The impact of territoriality and kinship upon an Ego-centred interaction system in the highlands of N.W. Tunisia:
Methodology, statistics and results.

Wim M.J. van Binsbergen
University of Zambia
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ABSTRACT. This paper presents a technique for quantitative analysis of the impact of territoriality, unilineal descent and kindred (close agnates, cognates and affines) upon actual interaction in rural areas: operationalization, data processing, statistics and mathematical formalization. Kinship ties are made accessible to quantitative analysis. Application to the highlands of N.W. Tunisia (the Khumiriyya region) shows (after analysis of the geographical distribution of kinsmen) that here, for actual interaction, territoriality is crucial, kindred secondary, and unilineal descent insignificant.
key words: N. Africa; quantitative analysis; territoriality; kindred; unilineal descent; network.

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1. Introduction

The first aim of this paper is to present some tools for the analysis of the social structure of the peasant society in the highlands of N.W. Tunisia (the Khumiriyya region).

As I presented and explained these elements within a general theoretical framework elsewhere (Binsbergen 1971b), I will confine myself here to some preliminary remarks.

Khumiriyya has an indigenous societal ideology, which (at least in the first analysis; however, cf. Binsbergen 1971b: section 7) seems to comprise the following statements: unilineal (agnatic) descent, worked out into a segmentary lineage system, is supposed to be crucial in all fields of the social life; Ego's immediate social environment (his neighbours, fellow-villagers, inhabitants of the same valley) is supposed to be completely made up out of Ms agnates, in such a way that, with respect to a particular individual, geographical distance to Ego is supposed to be the smaller, incidence of interaction with Ego is supposed to be the more likely, and frequency of interaction with Ego is supposed to be the higher, the closer the agnatic tie between this individual and Ego is. In this form the Khumiri ideology is an indigenous equivalent of the classic segmentation theory in anthropology, as founded by M. Fortes and E.E. Evans-Pritchard some thirty years ago.

In contrast to unilineal ideology and segmentary lineage model I suggest, for Khumiriyya, a model of territorial segmentation, where not unilineal descent is crucial, but territoriality (being defined as 'the social aspect of the geographical distribution of people'). According to this view any individual in Khumiri society belongs to a certain series of, hierarchically inclusive, territorial segments: from household, via compound, hamlet, village and valley, up to sheikhdom. AB I worked out elsewhere (Binsbergen 1970, 1971a, 1971b) many aspects of social structure and religion in Khumiriyya can be described awl explained on the basis of this model. Analysis of the impact of territoriality and kinship upon actual interaction is one step towards deciding whether my model, apart from being applicable, is really more adequate t an the segmentary lineage model.

The present analysis will show that, for actual interaction in Khumiriyya, territoriality (as operationalized by 'geographical distance between houses') is of great importance; whereas unilineal descent as such is of very little importance. oreover it will turn out that, in addition to territoriality, kinship in a wider sense forms an independent, although secondary, determinant of actual interaction: the 'kindred', consisting of agnates, cognates and affines jointly, linked to Ego by a comparatively close kinship tie.

My results are not only relevant for Khumiriyya. They might contribute to the revaluation of territoriality, to a correction of the anthropologists' tradition overestimation of unilineal descent as such, and to modern discussions of the kindred (cf. Campbell 1963; Mitchell 1963; Leach 1968). One way to disentangle these theoretical issues from mere speculation, controversy and proselytizing is investigation lay means of suitable quantitative methods, e.g. along the lines proposed here.

The present analysis consists of the 'processing' of several characteristics of dyadic network relations (notably: geographical distance, the particular character of the kinship tie, the incidence and frequency of interaction), as measured for a certain number of Ego's (heads of household), all of whom were, during the inquiry, resident in two adjoining villages (Sidi Mhammad and Mayziya).

The analysis of network relationships recently gave rise to a new branch of social research (cf. Mitchell 1969; this book contains also an extensive bibliography). In this field sophistication and quantification have already been developing to a remarkable degree. Here again the approach set out in this paper, however preliminary and open to criticism, might be a useful contribution,

It is not often that anthropological inquiry leads to the kind of formulae as presented in section 7 and 8 of this paper, I believe that they are more than coquettish pseudo-exactness. On the one hand these formulae might stimulate some additional ways of looking at the quality of interaction in various social settings} on the other hand, they form a confirmation of the classic 'principle of least effort' of Zipf (1949), who also concentrated on exponential functions (cf. Binsbergen 1971b: section 8)} and finally they turned out to be applicable in a simple mathematical model of mate selection in the highlands of N.W. Tunisia (Binsbergen & Binsbergen, forthcoming).

Although the results presented in this paper were afterwards confirmed by qualitative research in Khumiriyya, both by my colleagues in Amsterdam University and by myself, I should warn the reader that the actual quantitative data used are defective in several ways. Of course this is commonplace for social research in non-experimental groups! As a result, any interest this paper might have would rather lie in its methodology (including statistics and mathematics) than in its concrete statements about a particular society.

The quantitative data used in this analysis relate to: the geographical distance between two houses} dyadic interaction; the kinship tie between two persons. These data will be used in order to solve the following problems:

- the relationship between geographical distance and the recruitment of interaction partners (regardless of frequency of interaction);
- the geographical distribution of kinsmen;
- the relationship between kinship and the recruitment of interaction partners (regardless of frequency of interaction)
- the relationship between geographical distance and frequency of interaction}
- the relationship between kinship and frequency of interaction.

I shall first explain how these data were obtained and how they have been prepared for quantitative processing. Next I give a discussion of the processing methods used. For each problem follows then the analysis and the results. The paper ends with a summary of conclusions.

2. Geographical distance

On the basis of the ordnance map of the area (Institut cartographique national, Paris), aerial photographs, and my own sketches, I drew a map (l ; 5,000) of the villages of Sidi Mhammad and Mayziya with their immediate surroundings. Thus the distances between houses in these villages could be measured. These distances I classified: the first class being 0 – 25 m., while the subsequent classes all have a width of 50 m. In this paper, distance class will be referred to as DC.

Apart from errors in the map, the distances measured in this way have only an apparent precision. In so far as geographical distances are socially relevant, we should not measure them as the crow flies, but rather take in account the precise layout of the paths, the relative difficulty of the terrain, (slopes, mud, cobbles), natural and man-made barriers (brooks, cactus hedges, compounds one should not trespass into). The on distances as measured on the map are also distorted because of the fact that the slopes were shortened when projected on the plane. In general the distance measured will always be somewhat shorter than the actual one. However, the overall picture will not be much distorted by the present operationalization, when analyzing the relationship between geographical distance and other variables.

