)	-0.479	NA	0.705	
Network lag term	Wy	1.793	0.068	0.875	
Low Population Density	v64	*0.031	-0.180	0.000	***
Jurisdict. Hier. of Local Community	v236	0.243	0.427	0.005	**
Jurisdict. Hier. of Beyond Cmnty	v237	0.158	0.577	0.116	~.10
Low **v236*v237**	v2370236	*0.064	-0.739	0.057	*
Low Family size (Nuclear Family)	v80	*0.050	-0.181	0.006	**

Three of the WiMo predictors apply to those of Wife's Father Avoidance, as shown in Table 3. Again we see that there is a significant association between population density and *decline* in Avoidance. Other predictors are Low Importance of Hunting, as seen in Figures 2 and 3 for foragers, Low Mean Temperature in the Dry Quarter of the year, and Jurisdictional Hierarchy of Local Community, which we suspect is a not a cause but a *consequence* of WiMo Avoidance as a means of local cooperation, integration, and conflict reduction.

Table 3: WiFa

Wife's Father Avoidance [[Dd1198.3]] WiFa n=7/35 Rsq=.584						
WiFaAvoid.eW.2olsresults.xlsx distance=0% language=20% ecology=80% Tables 2,4						
Logistic regression	(no R^2)	(no R^2)				
Autocorrelation regression	Variables	coef	stdcoef	VIF	hcpval	Star
(Intercept)		0.5688	NA	NA	0.0717	*
Wy Network lag term	Wy	-1.5266	-0.4630	2.2632	0.0013	**
Low Mean Temp. Dry Quarter	Bio.9	*0.1564	-0.4191	2.1414	0.0012	**
Jurisdict. Hier. Local Commun.	v236	0.2108	0.3026	1.2241	0.0125	**
Low Population Density	V64	*0.1509	*0.8034	2.3755	0.0001	***
Low Importance of Hunting	V817	*0.0073	*0.3466	2.4824	0.0636	*

Husband's Father Avoidance (Table 4) also shows, as with WiMo and WiFa, Low population density (v64) and Low Importance of Hunting (c as predictors for **decrease** of Avoidance. Population density squared (v64Sq), warm Niche Temperature Squared (v854Sq), Low Annual Mean Temp Squared (bio1.Sq), and Mean Diurnal Range-monthly (bio.2) are predictors of **increase** in HuFa Avoidance

Table 4: HuFa

Husband's Father Avoidance [[Dd1204]] HuFa n=14/50 Rsq=.789 HuFaAvoid.eW.01d.xlsx distance=80% language=0% ecology=20% Tables 3,5					
Logistic regression	**Coef**	**fst**	**df**	**hcpval**	**star**
(Intercept)	(no R^2)				
Network lag term					
Population Density v64					
Autocorrelation regression	Variables	coef	VIF	hcpval	star
(Intercept)		0.8631	NA	0.0038	**
Network lag term	Wy	-1.0011	1.1563	0.0002	***
Low Population Density	v64	*0.2790	41.0962	0.0056	***
Pop Density Squared	v64Sq	0.0283	33.1727	0.0055	***
Low Importance of Hunting	v817	*0.0105	3.1313	0.0003	***
Niche Temperature Squared	v854Sq	0.0203	2.5575	0.0000	***
Mean Diurnal Range (monthly)	bio.2	0.1018	1.4362	0.0046	***
Low Annual Mean Temp Squared	bio.1Sq	*0.0917	2.4962	0.0009	***

We find four of the HuFa predictors when we model Husband's Mother Avoidance, shown in Table 5. Here, the logistic regression tends to match almost exactly that of autocorrelation regression. The autocorrelation regression predictors in common are Lo Population density (v64), v64Sq, Lo importance of hunting (v817), and Mean Diurnal Range (Mean of monthly). No predictors involve Jurisdictional Hierarchy (v236, v237, or their product, v236*v237). Other Climatic predictors are low Annual Mean Temperature squared, high Niche Temperature, and high monthly Temperature Range. These model results must be taken with caution because the number of societies with HuMo avoidances is only four out of a total sample of 33.

Table 5: HuMo

Husband's Mother Avoidance V1205 HuMo n=4/33 [[Dd1205]] **Rsq=.789** HuMoAvoid.eW.1dX3160217.xlsx distance=80% language=0% ecology=20% Tables 3,5						
Logistic regression	(no R^2)	**Coef**	**fst**	**df**	**hcpval**	**star**
(Intercept)		92.887	1.12	9	0.3168	
Wy Network Lag Term	Wy	-288.029	8.71	9	0.0162	**
Low Population Density	v64	*80.1313	7.20	9	0.0251	**
Low Importance of Hunting	v817	*3.62	5.18	9	0.0489	**
Population Density Squared	v64Sq	8.1545	7.90	9	0.0203	**
Niche Temperature (Approximate)	v854Sq	1.1503	10.03	9	0.0114	**
Mean Diurnal Range (Mean of monthly)	bio.2	8.9180	1.64	9	0.2324	
LowAnnual Mean Temp.(dgC*10)Squared	bio.1Sq	*22.0127	5.73	9	0.0403	**
HuMoAvoid.eW.1dBTO6olsresults.xlsx	Below:HuMoAvoid.eW.1dX3160217.xlsx					
Autocorrelation regression	Variable	coef	stdcoef	VIF	hcpval	star
(Intercept)		0.8815	NA	NA	0.0036	**
Wy Network Lag Term	Wy	-0.9577	-0.3820	1.130	0.0004	***
Low Population Density	v64	*0.3019	-2.0027	41.673	0.0033	**

Low Importance of Hunting	v817	*0.0105	-0.5816	3.135	0.0004	**
Pop Density Squared	v64Sq	0.0315	1.5868	33.510	0.0026	**
Niche Temperature Squared	v854Sq	0.0200	0.9568	2.552	0.0000	***
Mean Diurnal Range (monthly)	bio.2	0.0967	0.3381	1.420	0.0070	**
Low Annual Mean Temp Squared	bio.1Sq	*0.0898	-0.4193	2.493	0.0015	*
v1205HuMoTolga.olsresults.ew.xlsx has distance=20% language=80% ecology=0%						

Table 6, uniquely among the five Avoidances, shows a predictor of Importance of Fishing for WiBrWi Avoidance. Two predictors are opposite to those of WiMo for local and extra-local Jurisdictional Hierarchy, i.e., negative rather than positive effects. We speculate that these are causal effects because among foragers, fishing societies are more complex socially and Jurisdictional Hierarchies compete against Avoidances as sources of cooperative integration. The product of local and extra-local Jurisdictional Hierarchy (v236*v237), also has negative effects. These results must be taken with caution because the number of societies with HuMo avoidances is only 7 out of a sample of 13.

