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Persistence of close personal ties over a 12-year period

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Abstract

Using data on 60 intentional communities from the Urban Communes Data Set, we examine factors related to the persistence of ties 12 years later, when nearly all members had left the groups. We find strong evidence of triadic effects—people are more likely to remain in contact with others when they share patterns of contact with third parties. Such triadic effects retain importance even when we use alternative measures of contact, and when we control for individual-, dyadic-, and group-level effects including geographic separation. When we examine friendship as opposed to contact, we find that the triadic effects can be decomposed into some effects pertaining to *hierarchy* and other effects pertaining to *reciprocation*, giving us a sense of how networks structure themselves over time.

Keywords: Tie persistence; Tie decay; Social networks; Longitudinal analyses

As network analysis has become increasingly sophisticated, there have been more calls for a better understanding of how networks change over time (e.g. Marsden, 1990; Knoke and Kuklinski, 1982), and a number of noteworthy recent efforts (Jerusalem et al., 1996; Leik and Chalkley, 1997; Morgan et al., 1997; Wellman et al., 1997; van de Bunt et al., 1999). But even so, as Burt (2000) has recently remarked, stunningly little is known about the persistence versus decay of relationships, especially over long periods of time. (Very recent exceptions may be found in work on long term changes in personal networks in

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Canada (Wellman et al., 1997), China (Ruan et al., 1997), and the US (Suitor and Keeton, 1997)).

In this article, we examine factors associated with the persistence of personal ties over the relatively long period of 12 years. Using data from a sample of 60 different intentional living communities – voluntary groups that generally involved strong ties – we examine which members remained in contact over a decade later. In the intervening years, almost all members left their groups, many dispersed geographically or formed families, and all aged (from mean age 25 to mean age 37). We are interested in determining how these changes affected their interpersonal ties, both in terms of contact, and in terms of friendship choices.

We argue that in both the case of contact, and the case of friendship choice, structural effects are crucial for the retention of ties. When we treat ties as potentially asymmetric choices of friendship (as opposed to contact, which is inherently symmetric), we find that this structure is an inherently hierarchical one. We begin with the more general question of tie persistence, and then distinguish this from the retention of friendship. We then derive hypotheses from the existing literature, then describe the data set, then the methods used, and then proceed to our analyses.

1. Factors affecting tie persistence and decay

Network analysis has developed a number of elegant ways for envisioning or analyzing social networks conceived as static snapshots (most importantly, as binary matrices). Much less is known about the more prosaic social processes whereby ties are formed and broken. In particular, little is known about the retention of social network ties over substantial portions of the lifecourse. But a number of studies have suggested that tie persistence is likely to be affected by *individual* characteristics of the members of any dyad (such as age), by *dyadic* characteristics (such as the intensity of the tie), and by *structural* characteristics (pertaining to the network as a whole). We review the findings of relevant research regarding each in turn, and derive hypotheses that will guide our subsequent investigation. Since we apply these hypotheses to the particular situation of ties that were formed in the context of a number of independent groups, we also discuss group characteristics that may affect tie retention.

1.1. Individual characteristics

There may, of course, be some individual factors stemming from durable personality characteristics that affect the likelihood of retaining ties: for example, one can imagine various traits that strike others as so disagreeable that most people will drop friends possessing them. But since such factors are likely to also affect the formation of ties, they are perhaps less theoretically interesting than are those individual characteristics that change over time, such as those related to stages in the life course. In particular, there is reason to think that in general, marriage and childbearing decrease attachment to previous friends and instead replace these ties with ties to others who are more local (Stueve and Gerson, 1977). Further, having children has generally been found to reduce women's ties to men

and increase their ties to other women and draw the sexes apart in terms of their network structure (Ridgeway and Smith-Lovin, 1999, p. 194; Louch, 2000; Kalmijn, 2002, p. 114). Thus we would expect that those individuals who have married (hypothesis HI-1) and those who have had children (HI-2) since leaving the group will be less likely to retain ties than will similar respondents who have not married and/or had children. Of course, in our case, some of those who have married have married other group members: we will treat these differently. Further, we expect that women's marriage will reduce contact with men other than the woman's spouse (HI-3); we test similar possibilities for men as well.

While it is thus reasonable to expect family formation to decrease tie persistence, this same family formation tends to increase the likelihood that people will affiliate with a religious group, or return after disaffiliation (Argue et al., 1999, p. 424). To the extent that a member's group was a *religious* one, we may expect the results of family formation to be different. Hence we expect that (HI-4) the effects of family formation will be different in religious and non-religious groups.