The DCs each form circle rings, concentric around an inner circle with a radius of 25 m., and with Ego's house in the centre. As table 1 shows, the surface of these rings decreases towards the interior.

DC	radius in m (upper boundary)	surface (* 10^4 π m^2
1	25	0.06
2	75	0.50
3	125	1.00
4	175	1.50
5	225	2.00
etc.		

Table 1. The 'surface problem': how the surface of distance classes increases with distance (-= radius).

Within one village the houses are, roughly, equally distributed m earth's surface. This implies that the observed frequencies of certain phenomena in certain DCs can never directly be compared to the corresponding observed frequencies in other DCs? we have to realize that the more interior DCs (because of their smaller surface) cannot but contain much less people than the more peripheral ones. This effect is most important within 500 m.; at larger distances it is somewhat compensated by the occurrence of uninhabited terrain between hamlets and between villages.

3. Dyadic interaction

During the inquiry I recorded, whenever possible, which persons I saw in interaction with what other persons, as for: visits to one another's house; cooperation in agriculture, in fetching water, and in gathering forest products; simultaneous visits to the men's meeting place (and to the adjacent shop); cooperation in the unemployment relief,work. (in this paper I do not pay attention to religious activities, which have been analyzed, both quantitatively and qualitatively, in: Binsbergen 1971a.) Each observation I counted as one interaction.

Here a problem arose: if two persons are simultaneously present on the same place this does not always imply that they chose one another directly as interaction partners. For instance, if A and B are simultaneously in C's house, we can be sure that both have been chosen by C as his interaction partners} in Khumiriyya nobody, except a thief, would enter some other man's house without explicit invitation (generally presupposing a close positive relationship). However, it remains possible that the simultaneous presence of A and B is a coincidence, and that actually there is no direct relationship between A and B. This consideration made me reject those observations that might be based upon coincidence. Thus visits to the men's meeting place, and cooperation in relief work, were ruled out.

The data on interaction of any member of a certain household were counted on the head of Household, In the analysis of the relationship between interaction and kinship only the kinship ties between heads of household were taken in/account. ('Head of household' is the eldest male in the household if adult, and else the eldest female in the household: a widow' or divorcee.)

All persons in Ego's social environment are considered to be Ego's potential interaction partners (henceforth called PIP). All persons who are recorded to have been in interaction with Ego at least once during the inquiry, are considered to be Ego's actual interaction partners (henceforth called AIP), in such a way that interaction of others than heads of household are ascribed to their respective heads of households.

4. Kinship ties

Genealogical knowledge in Khumiriyya (Binsbergen 1970} 1971b, and forthcoming-b) is rather limited. Formulations in terms of kinship are often opportunistic one just presents somebody else as a kinsman, if one has a positive relationship with him, irrespective of the actual, objective kinship tie. Only close objective kinship ties are so well established and so commonly known, that they cannot be manipulated} exclusively in these cases kinship could possibly be an independent determinant of actual interaction. Continuous and ubiquitous genealogical manipulation makes it difficult to reconstruct historically correct genealogies (including marriage ties)} yet I succeeded in this reasonably well, having an abundance of genealogical data at my disposal (cf. note (l)). The reconstructed genealogies enable me to trace the precise, objective kinship ties between all inhabitants of (among other villages) Sidi Mhammad and Mayziya.

Each of these ties is a tauten chain consisting of an ordered selection out of the following basic elements: Fa, Br, So, Da, Si, Mo, Wi, Hu. When these elements occur in various numbers, the amount of possible permutations is astronomically large. In order to master this material I tried to devise an acceptable system capable of taking together a large number of different chains within one and the same category. It is only the comparatively short chains that interest us: for, as noted above, only rather close kinship might be relevant for actual interaction.

Two important aspects of kinship ties are: 'length of chain' (= the number of elements in the chain), and the ‘degree of lineage alienation’. By degree of lineage alienation I mean: the number of times that, in a given chain, we can on formal grounds conclude to a transition to a different lineage.[1] The concept of lineage alienation is important for my argument: it enables us to distinguish between unilineal kinsmen (that means, in this strongly patrilineal society, *agnates*) and non-unilineal kinsmen, so that we can test whether unilineal rife* descent is an independent determinant in the network relationships investigated here.

According to indigenous ideology, Khumiriyya is a patrilineal society, Now in a patrilineal system, lineage alienation occurs at the following elements (the dash indicates the place of transition): Da-, Wi-, -Wi, Hu-, -Hu, -Mo, Mo-, Si-; in short: in the case of a woman’s offspring, and in the case of a marriage. If we designate length of chain by ‘k’, and ‘degree of lineage alienation’ by ‘l’, then (in just these respects) any kinship tie can be described by an ordered pair (k, l). (Where k ≥l the degree of lineage alienation cannot exceed the number of elements in the chain.) for instance: BrWiBr = (3, 1); HuSiDaSo = (4,3); FaBrSoDa = (4, 0).

The next step is to take together kinship ties with the same characteristic, even although these ties differ as to the nature and order of the elements involved. This procedure is, undoubtedly, questionable: we overlook the undeniable differences between, e.g., the following ties: BrWiBr vs. FaSiDo, both having (3, 1); WiMo vs. HuWi (in case of polygamy), both having (2, 2). My method is merely a first attempt. However, generational differences somewhat limit the range of actual chains: it would be very unlikely that, for a certain Ego, both the tie with his FaFa and am that with his SoSo (both having (2, 0)) are simultaneously relevant – either the FaFa is already dead, or the SoSo does not yet participate in adult life.

Now we have a number of categories of chains, each category with its own characteristic. The final step is to combine a number^ of these categories, provided that they are close enough to one another with regard to k and l. Thus we arrive at Diagram 1.

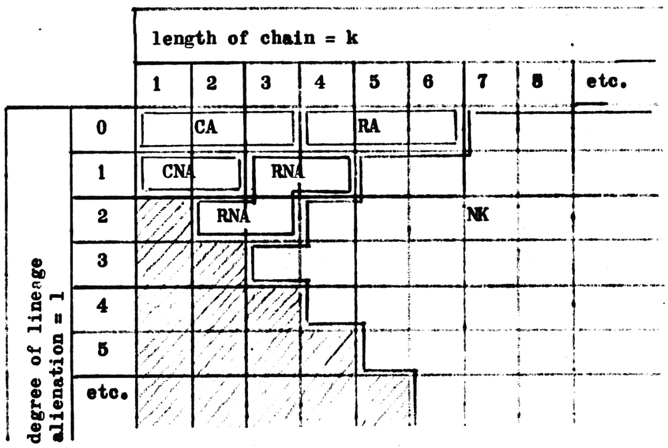

Diagram 1. Coding kinship chains.