Table 6: WiBrWi

Wife's Brother's Wife Avoidance [[Dv1196.2.1]] WiBrWi n=7/13 Rsq=.725 v1196.2.1.olsresults.ew.xlsx distance=80% language=20% ecology=0% Tables 6&7					
Autocorrelation regression	Variable	coef	VIF	hcpval	star
(Intercept)		3.1065	NA	0.0002	***
Network Lag Term	Wy	0.5292	20.4256	0.0115	**
Importance of Fishing	v104	0.2115	1.4603	0.0004	***
Low Jurisdict. Hier. Local Community	v236	*1.3171	30.6815	0.0056	**
Low Jurisdict. Hier. Beyond Cmnty	v237	*1.9780	2.6885	0.0000	***
Low overall slope for **v236*v237**	Low 2370236	*0.6634	8.4064	0.0462	**
V64 needed as last element	**Coefs. For v236 and v237 opposite those for WiMo**				

Table 7 shows a model for the sum of eight avoidances where the v236 and v237 are eclipsed by more predictive variables with higher significance and R squared. It is repeated in Figure 8 ("Reevaluation" Section) in comparison to a simple OLS regression model which fails to capture the complexities of this aggregate model.

Table 7: Sum of WiMo, HuMo, WiFa, HuFa, WiBrWi and three other avoidances

Wife's Brother's Wife Avoidance [[Dv1196.2.1]] WiBrWi n=7/13 Rsq=.86 v1196.2.1.olsresults.ew.xlsx distance=20% language=80% ecology=0% Tables 6&7					
Autocorrelation regression	Variable	coef	VIF	hcpval	star
(Intercept)		3.9029	Nan	0.0000	***

Network Lag Term	Wy	-2.5893	1.41	0.0000	***
Nuclear family	V80	*0.3056	1.60	0.0031	***
Importance of Fishing	V816	0.0716	5.21	0.0000	***
Importance of Gathering	V818	0.0583	1.37	0.0000	***
Imp. Fishing X Male.Cont.Subsistence	V889x816	*0.0017	4.72	0.0000	***
No External War – Attacking	V892	*0.4584	1.4	0.0002	***

Summary of the correlational, logistic and autocorrelation regression models

Table 8 shows the frequencies of shared predictors for different Avoidance Models 2-6 and the sum of eight models shown in Figure 8. Low Population density (LoPD) is the most frequent predictor, Low Hunting and Nuclear family next (three predictors, followed by five variables with two predictors each: LoPD squared, bio.2 (Mean Diurnal Range, monthly), Jurisdictional Hierarchy at the community level (JurisHier1) and beyond the community (JurisHier2). Finally, the product of the Jurisdictional variables (JH Product).

WiMo has positive Jurisdictional hierarchy predictors for WiBrWi these predictors are negative. Both have predictors that are negative for the product of JurisHier1 (community) and JurisHier2 (beyond community). WiBrWi societies have negative predictors for building jurisdictional hierarchies but no Low Population (LoPD or LoPD Squared) constraint, which implies that with this Avoidance type their population may grow. For foragers is also predicted by Fishing, which implies a more complex social organization than societies with other types of Avoidances. The case of the Tenino, discussed below as a case of WiBrWi avoidance, are an example.

Table 8: Frequency of shared predictors for different Avoidance Models

1 Variables	2 WiMo	3 WiFa	4 HuFa	5 HuMo	6 WBW	7 Sum	Frequency
LoPopDen	X	X	X	X			4
Lo Hunting		X	X	X			3
JurisHier1	X	X			-X		3
JurisHier2	X				-X		2
JH1 X JH2	-X				-X		2
NuclearFam	X					X	2
LoPDSquared			X	X			2
Bio.2			X	X			2
Distance	0	0	**80%**	**80%**	**80%**	20%	3x80%
Language	**65%**	20%	0	0	0	0	1X65%
Ecology	35%	**80%**	20%	20%	20%	80%	1x80%
Sum	5	3	4	4	3	1	21/40
Cases:Av/total	25/60	7/35	14/50	3/33	7/13		

The percentages of autocorrelation controlled for each model are given toward the bottom of Table 8. The easiest explanation is that WiMo Avoidance is the most common (65%), ancestral invention, associated with language, and is spread initially through language groups and ecology (35%). For North America, for

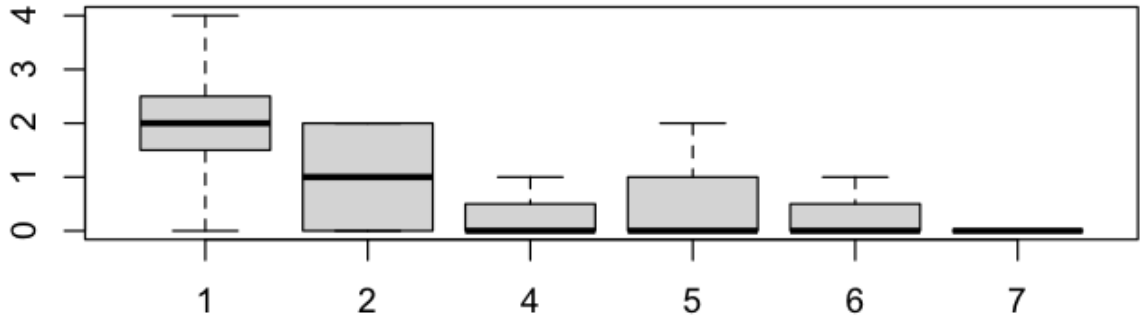
example, Driver (1996) showed that Avoidances are predominant in four widely separated language groups (Penutians, Siouans, Muskogeans, and Haida-Tlingit), the only ones in North America connected with Crow-Omaha kinship terminology. WiBrWi Avoidance is also associated with Crow-Omaha kin terms which also involve the extension of marriage prohibitions. [11]

WiFa Avoidances probably evolve and spread next through optimal ecological adaptations (Jorgensen 1983: these can be investigated further following the work of Driver 1956, 1966). The spread of the remaining three avoidances – HuFa-HuMo, and WiBrWi Avoidances – probably occurs next, through diffusion (Distance autocorrelation), with the HuFa-HuMo pair probably spreading together given that their predictive models are very similar. Residence and lineage variables are not predictors in any of the logistic or regression models.