We also suspect that there may be an age effect, although it is not clear whether age should decrease tie retention (as members shed ties to those from an earlier stage of their life), or increase it (since older people are less likely to take on new, and shed old, voluntary commitments in general (Rotolo, 2000)). Even if the existence of ties was unchanged, age might change the frequency of contact. Hence (HI-5) frequency of contact is expected to vary with age.

1.2. Dyadic characteristics

There are two different types of dyadic characteristics that may affect tie persistence. On the one hand, there are some characteristics of the *relationship* between the two persons that are likely to make the tie persist. On the other hand, there are some *shared individual traits* that may make the tie persist. Taking the latter first, it may be that dyads in which both members share a certain individual trait are more likely to interact than dyads where these members differ, even taking into account their previous relationship quality. One individual attribute that, when shared, may affect frequency of personal contact is simply position in geographical space. It is both intuitively plausible and frequently confirmed that frequency of contact, even among acquainted dyads, tends to decrease with geographical separation (Festinger et al., 1963 [1950]; Fischer, 1982; Fischer and Stueve, 1977, p. 168). Thus we would expect (HD-1) persons who are farther apart to have less frequent contact.

Second, there is evidence that homophilous network ties are more likely to persist (Suitor and Keeton, 1997). By homophily, we mean "liking the like". Lazarsfeld and Merton (1954) distinguished two kinds of homophily. The first turns on likeness of *status*, and the second on likeness of *values*. To some extent, evidence of status homophily may turn out to be a proxy for common interests or tastes, which really falls under the category of value homophily. But even apart from similarities in tastes and interests, there are reasons why we may expect persons of similar status to remain in contact. For one, as Louch (2000) notes, it can simply be harder for individuals who are in different walks of life to remain in contact for a long period of time. From this hypothesis, we predict (HD-2) that persons of similar education, persons in similar family situations (HD-3), and persons of similar age (HD-4) are more likely to be retain ties than are others. The second type of homophily ("value homophily")

turns on likeness of value and personality. We would expect that those who agree more in terms of what they believe (HD-5) will be more likely to retain ties than those who have lower agreement.

There are also characteristics of the relationship as a relationship that we expect will affect persistence. Most obviously, we expect positive relationships to persist, while people who never liked each other all that much will cease regular contact. In other cases, we might also expect age of the relationship to be an effect, but since we have such complete measures of tie quality at time 1, we need not use age as a rough proxy for relationship quality. We thus expect that (HD-6) more positive relationships will lead to greater contact at time 2.

1.3. Group characteristics

Most research on tie persistence has examined either samples of persons, or a single group. In our case, however, we have reports from different groups, and it seems reasonable that there are group-level characteristics that will affect tie retention. These can be divided into those that are a proxy for individual self-selection, and those that pertain to experience within the group. Taking the latter first, it may be that the *time of dissolution* of the group will affect ties; this would be the case if, most simply, we imagine that tie decay begins only after a group dissolves. Groups that dissolved only a short time before the second wave may have concentrated members geographically making it easier for ex-members to find one another. Hence we expect (HG-1) that year of dissolution is positively related to tie retention. Second, groups that had a longer lifespan may have been more successful at involving their members, and hence led to a greater loyalty after dissolution, which should increase contact rates. Hence we expect (HG-2) that contact rates will increase with the length of a group's lifespan.[1]

Finally, it is reasonable to expect that group size may have an effect on contact rates. In particular, if we imagine a relatively low ceiling to the number of friendships one can maintain, then the larger the group, the less likely any one person is to be tied to any other. For example, if all people remain in contact only with their two best friends, we would see, on the dyadic level, a lower average level of contact in larger groups. There may of course be a countervailing force of "critical mass" whereby the larger groups leave enough ex-members in some area to keep them from losing track of each other. While this is of course a real possibility, we still expect that (HG-3) in general, larger groups will tend to have lower contact rates.

1.4. Structural characteristics

We have, so far, considered effects that do not involve any structural features of the network, though it is such structure that has been of greatest interest to social network analysts. It may be that there are structural properties of the network considered as a whole that affect dyadic tie retention, but here we wish to propose a more simple, and intuitively reasonable, dynamic, according to which dyadic tie retention is affected by the *local* structure that

[1] It is conceivable the opposite would happen—the dissolution of a long-lived group would feel more of a failure and leave more wounded feelings and hence decrease contact among ex-members.

surrounds it. In particular, it is a common finding that when a dyad is "embedded" in a set of other friendships, the members are more likely to remain in contact (e.g. Hammer, 1979/1980, p. 173; Hallinan and Hutchins, 1980; Louch, 2000; also see Hummell and Sodeur, 1990; Burt, 2002, p. 344). Indeed, Burt (2000) not only found evidence that local embeddedness increased the retention of ties, but found that this structural effect explained what seemed to be effects of homophily and tie age. Accordingly, we expect (HS-1) that ties between respondents who have more ties in common are more likely to be retained than ties between those with fewer common ties.