Chains with the characteristic (l-3,0) I call closely agnatic (CA); those with (4-6, 0): remotely agnatic (RA); those with (l-2, l) closely non -agnatic (CNA); those with (3-4, l) and (2-3, 2) remotely non-agnatic (RNA). The categories CA, HA, CM and RN.\ jointly make up Ego’s kindred (^); the chains with all other characteristics refer to persons who, within a Khumiri context, should be called non-kinsmen (MK) »

The concept of lineage alienation does not permit us to distinguish between cognates and affines. This is no great disadvantage, I think. In an ideally patrilineal system the set of Ego’s own agnates is distinguished from all other people not connected with Ego through agnatic ties – and then 0 it is, at least formally, (only of minor structural importance whether Ego shares non-agnatic ancestors with these other people (if so, they are Ego’s cognates; if not, his affines). As indigenous ideology claims Khumiriyya to be truly patrilineal (and as application of the anthropological segmentary lineage model would only be justified under the same claim), we are allowed to overlook the difference between cognates and affines.[2]

In Khumiriyya, genealogical knowledge is greater for agnatic than for non-agnatic kinship. This implies that, at a certain length of chain, agnatic kinship might still be relevant for actual interaction heel non-agnatic kinship is not any longer. Thus lineage alienation, in addition to length of chain, imposes a constraint on the relevance of kinship. I tried to take this fact into account by extending the boundaries of K, as opposed to NK, wider in the case of agnates than in the case of non-agnates (diagram l).

The boundaries I set to the NK category reflects a mean tendency, estimated on the basis of my intensive participation in Khumiri society (where I was linked to dozens of people by ties of fictive kinship), and on the basis of my analysis of t-.e functioning of genealogical knowledge. My rigid definition of the NK category is an approximation of the indigenous Khumiri distinc-

[1] The statement ‘on formal grounds’ means: without using any other information than the chain itself contains. For it is possible that two persons linked by a chain that shows lineage alienation, in fact long to one and the same lineage, as might appear from another chain that is equally applicable; an example of this is given in diagram 2 (BrWi and MoSoDa, as opposed to FaBrDo).

[2] (4) Even though Khumiri kinship terminology does distinguish between close cognates and close affines; e.g. MoBr = *khali*; MoBrSo = *wild khali*; WiFa, WiBr, BrWiFa, BrWiBr = *nsibi*.

tion between persons who are still regarded as kinsmen, and other persons who are 'too remote' (although one might be able to reconstruct some long and complicated link). Indigenously, Khumiris would classify most members of our k category (and, unfortunately, some members of our NK category), as 'familya', 'persons having some ancestor in common', 'persons linked by a recognizable, specified, and to some extent effective kinship tie'; however, the Khumiri usage necessarily implies rather vague boundaries, and manipulation.[3]

Of course the reconstructed genealogies enable us to trace much longer chains, e.g. FaFaFaFaBrSoSoSoSo, FaPaBrWiBrDaHuSiSo. But it is nonsense to expert, in the case of so long chains, kinship to be a determinant of actual interaction: if any interaction occurs between two persons linked by chains that long (and such is by no means unlikely), then the kinship tie is no explanation. For hardly any Khumiri would be able to trace these chains, and at any rate there would be no consensus about them (cf. Binsbergen 1971b), Thus Kinship would be deprived from its essential meaning} providing two or more persons with a common frame of reference within which they can mutually identify in a way that is relevant for actual interaction.

The concept of kindred in this paper follows the approach of Mitchell (1963), as for including affines in the kindred (l963:351), and for the basic insight

> 'that the kindred as an Ego-oriented network of kin, and the extended kin group as a bounded corporate unit have different system-references and cannot be compared as mutually exclusive variations abstracted from the same order of social relations' (1963: 350).

Finally we must pay attention to those cases where between two persons more than one kinship tie can be traced. Diagram 2 gives an example (wholly compatible with actual Khumiri practice).

For this kind of complications I devised the following decision procedure :

- First reject those chains that lead to a remoter kinship category than any one of the other chains (i.e. prefer all other chains to one leading to NK; and prefer CA and CNA., jointly, to RA and RNA).
- Secondly, if still more than one chain is left, choose the agnatic one.

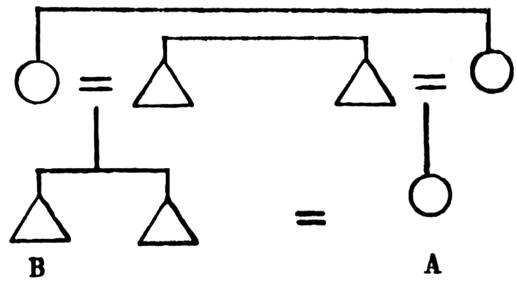

Diagram 2. Multiple possible kinship chains can be traced between A and B.

If between two persons, belonging to each other's kindred (as defined here), more than one kinship tie can be traced, this is based on kindred endogamy. Kindred endogamy, including the marriage between CA, is very common in Khumiriyya (about 30% of all marriages; cf. Binsbergen, forthcoming-a; Binsbergen & Binsbergen, forthcoming), – as it is elsewhere in the Arab world.

A disadvantage of the second step in this decision procedure is that types of kinship ties that are not really mutually exclusive, yet are in treated as such; e.g. as diagram 2 shows, somebody can be Ego's CA and CNA at the same time. I had to adopt this procedure in order not to complicate the analysis to much, fie On this point t e method presented here could be farther improved. However, is was seldom necessary to apply the second part of this procedure) in case of multiple chains, reduction by the first step was often sufficient.

5. The samples

I used three, overlapping, samples of beads of household:

- Sample I consists of all (68) heads of household in both villages.
- Sample II is an aselect sample of 15 heads of household, with replacement drawn from sample I
- Sample III consists of 4 heads of household, drawn from sample 1} it is unknown whether sample III is representative for sample I.

Sample I is used only for the analysis of the relationship between distance and choice of AIP (regardless of frequency of interaction). For analysis of the distribution of kinsmen, and of the relationship between kinship and choice of AIP, it was necessary to trace the kinship ties between each member ('Ego') of the sample used and all other heads of household in both villages: an extremely complicated and time-consuming task. Therefore I needed a smaller sample: II, which

[3] In this respect there is a marked difference between the Khumiri familya and the *indigenously strictly defined* kindred in a Greek mountain community as described by Campbell (1963). Another crucial difference is that the Greek kindred is exogamous, whereas in Khumiriyya about 30% of all marriages are kindred-endogamous.

can be taken as representative for sample I. Sample III is used only for the analysis of frequency of interaction. Here I had to draw a sample containing those heads of household for whom I recorded the largest number of interactions! the four members of sample III are selected exclusively on this basis* Naturally the results obtained with sample III have, at most, only exploratory value.