Our interpretation of the local and larger political hierarchy variables is the same for all five Tables 2-6, excepting Table 5 (HuMo), although v236 is a positive predictor only in the WiMo and WiFa Avoidances and is negative in the WiBrWi Model. Nonetheless, the evidence of both the logistic and regression models (2-6, both with autocorrelation controls) shows similar development of local community jurisdictional hierarchy with avoidances of the WiMo and WiFa types. Plausible hypotheses are that avoidances help feed the cooperativity that constructs community jurisdictional hierarchies among foragers but the latter may tend to outcompete WiBrWi Avoidances in more complex fishing societies. Beyond local communities, Jurisdictional Hierarchies advance to larger scales that are unlikely to be supported by Avoidances. Thus it is only within certain ranges of population density and jurisdictional hierarchies that avoidances are likely to be crucial elements in how societies maintain and construct social integration and cooperation at smaller scales of jurisdictional hierarchies.

Further tests are given for our hypotheses that Population density (in Figures 4 and 5) and Levels of Jurisdictional Hierarchy (in Figure 6) above the Local Community outcompete Avoidances as a means of social integration and cooperation beyond the community level.

Figure 4: The number of Parental avoidances per society (v1197 +v1198 +v1204 +v1205) by population density (v64)



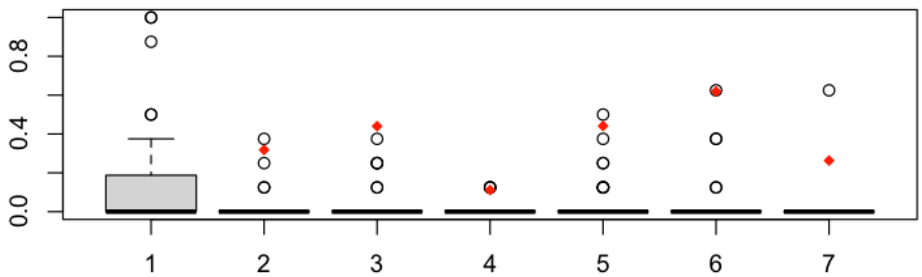
agg.avoid <- dx$v1197+dx$v1198+dx$v1204+dx$v1205

[11] See footnote 2 and 3 and White (1975:297) discussions where WBW terms are shared with off-generation skewed Crow-Omaha relatives.

```
summary(lm(formula = agg.avoid ~ dx$v64))
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  2.13267    0.39019   5.466 2.01e-05 ***
dx$v64      -0.33002    0.09142  -3.610  0.00164 **
```

Figure 5, for the eight most frequent avoidances, shows that some of the avoidance types are present at low population density and are increasing in number, whereas there is a sharp decline at middle densities, increasing again with higher population density, but then drop drastically at the highest densities.

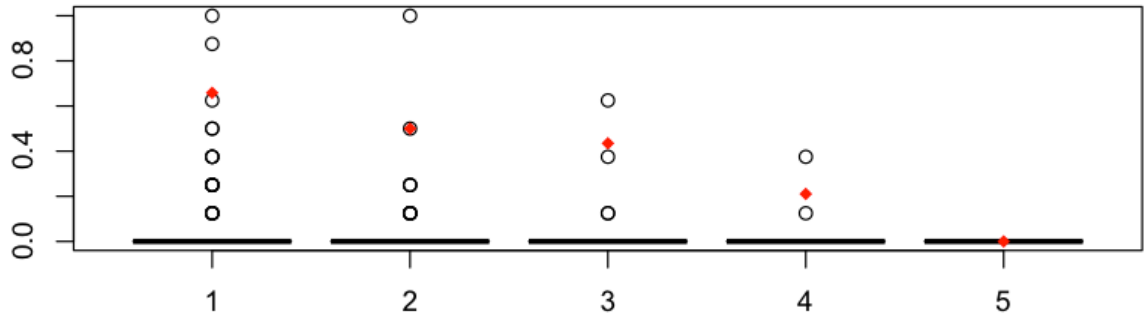
Figure 5. Sum of Eight Avoidances by Population Density (needs a label)



r=-.16, p=0.03 rsq= .03 corr.test(agg.avoid/8,dx$v64*dx$v237)
r=-.14, p=0.05 rsq= .02 corr.test(agg.avoid/8,dx$v64)

Figure 6 shows the moderately strong effect of the frequency of the eight most common avoidances on decline of Levels of Jurisdictional Hierarchy *above* the Local Community. As population gets denser, societies form other institutions to resolve conflicts and create social integration so that kin avoidances can be dropped without detriment to societal survival. Figure 6 shows the relation between <u>extra</u> community political hierarchy and the 8 of most frequent avoidances normalized on the y axis so that a 1 means all 8 kinds are present in a given society and 0 means none of the 8 avoidance types are present.

Figure 6. Sum of Eight Avoidances by Levels of Jurisdictional Hierarchy above the Local Community (v237: 5 levels on x axis).