6. Methods of processing[4]

The samples consist of a number of Egos, each dwelling in a certain place somewhere in either village. There is a fixed geographical distance between the house of each Ego and the houses of all other heads of household (at a certain time). This distance falls into one of the DCs I devised. Most of my analysis was limited to 17 or 18 DCs (up to 825 m., respectively 875 m.). Now with respect to all Ego's in the sample, any head of household show, a number of characteristic attributes. For instance, with respect to Ego A, head of household B shows the following attributes:

- -B lives at a distance of m meters from A, i.e. with respect to A in the i-th DC.
- B is always a PIP of A.
- B is/is not an AIP of A.
- If B is an AIP of A: between A and B a number of n interactions have
- been recorded.
- B belongs/does not belong to A's K»
- If B belongs to A's K, then B belongs to one of the four categories
- within A's K (CA, RA, CNA, RNA).
-

For each of the problems mentioned in section 1, the basic approach will be as follows:

- According to the problem we take one of the three samples.
- According to the problem we make a choice out of the attributes in the above list; however, one of the attributes we shall always use is belonging to a particular DC with respect to a particular Ego in the sample.
- Separately for each Ego in the sample we count, for each DC, those heads of household (except this particular Ego himself) who show, with respect to this Ego, the particular attribute we are analyzing.
- If in a particular problem more than one attribute (apart from distance) is involved, then each attribute is processed in this way.
- This approach yields, for each Ego in the sample, a certain score in each DC. Next we add separately in each DC the scores for all Egos, with regard to this particular attribute. This yields a total score per DC. In this way, per DC, the many members (Ego's) of the sample are, as it were, amalgamated into one average Ego. If we next succeed in reuniting the separate DCs into one continuous variable ('geographical distance'), then, depending on the representativeness of the sample, the conclusions we arrive at (ideally formulated in terms of an 'average Ego') reveal us some general relationship between geographical distance and other variables within Khumiri society.

There are various ways of smoothing the DCs into one continuous variable:

1. One way to do this is to associate these total scores for a particular attribute per DC with the DC rank number. Here we make use of Spearman's ran;- correlation coefficient (r_S), corrected for ties whenever necessary (cf. Siegel n.d. :206f). We test on the 5% significance level. Given the number of distance classes, the value of r_S indicates whether the total scores for a particular attribute are demonstrably ('significantly') connected with geographical distance. In this way we establish the relationship between distance and the number of AIP.
2. When in a particular problem more than one attribute is involved (apart from distance), we compare, for each DC separately, the total scores for these various attributes.
3. The most simple approach for this comparison is: the proportion (between two total scores in the same DC). Per DC we associate then the size of the proportion with the DC rank number, and compute r_S,. Thus a connection is established between distance and:
   - the fraction of Ego's AIP among Ego's PIP;
   - the fraction of Ego's K among Ego's PIP (geographical distribution of K);
   - the fraction of CA, RA, CNA, and RNA separately, among Ego's PIP (geographical distribution of categories of kindred);
   - the average number of recorded interactions per AIP (frequency).
4. As geographical distance and size of proportion are both measured on ratio scales, for some of these relationships we can go beyond the non-parametric approach of r_S: some relationships seem to be reasonably described by an exponential function.

[4] For the mathematically minded reader I must apologize for the rather loose and discursive description in this section, The whole procedure could be described more adequately and more briefly by some simply formula – involving however a degree of formalization that would unnecessarily put off the majority of readers.

5. The comparison, per DC, of several total scores (each for a particular attribute), can take a more complicated form. For instance: per DC we compute the following total scores: number of PIP; number of AIP; number of K among PIP; number of K among AIP (table 2).

	K	NK	total
PIP	x	y	q
AIP	g	h	p

Table 2. Relation between some variables in distance analysis (A)

Now the problem is, obviously: does the average Ego (in the i-th DC) choose more K as his AIP, than could be expected from the occurrence of K among PIP (in this DC)? This problem may be elucidated by table 3.

	K	NK	total
expected number of AIP	x/q * p	y/ q * p	p
observed number of AIP	g	h	p

Table 3. Relations between some variables in distance analysis (B)

The figures in table 3 (represented by x, y, etc.) are affected by chance fluctuations. Therefore we apply a statistical test in order to decide whether there exists, in actual interaction, a preference for K.

6. For problems if this type a usual test is the test. However, this test has the disadvantage that for each cell a minimal expectation value of 5 is required. This requirement is absent in Spitz's l' test (1961), which in all other respects is »j equivalent to the χ^2 test.[5] The formula for the 1* test is:

$$l' = 2\sum_{j=1}^{a} n_j * \ln\left(\frac{n_j}{e_j}\right) \text{ ; def = a- 1 ....(i)}$$

where: n_j = number observed in the j-the class[6]
e_j = number expected in the j-the class
ln = natural logarithm
df = number of degrees of freedom
a = number of classes)

For the interpretation of the value of the l' statistic we consult a χ^2 table; we test at the 5% level.

7. The method of table 3 will be used for the analysis of the relationship between:

- kinship and choice of All (regardless of frequency of interaction) ;
- choice of AIP and belonging to a particular category in. thin Ego's kindred}
- kinship and frequency of interaction.

For these problems it is necessary to keep the variable 'geographical distance' constant, as the preceding analysis of the other problems will have demonstrated that precisely this variable is of great and independent importance. We keep this variable constant by applying the 1' test for each DC separately.

7. Geographical distance and actual interaction partners. The relevant data are summarized in table 4.

1. In Table 4, column II shows the observed number of AIP per DC. As the DC is more peripheral, this number decreases. There exists a demonstrable relationship between distance and number of AIP ($|r_S| = 0.87 > r_{S\,N=18;\,5\%}$). This is the more remarkable, as the more peripheral DCs generally contain more PIP.
2. The difficulty arising from the latter condition (the 'surface problem') met in column III, where I divided, per DC, the number of AIP by the number of PIP. Diagram 3 gives a graphical representation.

We now find a demonstrable relationship between geographical distance and the size of the proportion of AIP among PIP ($|r_S| = 0.87 > r_{S\,N=18;\,5\%}$).

The 'average Ego' preferably chooses his AIP among his very close neighbours, so that the proportion of people with whom he interacts (among the total number of PIP) rapidly decreases as 'he geographical distance increases – even though at larger distances the 'supply' of PIP is substantially larger.

[5] Thus the l'-test is particularly suited for anthropological research, where we often have to cope with small samples.

[6] It should be understood that the classes we are dealing with here are quite distinct from the distance classes discussed earlier. The classes in formula (i) just refer to column entries in contingency tables such as tables 2 and 3 (where a = 2).

I DC rank	upper boundary (m)	II: AIP	III: AIP/PIP	IV: standard deviation
1	25	42	0.89	0.15
2	75	52	0.53	0.44
3	125	57	0.35	0.38
4	175	59	0.27	0.33
5	225	46	0.23	0.26
6	275	19	0.11	0.16
7	325	32	0.16	0.25
8	375	18	0.08	0.17
9	425	15	0.06	0.15
10	475	17	0.05	0.16
11	525	8	0.04	0.13
12	575	15	0.03	0.17
13	625	9	0.05	0.18
14	675	21	0.05	0.14
15	725	5	0.01	0.04
16	775	6	0.03	0.17
17	825	10	0.09	0.26
18	875	0	0	0

Table 4 Number of Actual Interaction Partners (AIP) per distance class, as fraction of number of Potential Interaction Partners (PIP), and the standard deviation of AIP/PIP

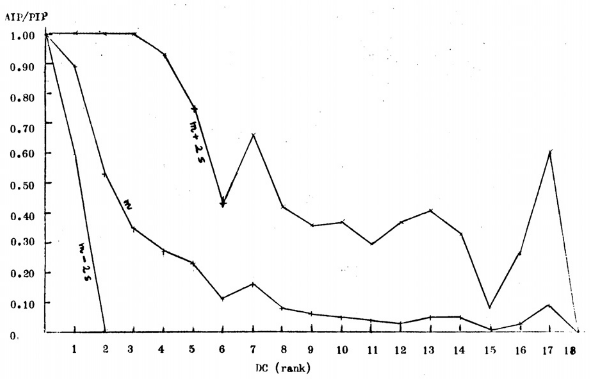

Diagram 3. The distance gradient of the Actual Interaction Partners as a fraction of the number of Potential Interaction Partners (AIP/PIP), with confidence interval (= AIP/PIP + 2 * standard deviation)

The proportions in column III (table 4) present, per DC, the mean for all Egos in the sample. In this case I made one more step, and computed, from the scores of each individual Ego, the standard deviation around this mean, per DC. From mean and standard deviation we compute, per DC, the confidence interval of the population mean. (When N' =68-1 (Ego) = 67, the probability is higher than 95J& for the population mean to lie between mean + 2 x standard deviation.) Thus it turns out that not only the proportion, but al so the boundaries of the confidence interval decrease along with distance(diagram 3). This makes it very unlikely that our findings are mere artefacts of analytical procedure.

The layout of the curve suggests an exponential relationship between geographical distance and the size of the proportion of AIP; in a general formulas:

$y = \alpha * e^{-x/\beta}$ ....(ii)

(where: y = AIP/PIP
x = geographical distance (m)
e = basis of natural logarithms (= 2,72)
α = a parameter
β = a parameter (km.).)

In order to find the numerical value of the parameters α and β, we compute, by means of the well-known method of least squares (e.g., cf. Crow et al. 1960: 152f), the regression of:

$y'_i = b * x_i + a$ .... (iii)

(where: y'i = ln y in the i-th DC
$b = -1/\beta, m^{-1}$
a= ln α
xi= middle of the i-th DC, m.)

Computation results in:

$y = 0.5 * e^{-x/300}$..(iv)

This formula abstracts from distance classification, and enables us to predict^ directly the size of the proportion y, for any distance smaller than 825 m. (and possibly also for larger distances).

8. The geographical distribution of kinsmen.

Because of the 'surface-problem', for our present problem of the distribution of kinsmen we only pay attention to the relative frequency of I (as compared to per DC, i.e. regardless of absolute frequencies.

Table 5 presents the relevant data, on which the following conclusions are based.

Column II. There is a demonstrable relationship between belonging to Ego's kindred and dwelling in Ego's proximity ($|rs| = -0.95 > r_{S_{N=17;\ 5\%}}$). If we consider Ego's nearest neighbours to live within a distance of at most 25 m. from Ego's house, then 87% of Ego's nearest neighbours belongs to Ego's K. This percentage decreases as distance increases:it is 50% at about

100 m., and it comes down to under 10%$ above 700 m.

In column II the entire kindred (in as far as living within a distance of 825 m.) is taken together. However, it is necessary to differentiate between the categories within the kindred. For although the above conclusion states an important relationship, it does not explain backgrounds* And these differ for each category of kindred, as the following argument may

From the second generation onward, the Khumiri household is subject to a continuous process of spatial dispersion. When coming of age, sons use to build Separate houses o their father's compound, they marry and have children; generally after some years (particularly after their father's death) the relationship between the brothers develops into serious conflicts, resulting in the break-up of the paternal compound t one or more brothers move into the proximity of other people (Costly within the same village, but not necessarily kindred) with whom they are enjoying, for the moment, more positive relationships than with their brothers.

Against this background it would seem that, when neighbours are CA, the CA tie is primary, and dwelling in one another's proximity is rather a secondary 'effect' of common agnatic descent. Likewise the kinship tie is primary in the case of uxorilocal marriage: for in that case Ego acquires a new neighbour because this is a close affine. (However, only 5% of the marriages in the research area are uxorilocal, the remaining 95% being virilocal.) In the above cases kinship brings about proximity; on the other hand, in many cases the reverse proposition holds true. Thus it is a basic principle in the Khumiri marriage pattern that people who mutually interact frequently and who have very good relations, will try to establish close affinal relations (cf. Binsbergen forthcoming-a) } as, moreover, interaction is closely connected with geographical distance (this paper), affinal kinship is often rather an 'effect' of proximity (cf. Binsbergen & Binsbergen, forthcoming). This reasoning explains the majority of cases of proximity between CNA kindred (uxorilocal marriages being responsible for some of the other cases); and, in addition, it explains almost all RNA cases.

Let us now, against these backgrounds, examine the four categories of kindred separately.

Column III. There is a demonstrable relationship between belonging to Ego's CA and dwelling in Ego's proximity ($|r_s| = 0,74 > r_{S\ N=17;\ 5\%}$). It turns out that CA constitute the greater part of Ego's nearest neighbours (up to 25 m., 53% of neighbours is CA). However, their share rapidly decreases to under 10% (at about 250 m.). We find that, for an average Ego (and with regard to that part of his kindred that is dwelling within a distance of 825 m.), about 35% of Ego's CA lives at larger distances than 250 m. from Ego. This fact shows the great impact of the spatial dispersion of parental households already within two generations.[7] If one were to take the indigenous Khumiri vision of society as a testable scientific statement (which it is not, in reality; cf. Binsbergen 1971b: section 7), it would imply 'all CA are neighbours, and all neighbours are CA'; it here turns out that neither part of this statement is tenable.