237 R=.55, R2=.3025 pval=.02 (search obsolete graph for 236 below)

Next, using a "concept lattice" that represents isomorphically the worldwide occurrences of different types of all 27 known types of Avoidance dyads (some so rare they are absent from the SCCS dataset), we explore the co-occurrences between

each pair of types of Avoidance, and the most likely sets of societies that have each set of Avoidances. We say "likely" because the analysis began with statistical entailment analysis [12] (White 1984, White and McCann 1988, Ross, Belknap, Dunn 1990, White, Burton and Brudner 1997) in which set-subset relationships between types are estimated using Signal detection theory (Green and Swets 1996) rather than a conventional significance level,

> "to specify optimal cutoffs given an ordering of ratios of actual to expected across levels of exception and relevance…. to deal with partial orders of quasi-implication in pairs or chains of dichotomous variables, supported by statistical evidence of departure from bivariate independence and conformity to the rules of transitivity. Statistical approximations simplify a lattice representation of discrete structure by forcing quasi-implications (ignoring exceptions), for example, but they also provide information about those implications in the lattice that represent statistically significant tendencies. Given a lattice representing the discrete structure of a raw data matrix, the findings of entailment analysis describe additional structural regularities (tendencies towards further statistical constraints on Boolean patterns that occur in the data) that can be used to simplify (by approximation) the lattice of empirical patterns" (White and McCann 1988).

If a chain of entailments, x entails y entails z, as Boolean sets with data elements such as x_i=1, y_i=? and z_i=1 (x,y,z being dichotomous variables coded for a particular case i), then y_i can be given an expected discrete value 1, while if x_i=0, y_i=? and z_i=0, y_i can be given an expected discrete value 0. Although the binary coding of Avoidances has many missing data values, these Boolean inference rules estimated a majority of the missing data.

Statistical entailment analysis was applied not only to sets of 0/1 or binary Avoidance variables but to sets of societies having particular sets of Avoidances. When this is done the intersections of the entailments for a lattice with rare sets of variables starting at the top (having many societies and few Avoidances, the parent-in law avoidances) and the more unique sets of societies starting at the bottom (having many Avoidances but few societies), form a "dual", or "concept" lattice, where the nodes in the lattice are "dual concepts" for subsets defined by intersections of Avoidance types and of corresponding sets of societies with precisely those types of Avoidance. The "concept lattice," then recovers as close to an isomorphism to the original data as is possible with a certain residue of missing data: but this is as good an approximation of the actual data as is possible statistically. Each small circle in the graph is actually a rectangle with Avoidances from "above" intersecting with societies from "below" to describe a set of cases with specific intersections of variables (Freeman and White 1993). The mathematical construction of the Concept lattice in Figure 7 below was done by Rudolf Wille for the frontispiece of a book (Baker, Birkhoff and Wille 2007) honoring mathematician Garret Birkhoff for his foundational work on Lattice Theory (Birkhoff 1979 [1940]), originally called Galois Lattices and later renamed "Concept Lattices" by Wille and his colleagues.

---

[12] *"Statistical entailment analysis … aims first at a rigorous evaluation of null hypotheses of statistical independence as a potential source of binary data structure, and second at constructing a discrete structure (Boolean) model of those statistical interactions that remain when the null hypothesis is rejected for particular subsets of variables (White and McCann 1988).*

The Evolutionary Lattice of Kinship Avoidances

WiBrWi and cross-sex Parents-in-law overlap and together are entailed by all other Avoidances but WiBrWi and same-sex Parents-in-law are mutually exclusive

The Avoidance ("concept") lattice in Figure 7 is the result of intensive study of the data on the twenty-one of the types of Avoidances coded by Murdock (1981 and n.d.), which we have been studying here, except that the societies go far beyond those coded for Avoidances in the SCCS. The number of types in the circles for each row of the lattice in Figure 7 number —each type indicated by an abbreviated name connected to an element in a circle—, cumulatively: 4 types (parental: top circle), 5 (WiBrWi) counting the next row, then 6 (HuBrSo, Br/Si, pXo=Paternal cross cousin, HuElBr, then in a single circle, HuSiSo and WiBrDa), 1 (mio=Maternal parallel cousin), 2 (pio=Paternal parallel cousin, mXo=Maternal cross-cousin), 2 (Wi's elder Si, HuSi), 4 (MoBr, FaSi, HuYoBr, WiYoSi), and 1 (WiBr), reaching toward the bottom of the lattice. The order of the circles connected by lines is determined by set inclusion: each black dot represents a set of societies that have all those types of Avoidances marked by its interior labels and by all those above it on an inclusion path to both an upper circle and to a comparable black dot in an upper circle or in an upper black dot within that circle. The lattice is a near-isomorphism (with a minor amount of missing data) of the raw row-by-column data matrix of types of Avoidance (columns) by societies having some set of each type (rows), although in many cases inferences can be made about values of a type from a black dot below and inferences about a society can be made from the black dots above. For example, the Kurtatchi (lower right circle) has the Avoidances in two of the circles above it (HuYoBr and WiYoSi), in the circle above that (HuSi), and on up to include HuSiSo and WiBrDa, then WiBrWi, and finally WiFa and WiMo Avoidances, plus many others from other upward paths. Thus the fewer societies in lower circles in the lattice have many types of Avoidances, cumulated upwards, while those more numerous societies that are located upward show by design fewer single or multiple types of avoidances that characterize more societies.

Abbildung 2: Begriffsverband zum familiären Meidungsverhalten in unterschiedlichen Kulturen