I: DC, rank	II CA/PIP (%)	III RA/PIP (%)	IV: CNA/PIP (%)	V: RNA/PIP (%)	K/PIP (%)
1	53.3	6.7	6.6	20.0	86.6
2	44.4	5.6	5.6	5.6	61.1
3	12.5	8.3	8.3	16.7	45.8
4	10.9	0	4.3	23.9	39.1
5	13.0	2.2	8.7	8.7	32.6
6	0	0	4.8	33.3	38.1
7	10.5	5.3	7.9	5.3	28.9
8	3.3	0	8.3	15.0	26.7
9	4.3	0	1.4	4.3	10.0
10	0	0	2.8	15.5	18.3
11	1.9	3.8	1.9	5.8	13.5
12	0	0	2.3	5.7	7.9
13	8.8	5.9	0	2.9	17.6
14	4.7	4.7	0	3.1	12.5
15	0	0	0	3.5	3.5
16	0	0	0	0	0
17	0	6.5	0	0	6.5

Table 5 (Sample II) Categories of kin as percentage of Potential Interaction Partners (PIP), per distance class

Column IV. There is no demonstrable relationship between belonging to Ego's RA and dwelling in Ego's proximity ($|r_S| = 0,21 < r_{S\ N=17;\ 5\%}$). Whether near to Ego, or far from Ego, the percentage of RA kinsmen is always less than 10%, and nearby it is not really higher than further off.

[7] That no more than two generations are involved here, is clear from the following argument. The most distant kinship tie that I still call CA has the characteristic (3,0). When we neglect half-sibling ties, and uneconomically stated ties (e.g. Brava = FaFa; SoBrFa = Ego) this characteristic applies to the following ties: FaFaFa, FaFaBr, FaBrSo, FaBrDa, BrSoSo, BrSoDa, SoSoSo, SoSoDa. Generational differences justify discarding all these ties in our analysis, except FaBrSo and FaBrDa; and the latter are really no more than two generations moved from the original household of Ego's (and their) FaFa.

Column V. There is a demonstrable relationship between belonging to Ego's CAN and dwelling in Ego's proximity ($|r_S|=0{,}84>r_{S\ N=17;\ 5\%}$). Although the share of CNA is greater nearby than further off, it is always under 10%.

Column VI. There is a demonstrable relationship between belonging to Ego's RNA and dwelling in Ego's proximity ($|r_S| = 0.78 > r_{S\ N=17;\ 5\%}$). Amongst Ego's nearest neighbours the share of RNA. (20% up to 25 m.) is greater than that of any other category of kindred, except CA.

Analogous to the method applied in the preceding section, we can express the geographical distribution of kinsmen (according to the various categories) by means of exponential functions. When doing so, we have to find some solution for the empty DCs in table 5 (for ln 0 = – ∞ would impede computation). We can meet this difficulty by combining the empty DC (or series of empty DCs) with the immediately preceding nun-empty one. Thus we form new combined DCs, each with new combined class middles; from the rough data (not presented in this paper) we have to compute again the percentage of kinsmen (in the relevant category of kindred), i.e. the number of kinsmen / PIP, in the combined DC. This approach finally yields the following formulae:

CA : $y = 0.3 * e^{-x/200}$ ....(v)

RA : $y = 0.03 * e^{-x/4800}$ ....(vi)

CNA: $y = 0.1 * e^{-x/300}$ ....(vii)

RNA: $y = 0.2 * e^{-x/400}$ .... (viii)

K : $y = 0.6 * e^{-x/300}$ ....(ix)

NK : $y = 1 – 0.6 * e^{-x/300}$ ....(x)

These formulae are but rough approximations of the empirical values presented in table 5. The approximation would be better if we had more and better data.[8] The data available deny us the use of confidence intervals, mainly because the DCs are chosen by the investigator, instead of being stochastically distributed. Also we could consider if any other approximation than these exponential functions would be more satisfying. This is especially interesting in the case of RNA, where the on curve oscillates heavily but seems to reach its maximum only at 275 m.

9. Further observations on the geographical distribution of kinsmen.

Though the proportion of CA amongst Ego's nearest neighbours is remarkably high, table 5 shows that the relationship between belonging to Ego's kindred and living in Ego's proximity can by no means be attributed to CA alone. For the same relationship was demonstrated for the other categories of kindred (except RA). It is clear that, apart from the most interior DCs (up to 125 m.), CA do not constitute a remarkably high proportion within the kindred, as compared to the other categories. Thus the following general conclusion can be drawn: *the nearer to Ego's house, the larger is the proportion or Ego's kindred among the villagers, while within this picture Ego's CA is no sooner to be differentiated as a distinct category than very close to Ego's house.*

Because of our method of classifying kinship ties (section 4), in the present analysis CA have some advantage, as to the size of their proportions, over CNA, Probably we would find a CNA curve that is more like the CA curve, if we processed the data anew in such a way that the CNA-category is allowed to contain also those CA that, in consequence of kindred endogamy, have close affinal ties with Ego. However, I do not think it essential to extend the analysis in this direction.

Now how can we explain that, as shown in table 5, the RNA proportion attains its maximum at a distance as large as 275 m.?

As I stated above, the Khumiri household is subject to spatial dispersion. Ego's CNA consists of persons who established marital ties with go or with Ego's CA, either in Ego's own generation of in the generations immediately preceding or following. If we assume that the degree of spatial dispersion is more or less the same for all households in t e research area, then for each individual A we can indicate an area (centring around his present house), where A's son, B, is likely to dwells B will live on a distance of d km. from A's house. Here d is a variable that takes, for each individual, a certain value between 0 km. (B remains where father lived) and, at most, several hundreds of km. (B migrates to Tunis, to Europe); in general d takes values between 0 and 2 km., in the present-day Khumiriyya.

Let us assume that on a certain time P and Q, (no CA relation) establish a marital ties P's daughter marries Q's son (diagram 4).

As stated earlier, the probability of this marriage is connected, to an high degree, with the geographical distance between P and Q., Q. and their offspring show spatial dispersion. Let us, for the sake of simplicity, assume that P and Q, are stationary. Let Ego be Q's son. Ego moves from Q over a distance of d1 km. P's So moves from P over a distance of d2 km. P's SoSo

[8] And if the exponential fiunction would be the best possible mathematical model for gravity processes; it is not, the Bessel function (which is much steeper for the lower values) is much to be preferred, for reasons I will set out in a later paper.

moves over a distance of d3 km. from P's So; by this removal P's SoSo might get back to the place of P's house, but this is unlikely. Finally P's SoSoSo moves over a distance of d4 km from P's SoSo[9].