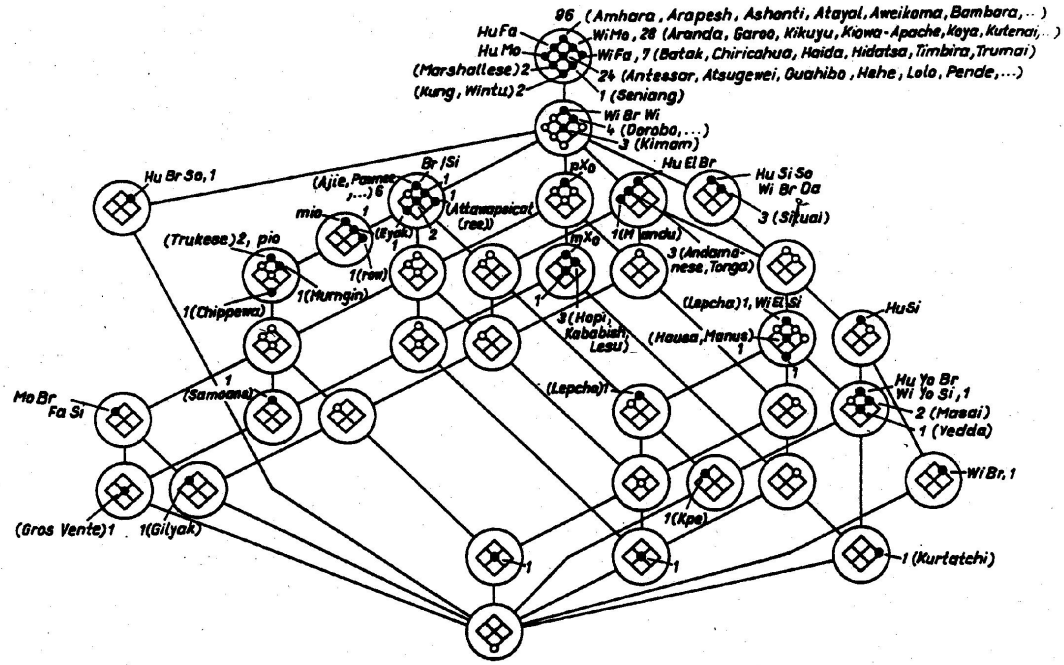


Figure 7. Global Entailment Lattice of Avoidance Behaviors. The upper set contain the four types parent-in-law avoidances, two inclusions of cross-sex (WiFa in WiMo) and same-sex (HuMo in HuFa) relatives, and four other types of combinations of these four Avoidances.

The Avoidance Dyads that are Entailed by Parent-in-law and WiBrWi Avoidances

Reading the Avoidance lattice in detail, as we have explained, shows that the four types of parent-in-law occur individually and in combinations except those pairs of types where one is a subset of another: WiFa entails WiMo and HuMo entails HuFa. Those two examples are same-sex Avoidances entailing a larger set of cross-sex Avoidances through the same linking spouse, Wi or Hu. The lattice can be read from the upper circle down: black dots show 86 societies that lack Avoidances at the very top of the lattice, 28 occurrences of WiMo, of which all those of WiFa are a subset; ~7 are occurrences of HuFa, of which HuMo Avoidance are a subset; ~24 are co-occurrences between WiMo and HuFa, 1 of HuFa with WiFa, and so forth. These observations are defined within the upper circle of lattice elements. In a lattice of this sort, all lines going down approximate, given missing data, proper subsets of one or more types of Avoidance.

That the set denoting WiBrWi Avoidances is at the top of the second circle of avoidances denotes that they are not a proper subset of any of them; they occur independently. But this position in the lattice also denotes that they may overlap with Parents-in-law of any type in the circle above them. The lattice structure denotes the fact that the WBW node is at the top of its circle, linking upwards to the top node in the circle above, which is a zero or empty set of no Avoidances, a type that describes 86 societies. The vertical jump of an implicit line from the black dot for WiBrW to the "Zero" node in circle above thus denotes the lack of a proper

subset relation of WiBrWi with one or more parental Avoidance, i.e., an independent set. Moving down from the WiBrWi circle via the second link to its left, we see that all six Br/Si avoidances are subsets of societies with WiBrWi avoidance. To our knowledge, this has not been recognized in the ethnography of kinship role behavior.

Starting at the bottom of the full lattice, all lines going upwards start with the lowest element, which is empty of avoidance types, and point to the fuller subsets of co-occurrences defined by those societies with Avoidances indicated by ordered labeling of nodes. The lattice is an isomorphic map of different distributions of Avoidance behavior types that characterize different sets of societies worldwide, given some margins for missing observations that cannot be strictly determined by their position in the lattice but can be inferred statistically.

Reevaluating our evidence

Having evaluated our evidence, we felt that avoidances themselves could be among the predictors of Jurisdictional Hierarchy at the Community level (v236). This hypothesis failed. We did find, however, something similar to our findings for foragers, in the early part of this article, as seen in the autocorrelation regression in Figure 8 below. The Rmodel, controlling for autocorrelation, finds all of the following predictors at p<.0003: Importance of Fishing and of Gathering, Importance of Fishing X Male Contribution to Subsistence (balanced against gathering), Nuclear family, and No External War – Attacking, with total R^2=0.86. This model only partly replicates in the OLS model, where it is fishing and gathering that are predictive of Avoidances (R^2=0.53). In both models the dependent variables is agg.avoid <- dx$v1197+dx$v1198+dx$v1204+dx$v1205 as in Figure 4, the sum of parent-in-law avoidances, with a total n=23, 12 with no avoidances and 11 with 1, 2, 3, or 4 avoidances, mostly 1 or 2. The more avoidances the more the fit to the Rmodel.

Figure 8. Sum of Eight Avoidances by Levels of Jurisdictional Hierarchy in the Local Community (v236: x axis). The Rmodel was shown in Table 7.

```
Rmodel (* starred coef were negative: label changed instead). $totry "v816:v818"
"v889:v816" appeared in previous model, Source: [[DdAvoid]]. Next model had
$totry [1] "bio.14Sq" "bio.17Sq" "v80"      "v80Sq" (v80 was chosen)
$Rmodel $totry [1] "bio.9" does not improve the model
                coef  stdcoef     VIF    pval  hcpval star
(Intercept)  3.90291      NaN     NaN 0.00000 0.00000  *** R²=0.86
v80         *0.30560 -0.33857 1.60435 0.00073 0.00031  *** Nuclear family
v816         0.07216  1.25215 5.20994 0.00000 0.00000  *** Importance of Fishing
v818         0.05939  0.94174 1.37867 0.00000 0.00000  *** Importance of Gathering
v889x816    *0.00172 -0.78886 4.72645 0.00000 0.00000  *** Imp. Fishing X Male.Cont.Subs.
v892        *0.45843 -0.34209 1.40171 0.00026 0.00002  *** No External War - Attacking
Wy          -2.58937 -0.50146 1.41501 0.00000 0.00000  *** Wy is endogenous
Distance effect 20% language effect 80% for Wy.
```

OLS Model

agg.avoid <- dx$v1197+dx$v1198+dx$v1204+dx$v1205

summary(lm(formula = agg.avoid ~dx$v816+dx$v818+dx$v8))#+dx$v892))

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)	Significance
(Intercept)	-1.624725	0.677076	-2.400	0.0298 **	R^2=0.53

dx$v816	0.017282	0.008551	2.021	0.0615 *	Importance of Fishing
dx$v818	0.031526	0.011778	2.677	0.0172 **	Importance of Gathering
dx$v8	0.807495	0.335746	2.405	0.0295 **	Fishing

All of the variables in the Rmodel are phrased positively (altering the name of variables where the coefficients were negative) and results correspond closely to the model of the foragers with avoidances in Table 1, with gathering and fishing but low hunting, and few Joking dyads. In addition, we learn that nuclear family size (not large extended families) is common with parent-in-law Avoidances, and lack of warfare against others. These features fit with the characteristics of an ethnographic example discussed below, the Tenino, although the Tenino have WiBrWi avoidance along with Br/Si avoidances inferred from the Concept Lattice, and no parent-in-law avoidances. The OLS model captures only two of the five variables found to be significant when autocorrelation is controlled in the R model.