With each new removal we see a decrease of the degree in which the geographical distance between Ego, on the one hand, and P and his offspring, on the other heady is a reflection of the initial geographical distance between P and Q, There is no reason at all for the dispersion of P's offspring to converge systematically with the dispersion of (1*8 offspring in such a way that, in the long run, Ego would find his RNA primarily amongst his nearest neighbours. Here we have an explanation for the fact that the maximum proportion of RNA does not fall in the nearest DC around Ego's house (as is the case for CA and CNA). Further mathematical analysis, including substitution of empirical values for d, might show why this maximum lies at about 275 m.

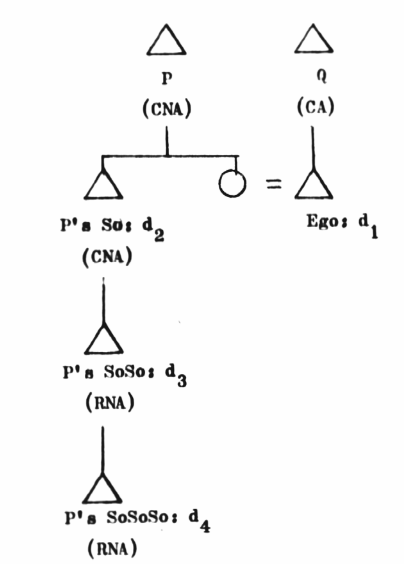

Diagram 4. An example of the consequences of the dispersal of the parental family for the geographical distribution of agnatic kin.

10. Kinship and actual interaction partners.

From the data for actual interaction of the Ego's in sample II it can be derived that 58% of an average Ego's AIP (dwelling within a distance of 825 m.) belong to Ego's K, and 42% do not belong to Ego's K. In other words: within his own village and an adjoining village, Ego by no means interacts exclusively with kindred.

Also we found: AIP are preferably recruited within very small distances, and K tend to be living within very small distances. It is now a logical step to analyze whether the occurrence of K amongst can be wholly attributed to the factor 'geographical distance'; if not, we have to introduce 'preference for kindred' as an independent factor, in addition to geographical distance.

Table 6 summarizes the relevant data.

DC rank	AIP	l'	conclusion
1	15	0.00	ns
2	11	2.81	ns
3	7	1.93	ns
4	18	10.67	s
5	17	23.71	s
6	7	0.89	ns
7	5	0.70	ns
8	7	1.56	ns
9	9	1.42	ns
10	5	13.80	s
11	2	4.16	s
12	7	5.78	s
13	4	2.12	ns
14	7	8.17	s
15	0	-	-
16	0	-	-
17	3	0.49	ns

Table 6. Sample II: Is there still a statistically significant evidence of Ego's preference for kindred in actual interaction, *if we control the factor of geographical distance.*

$l'_{df=1;\ 5\%} = 3.84$

(Note: since it is known that kinsmen have a particular geographical distribution around Ego, geographical distance as an indepe3ndent factor in itself will already lead to the selection of a large number of kinsmen as interaction partners, but this need not be because the are kin, but may simply be because they are living nearby).

We must conclude that in some DCs there exists a demonstrable preference for kindred; while in some other DCs this preference seems to be absent. The distribution of significant and non-significant results over the DCs can, statistically, be attributed to chance (runs test, Siegel n.d. :52f). Yet I want to comment on one series of subsequent DCs with non-significant results: the area of 0 to 125 m., Ego's near neighbours.

Among these, 39% do not belong to Ego's K. This figure is large enough for a preference for kindred to emerge as statistically demonstrable,if it would occur at all. However, among near neighbours, no don such preference could be found, with regard to actual interaction.

[9] These removals are all characterized by a certain distance and a direction: vector calculus would provide an exact description of the entire model.

This reflects the fact that, in Khumiriyya, near neighbours almost invariably fill into a special type of very close positive relationship, indigenously called MM metering (‘faithful ones’, vis-à-vis Ego). During his lifetime, Ego freely engages in metasrin relationships with a limited number of his AIP. • Essentially, the content of the metasrin relationship reflects the ideal Khumiri norms of the relationship between fern real brothers. However, the main factors in the recruitment of metasrin partners are: proximity, shared economic interests leading to cooperation; m compatibility of personalities. Metasrin relations between real brothers are rare (although highly esteemed by everybody), whereas many metasrin relationships exist between NK. Objective kinship ties as such are irrelevant tarn for both the recruitment of metasrin partners, and tee the actual interaction between these partners once the metasrin relation is established. In fact, the metasrin relationship imposes fictive brotherhood, which to a high extent supersedes the relationships between actual, real CA (cf. Binsbergen 1971b: section 7).

In the more peripheral DCs the number of Ego’s metasrin, and of Ego’s All in general, rapidly decreases, whereas the number of PIP increases according to (roughly) the surface of the respective DCs. At these larger distances, belonging to Ego’s K might conceivably form an additional principle, guiding Ego in choosing AIP out of this large, and in other respects rather unstructured, supply. At any rate we find that the results here are now significant, now non-significant. In the significant cases we have to assume some preference for kindred RS such, Further research is required in order to isolate the factors underlying the somewhat confusing pattern in these more peripheral DCs(table 6).

Is there, within K, any preference for a particular category of kindred, with regard to recruitment of AIP?

In this section we have been analyzing the kindred as a unity, contrasting it with NK, Now we must consider whether we were justified in doing so. The Khumiri ideology suggests that agnatic kinship is the crucial determinant in interaction, Khumiri kinship terminology distinguished between agnates, cognates and affines. Moreover, from the analysis of geographical distribution of kinsmen, CA emerged, in some degree, as a distinct category vis-à-vis the rest of K. These considerations induce us to investigate now possible preferences for certain categories of K, in the choice of AIP.

Therefore we check, for each DC, whether from any category of K yore AIP are chosen than might have been expected on the basis of the relative occurrence of this category among the PIP, in this DC; the crucial issue being here whether agnates are preferred over non-agnates.

On closer inspection of -the data it turns out that, per DC, we are allowed to combine CA and RA on the one hand, CNA and RNA on the other: both for agnates and for non-agnates, respectively, the ratio of close kindred (as against remote kindred) amongst AIP nearly always fairly reflects the corresponding ratio amongst PIP in that particular DC. This is so evident a fact that we can even refrain, on this point, from a statistical test. Therefore we conclude that, as for actual interaction, there is no preference for CA over RA, neither for CNA over RNA (geographical distance beyond controlled and held constant, by means of testing per DC). Thus our analysis is much facilitated: we can just test, per DC, agnates (CA + RA) against non-agnates (CNA + RNA). Table 7 summarizes the results of this testing.