Extended trade networks with same-generation Avoidance behaviors

The complexities of linkages between Joking, Avoidance and other Kin Behaviors in single societies can be illustrated by cases in our sample of 34 foragers. For a complex example, we take the Dallas Tenino studied by Murdock (1980:133-136), a center for trading in Northern Oregon on the south side of the Columbia River near the Deschutes River outlet, with a number of riverbank villages and inland summer camps and trails that are mostly along other rivers navigable by canoe. The Tenino are an example of avoidances at medium population density but higher economic organization as shown in Figures 4, 5 and 6.

Tenino men do the long distance trading along rivers or trails between communities, and women do the local trading within their communities. In the context of the Tenino kinship network, exchanges can occur between male partners in long-distance gift-giving, notably by virtue of the WiBr/SiHu dyad. The kin-behavior expected for brothers-in-law is modeled on that of brothers: friendly and co-operative. In their friendship exchanges and gift-giving, they are in some sense "protected" by their expected Avoidance behaviors toward one another's wives as well as their own sisters; i.e., <u>by the women who comprise the links in every WiBrWi dyad</u> and in every brother-in-law chain. Hence while brothers-in-law could sleep in the same room, walk, ride, or sit together, unless someone else is present, a sister must avoid both her brother and her HuSiHu (he is reciprocally her WiBrWi). I.e., a sister cannot be left alone with her husband's trade partner HuSiHu, just as she cannot be alone with her own brother. These two prohibitions reinforce one another, suggesting a reason why Br/Si and WiBrWi avoidances might mutually entail one another in Figure 8 where our mathematician lattice-analysis chose a more conservative inference.

In the Tenino case there are no parent-in-law avoidances, and worldwide, Figure 8 is compatible with the idea that WiBrWi can occur with or without parent-in-law avoidances. These two types of avoidance dyads are very likely to be mutually independent. They are, however, equally predictive of – or better, causal of, organization features that enhance cooperativity.

Figure 8 illustrates (top) a hypothetical but common network structure of a brother-in-law chain, and then (lower down) shows how the details of Tenino Avoidance and Joking relations map onto that structure.

♂=♀•♂=♀•♂ brother-in-law chain

HZH ♂=♀•♂=♀ WBW

HZH ♂=♀•♂=♀ WBW HZHZHZH ♂=♀•♂=♀•♂=♀•♂ WBWBWBW

|ZH WB|

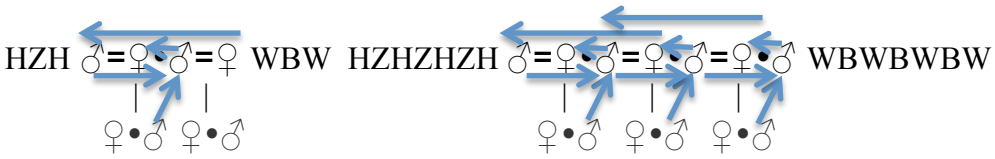


Figure 8. Extended Brother-in-Law chains with superimposed Tenino (1) Avoidances (upper blue arrows left to right) for WBW and Br/Si, (2) exchange relations (lower parallel reverse arrows) for a "brotherly" man's wife's brother (WiBr) as a trading partner, and (3) the "Joking" nephew (and niece) of that WiBr (diagonal arrows) who help the uncle. The Tenino have 'flat' Hawaiian nomenclature for cousins, unlike the 'skewed' Omaha terminology merging generations that is more typical of societies with WiBrWi avoidances.

The left-facing arrows in Figure 8 show how two types of **cross-sex** avoidances occur in leftward-directed chains of: 1) the WiBrWI and 2) the Br-Sister pair that links WiBr-SiHu as a close "brotherly" pair behaviorally. The lower horizontal arrows pointing in the opposite direction show the potential gift-exchange from wife-taker (SiHu) to wife-giver (WiBr). The woman in the center is the wife to one and the sister to the other. She avoids being alone with her Brother, and, unlike the Eskimo, never gives herself to her husband's trade partner. Recalling that Tenino wives do much of the intra-community trade, it would seem that in this scenario the wife might be seen as instigator of the Avoidance toward husband's trade partner who is also her Brother. This is a triangle in which sexuality is forbidden, perhaps out of respect that facilitates trade partnerships, with Avoidances as appropriately cross-sex kin behavior.

Murdock's (1965) ethnography reports that Tenino uterine nephews and nieces have reciprocal kin terms and mild Joking with their uncle, as shown in Figure 8 (diagonal blue arrow for SiSo/MoBr). Despite this 'equality' they were expected to work for and gift-give to their (MoBr) uncles, which better equip these uncles to gift-give to a WiBr. WiBr's daughter (SiSo/MoBr) is also a "Joking" relative to her uncle and can pass intimate information between her father and his trade partner, her maternal uncle. One could interpret this behavior network as contributing to the ease of directed gift-giving (from her father to her maternal uncle) along their WiBr in-law chain.

Tenino trading relationships thus involve the extensive local use of Avoidance and Joking as buffers and enhancers between in-laws who are somewhat widely dispersed along the half-dozen local routes of travel and (mostly gift-)

exchange. The local kinship links among dyads, however, form long network-chains of gift-giving and exchange.

As evidence supporting these interpretations, all four societies with Br/Si Avoidance (v1211=v1212) in the SCCS (which excludes the Tenino,) are predicted at p=.02 by "Fishing" (SCCS v7) as the regressor.[13] Adding Tenino (Fishing circa 55%) to that sample, this predictor is significant at p=.005. The societies that complement the Tenino, evincing this correlation (119 Gilyak 127 Saultaux 130 Eyak), all employ canoes as a means of riverine trade. The correlation is not expected to hold for WiBrWi avoidances because of missing data (n=13 codes), although R^2=15 and p=18 does not contradict the hypothesis.

Figure 8 is drawn to assume that gifts or exchanges are more likely here to travel from wife-taker "sister's husband" (SiHu=ZH) and his sister's children to WiBr=WB. The Tenino have no status difference between SiHu and WiBr, considered "brothers" of equal status. The Tenino disallow marriages between first and second cousins.[14] It is quite possibly the women who support Avoidances in order to facilitate cooperation and equality between the brother's-in-law for whom they are the essential links. The advantages accrue to the brother's-in-law who are not impeded in their exchanges by the possibility of sexual advances.

In these chains one may borrow property and return something of lesser value. Chains of brothers-in-law were involved in exchanges along trading routes. WiBr's daughter, Da of a man's potential trade partner WiBr, is "intimate but not sexually" with her Father's SiHu trade partner and can pass intimate information.

Tenino Brother and Sister reinforce this with an avoidance relation: they cannot even sit together or talk. WiBrWi is "like" a prohibited Br/Si sister in the Avoidance lattice. By avoiding WiBrWi there is no possibility of jealousy between WiBr and SiHu, the trade partners. In any case the Br/Si → WiBrWi entailment (WBW more widespread than Br/Si) goes against a universal "extensionist" priority of the nuclear family (Murdock, Shapiro, etc.).

Murdock's Atlas coding (for Nd 1: Tenino) implies that marriage is distributed well beyond close kin, entails recurrent gift exchange between stem families that are mostly virilocal and less often uxorilocal, and are not organized into lineages.[15]

Conclusions

Our "Reevaluating our evidence" section helps to give a more concrete picture, along with the Cheyenne, Arapaho and Tenino examples, of how Avoidances are variously organized, and the circumstances in which they occur. Of the 10

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[13] vv7=(dx$v7>=4)*1 "more than any single source of subsistence" (Societies 119 Gilyak 127 Saultaux 130 Eyak).
corr.test(vv7,dx$v1211) #r=0.14 pvar=.05
vv7=(dx$v205>=4)*1vv7=(dx$v205>=4)*1
corr.test(vv7,dx$v1211) #r=0.17 pvar=.02 "more than 54%" (55-64%).

[14] This does not correspond to Leach's hierarchical Gumlao system, for example, with MCCM marriage, where women are assumed to travel "down" (to SiHu) because WiBr is assumed to have **lower** status and marriage goods "up" (WiBr) because WiBr is assumed to have **higher** status.

[15] *Tenino Atlas Nd 1 columns include 9:46-55% dependence on fishing, 12:Gift Exchange between families 14:Stem families 16:Virilocality with uxorilocal alternative 19:Agamous communities 20:No patrilines 22: No matrilines 24:Kindreds 25:N marriage forbidden with 1st & 2nd husbands 27:Generational terminology.*

forager societies in "Reevaluating our evidence", 80% have Avoidances; of the 11 with avoidances, 8 are foragers. Cheyenne and Arapaho would be exceptions, carrying over WiMo Avoidance from a previous history as hunters without horses (consistent with conclusions from Table 8). The Tenino foragers were the major trading society at the junction of the Deschutes and Columbia Rivers. Tenino WiSi and SiHu siblings-in-law of opposite sex are intimate, and sexual intercourse may occur (Murdock 1965). Tenino brothers-in-law (WiBr-SiHu) are expected to behave as brothers and form chains of in-law trading partners with special privileges. The Tenino and other fishing societies (see Table 7) with riverine canoe trade conform to Binford's (2001) discussions about the complexity of fishing societies and their networks of brothers-in-law with WBW Avoidances (probable given missing data and inferences from the Avoidance lattice and correlations discussed for fishing). We have argued for and shown evidence for the hypothesis that Avoidances help to extend kinship networks through new in-laws not connected by close common ancestry, as is the case for the Tenino.

The Tenino example makes clear that Avoidances can be an effective means of reducing sexual jealousy involving a man's WBW as a trade partner in riverine societies. These Avoidances do not decay with time, as often the case with WiMo Avoidances. For brothers-in-law who customarily do gift-giving as a means of noncommercial trade, not having sisters or wives present during visits involving gifts and exchanges reduces the possibility of disruptive jealousies or liaisons. As with the Cheyenne mother-in-law, these relationships do not arise from projection of incest taboos, as conceived by Murdock or Westermark, but are a courtesy, acknowledging respectful distance, and having nothing to do with conflicts involving co-residence with parents-in-law or marrying into another lineage. Westermark and Murdock's psychoanalytic theories of the projection of Avoidances from deep sexual taboos have little to support them on the basis of our cross-cultural tests. We find this sort of functionalist theory to be invalided in that there are no significant correlations between uxori- or matrilocal residence and Avoidance of the wife's mother (and more weakly, the wife's father), or, in parallel, between viri- or patrilocality and Avoidance of the Husband's parents. Similarly, for lineage organization and Parent-in-law Avoidances the correlations to be nonsignificant. These functionalist hypotheses about Avoidances are close to dead in the water, whether psychoanalytic or social structural (see our discussions of insufficient evidence from Driver, Stephens and D'Andrade, and Jorgensen).

Eggan's ethnography and many others reporting Avoidances make it clear that Avoidance relationships are not based on fear but on respect, and gift-giving or stability in a recent marriage may lead to annulment of Avoidance. The predictors of Avoidances (Figure 8), as in our initial analysis of Avoidances in forager societies, make it clear that the type of foragers with Avoidances are not hunters, but food collectors (largely female) and fishers (largely male). The regressions for parent-in-law avoidance in Figure 8 and summarized in Table 8 report 80% of autocorrelation as due to common history (language groups), which probably extends to societies like Cheyenne and Arapaho, who were hunters and food collectors prior to acquisition of horses from the Spanish. They may have retained their WiMo Avoidances from an earlier period.