DC rank	number of K among AIP	l’ (df = 1)	conclusion
1	13	0.00	ns
2	8	0.19	ns
3	5	0.36	ns
4	14	0.01	ns
5	13	0.37	ns
6	3	-	—
7	2	2.48	ns
8	3	0.63	ns
9	2	3.92	s
10	4	-	-
11	0	-	-
12	3	-	-
13	2	0.62	ns
14	4	2.90	ns
15	0	-	-
IS	0	-	-
17	0	-	-

Table 7 (Sample II): Does Ego have a statistically demonstrable preference for agnatic kin over non-agnatic kin in actual interaction?
$l'_{df=1;\ 5\%} = 3.84$

Of course testing is impossible in the case of a DC where, among PIP, no K are available, or where Just one of either categories (agnates or non-agnates) are available; hence the open spaces in table 7. For the DC’ s that permitted testing, only one significant result was found. We are allowed to neglect this isolated case.

We conclude that, as for choice of AIP among - Ego’s K, (within a distance of 825 m.), Ego does not show any demonstrable pan preference for agnates neither for non-agnates. For the types of interaction investigated in this paper, the kindred appears as a set that need not further be divided up into subsets (categories of kindred).

11. Geographical distance and frequency of interaction

If there exists a relationship between geographical distance and frequency of interaction, then there should be a demonstrable difference between DCs with regard to the average number of recorded interactions per AIP. (As we compute this average number per DC, this analysis is not affected by our 'surface-problem'.)

Table 8 summarizes the relevant data.

We conclude to a demonstrable relationship between geographical distance and frequency of interaction ($|r_S| = 0.52 > r_{S\,N=17;\,5\%}$).

In general, Ego interacts the more with his AIP, the nearer they live to his house. This conclusion is only warranted for the very partial sample III; however, it may probably be generalized, as it is so much in line with the overall structure of Khumiri society, and •atom with qualitative field impressions both of myself and of my fellow researchers in Khumiriyya.

DC rank	AIP	number of observed interactions/AIP
1	1	3.0
2	5	2.4
3	8	3.6
4	11	1.9
5	8	1.6
6	3	1.3
7	5	1.4
8	2	1.0
9	0	-
10	4	1.0
11	2	1.5
12	1	1.0
13	1	2.0
17	1	1.0
24	2	1.0
25	1	1.0
26	1	1.0
28	1	4.0
73	1	1.0

Table 8 (sample III): Number of observed interactions divided that of Actual Interaction Partners (AIP)

In order to utilise as much of our data as possible, we include also information on interaction partners living at greater distances than 875 m:

& DC rank	boundaries (m)
24	1126-1175
25	1176-1225
26	1226-1275
28	1326-1375
73	3576-3625

Table 8a: Boundaries of extended distance classes

*12.Kinship and frequency of interaction**

If there exists any relationship between kinship and frequency of interaction, then per DC Ego should have demonstrably more interactions with those AIP that belong to his K, than might have been expected on the basis of the occurrence of K, respectively of NK, among his AIP, per particular DC.

To test this hypothesis, I checked I for all Egos in sample III which ones of their AIP belonged to their, respective, K. Next I applied, per DC, an I'-test. Table 9 summarizes the results.

Of course testing was only possible in those DCs where among the AIP both K and NK occurred: hence the many open cells in table 9. We find a significant result only in one DC.

That table 9 does not yield more significant results might depend on the small number of recorded interactions. To evaluate this suggestion we combine several subsequent DCs (the series of significant and non-significant results in table 6 give us a hint as how to combine the DCs with optimal chances of finding significant results.) We may assume that in the combined DCs geographical distance is still held constant, although not as strictly as when we use the original DCs. Table 10 summarizes the results for combined DC*s.

We conclude that, at least in the v ery partial data examined in this section (sample III), there is no demonstrable relationship between kinship and frequency of interaction. Kinship does not appear to be an independent determinant of frequency of interaction. It is not impossible that, once we acquire better data on this point, this conclusion will have to be amended. Moreover it would be interesting to investigate possible differences between the four categories of kindred, with regard to frequency of interaction; but again the present data do not permit such analysis.

DC rank	l’	conclusion
1	—	-
2	0.18	ns
3	0.65	ns
4	5.80	s
5	0.41	ns
6	0.47	ns
7	0.02	ns
8	-	-
9	-	-
10	-	-
11	0.34	ns
12	-	-
13	-	-
17	-	-
24	-	-
25	-	-
26	-	-
28	-	-
73	-	-

Table 9 (sample III): Is there a statistically significant relationship between kinship, and frequency of interaction? Original distance classification.
$l'_{df=1;\,5\%} = 3.84$

combined DC rank	AIP	l’	conclusion
1-3	14	1.25	ns
3-5	19	2.03	ns
6-9	10	0.01	ns
10-14	8	0.45	ns
15	7	2.03	ns

Table 10. Is there a statistically significant relationship between kinship, and frequency of interaction? Combined distance classes..
$l'_{df=1;\,5\%} = 3.84$

13. Summary of conclusions

The quantitative methods amply described in sections 2 to 6 of this paper lea-, when applied to an interaction system (conceived as ego-centred) in the highlands of N.W. Tunisia (as investigated by the present author in spring 1968) to (primarily) the following conclusions:

There exists a demonstrable (statistically significant) relationship between geographical distance to Ego’s house and following variables:

- number of Ego’s actual interaction partners;
- size of the proportion of Ego’s actual interaction partners among his potential interaction partners;
- belonging to -ego’s kindred; belonging to Ego’s close agnates, close non-agnates and remote non-agnates (as respective categories of kindred);
- frequency of interaction with Ego.

Several of these relationships could be expressed as exponential functions, where the parameters involved could be estimated from the empirical data.

Thus territoriality (as operationalized by geographical distance) turns out to be an independent, and very important, determinant in the social structure of this society. When the territorial factor is held constant, kinship (belonging to Ego’s kindred) appears as a secondary, but equally independent, determinant, manifest in a certain (but by no means consistent) preference for kindred in actual interaction (except among near neighbours), and in certain cases of proximity between close kindred (notably: close agnates; and close affines in case of uxorilocality). No connection could be established between kinship and frequency of interaction; neither could we find, as for actual interaction, any demonstrable preference for close kindred over remote kindred, nor for agnatic kindred over non-agnatic kindred.

These results are in striking contract with the indigenous model of Khumiri society and its scientific equivalent: the segmentary lineage model; they contribute to the view of Khumiri society as, to a high degree, dominated by territorially and territorial segmentation (cf. Binsbergen 1971b), and add to our understanding of kindreds in Mediterranean and Arab societies.

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