We find no evidence that jurisdiction hierarchy variables have positive effects on Avoidances: just the opposite, both sets of variables are integrative but at different scales. We can only speculate that the integration provided by Avoidances and lack of motivation to attack neighbors (Figure 8), evident also for the Tenino although they had one habitual enemy, might make it easier to construct jurisdictional hierarchy at the community level. Figure 6 makes it clear that greater jurisdictional hierarchy above the community level is incommensurable with Avoidance behaviors, which are effective at a smaller scale. Similarly for population density, shown graphically in Figures 4 and 5 in relation to the decline of Avoidances in larger, denser, and more broadly integrated through jurisdictional hierarchies. We take the evidence of decline in the evolution of Avoidances to be due to the competition from other forms of integrative hierarchy with the growth of organizational complexity.

Overall, it is clear that stereotyped *Joking* behavior promotes cooperation through sexual and nonsexual jesting between close marriageable relatives, and tends to be found in forager societies with small population density, mostly below the threshold at which foragers are forced to aggregate into more fixed communities. (check with *Amber Johnson*).

Avoidance behavior occurs most commonly among foragers and their historical descendants, such as horse nomads of the Plains, most of whom are well above the forager packing density. Their origin is in fishing and gathering societies with fixed settlements and/or seasonal migrations and cohesive groups, often with nuclear families and bilateral kinship networks rather than lineages. Avoidances promote cooperation at a larger scale than Joking because they are associated with marriages that link families who need not be kin-related aforehand. Joking is a more common occurrence with a kinship network of relatives inviting, e.g., marriageable cross-cousins.

Avoidances are respect relationships and are easily dissolved by turning into dyads marked by formal respect without avoidance. One might conceive of them as promoted by women to provide respect relations where jealousies might occur otherwise, as may be the case along the brother-in-law at one end of a ♂WBW chain and the sister at the other, while ♂WB are as close as brothers. These chains may well be the nonpsychoanalytic origin of brother-sister Avoidances as elements of intergroup alliances and trading or gift-giving networks among families who do not require common ancestries or prior intermarriages. Although there is a great deal of missing data from ethnographies about Avoidances, the inferential statistics that lie behind the Avoidance lattice (Figure 7) suggest that ♂WBW and brother-sister Avoidances are coterminous, part of one particular type of the network circulation of gifts that amounts to an exchange system. What makes our study somewhat different from others is that it employs a social network perspective as well as methods of statistical inference that combine the treatment of missing data with inference about network structure, including what is called Galton's problem about the influence of neighbors, common language, common histories, and interactions between local groups with others in their larger environment.

Except for Sister, stereotyped Avoidance behavior involves a response to a potential link that establishes a new kin-tie, such as in-law; Joking is almost universally with an [informal link] relative with a pre-existing tie such as Sibling's spouse, Spouse's sibling or Cousin. This explains their differential assortment with regard to population density. Historically, the differential assortment between Avoidance and Joking dyads contrasts in terms of a few consistent human distinctions separating types of kinship dyads (see footnote 3).

Our findings strongly support the theory of Radcliffe-Brown (1940) as opposed to Murdock (1971) as regards Avoidance.

> [A] theory of the place of respect in social relations … is a very wide and very important sociological problem; for it is evident that the whole maintenance of a social order depends upon the appropriate kind and degree of respect being shown towards certain persons, things and ideas or symbols.
>
> The kind of structural situation in which associated customs of joking and avoidance are found may be described as follows. A marriage involves a readjustment of the social structure whereby the woman's relations with her family are greatly modified and she enters into a new and very close relation with her husband. The latter is at the same time brought into a social relation with his wife's family, to which, however, he is an outsider. For the sake of brevity though at the risk of over-simplification, we will consider on the husband's relation to his wife's family. The relation can be described as involving both attachment and separation, both social conjunction and social disjunction…. The man has his own definite position in the social structure, determined for him by his birth into a certain family, lineage, or clan. The great body of his rights and duties and the interests and activities that he shares with others are the result of his position. Before the marriage his wife's family are outsiders for him as he is an outsider for team. [We would note that this is more a feature of Avoidance than Joking because the latter is usually between cousins, sibling's spouses, or spouses' siblings]. This constitutes a social disjunction which is not destroyed by the marriage….
>
> Social disjunction implied divergence of interests and therefore the possibility of conflict and hostility, while conjunction requires the avoidance of strife. How can a relation which combines the two be give a stable, ordered form? There are two ways of doing this. One is to maintain between two persons so related an extreme mutual respect and a limitation of direct personal contact. This is exhibited in these very formal relations that are, in so many societies, characteristic of the behavior of a son-in-law on the one side and his wife's father and mother on the other….
>
> This avoidance must not be mistaken for a sign of hostility…. I once asked an Australian native why he had to avoid his mother-in-law, and his rely was 'Because she is my best friend in the world; she has given me my wife.' The mutual respect between son-in-law and parents-in-law is a mode of friendship. It prevents conflict that might arise through divergence of interest.

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Appendix 1: Murdock Kin Behavior Data Summary.

In Murdock's sample (1971:414), the Joking dyads are: ElBrWi-HuYoBr 29/80=36%; YoBrWi-HuElBr 22/78=28%; WiElSi-YoSiHu 27/75=36%; WiYoSi-ElSiHu 22/77=29%. These numbers are very similar, averaging 32% +/- 4, as are cross-cousins FaSiDa-MoBrSo 18/58=31%; MoBrDa-FaSiSo 20/60=33%, averaging 32% +/- 2. Joking with Parents-in-law and between Cross-sex siblings average only 2%.

Only 53 societies in the SCCS are coded for presence or absence of avoidances, and of those, 22 (42%) have avoidances. Nonetheless, eliminating missing data, the frequency of avoidance in the 22 societies with avoidance behavior is extraordinarily high. There are 516 absences and 126 presences among the 53 cases, i.e., representing

20% of 53x52/2=1378 dyads minus 632 missing observations. This seems like a small number of cases in total but, of the 53 societies coded, 22 or 40% have avoidances, so that 48% of all the dyads in cases coded (20 * 53/22) are avoidance relations.