It is worth emphasizing two things. First, we are interested here not in triadic effects as a *description* of the structure of the data (as in the exemplary analysis of Lubbers (2003)), but as an explanation of *processes* producing that structure. To illustrate, if there are two types of persons, married and unmarried, we might find that all the married have high contact rates with one another, and all the unmarried have high contact rates with one another, but there is little contact between married and unmarried. In this case, the network would be characterized by high transitive closure, but there would be no triadic effects once we had taken homophily into account. We therefore seek to incorporate such structural effects in models testing individual, dyadic, and group-level effects.

Second, we assume that the importance of structural effects comes from the pattern of triadic ties at time 2, not time 1. That is, we explain the retention of a tie at time 2 as (in part) a possible result of the distribution of other ties at time 2. While it might be possible to conceive of a process in which a time 2 tie would be retained in response to local structure as measured at time 1, such a conception would not be useful for our data, where all ties are present at time 1. We go on to describe the Urban Communes Data Set and the methods used.

2. The data

2.1. The data set

We analyze data from the first and second major waves of Benjamin Zablocki's Urban Commune Project. This data set contains a wealth of information about the members of 60 different intentional communities. Ten communes (defined as having five or more adult members, either not all of the same sex or with at least one child, and with a collective identity known to others) were selected from the largest SMSAs in six of the census bureau's eight major areas in 1974 (for more information, see Zablocki, 1980; we describe the data set only in so far as it is relevant for our purposes). The groups were not picked randomly, but rather to fill certain distributions for key variables such as number of members, ideological type, and age. Thus the sample is multi-stage and weighted (Zablocki, 1980, pp. 14, 69–74, 373), but as the true population distributions are unknown, we treat the sample as if it were a random one. Communes ranged from 5 to around 40 members, with 10 around average.[2] In 1975 and 1976, additional waves of data were collected, leading to a total of 804 persons identified as being in one of the existing groups during at least one of these three years. In the

[2] We note that these data have recently been made public.

first year of data collection, 760 persons were asked about their dyadic relations producing 5432 dyads on which we have information.

In 1986, living respondents who had not withdrawn themselves from the study were contacted and given a set of questionnaires. Of the original 804 members, 15 had died and another 13 had left the continent, leaving 776 potential respondents. Of these, 70 (9%) could not be located, but of the 706 who were located, 693 (98%) were interviewed. Forty-five of these had a pre-test form and 648 the main questionnaire. Of the latter, 503 (78%) returned a valid survey on dyadic relationships. Each respondent (ego) was asked to report on his or her contact with each other member of the group (alter). When we include only those dyads on which we have valid information both in the first year of the survey (1974) and in this 1986 wave, we have 3792 dyads in our data set.

The members of these groups were hardly typical of US society (though the sample is more representative of the age and class distribution of the nation at the time than would be a convenience sample of undergraduates). Further, the processes of tie retention we uncover are likely to be shaped by the context of small group life. Of course, such processes are still of interest even if restricted to similar cases: for example, some power elite theorists (e.g., Mills, 1956, p. 67) emphasized the retention of ties formed in college fraternities. These ties were said to form part of the relational backbone forming the "power elite". But more importantly, the processes of the retention and extinction of ties formed as a group member are likely to be common across many settings and contribute to the overall geography of informal relationships.

One way in which the "random rewiring" that gives rise to the sorts of networks examined by Watts (1999) could take place is through geographical mobility which forces people to drop a portion of the ties made in relatively close-knit settings, such as neighborhoods, extended kin groups, places of employment, schools, and voluntary associations (such as churches), and make new ones. A succession of such moves may produce the high clustering and low path length characteristic of a small world. The typical commune differs from the above list of settings in being generally smaller and generally more involuted, but these are differences of degree, and there is no reason to think that the dynamics involved in the differential retention of ties formed in such groups (as opposed to the differential *formation* of ties) will be fundamentally different. If so, the processes uncovered here, coupled with what we know about differential entry and exit rates into voluntary associations (see Popielarz and McPherson, 1995), may be a major factor in determining the overall distribution of relationships.

2.2. Measures used

Our dependent variables pertain to the relationships between persons in 1986. We have measures both regarding the *quantity* of contact between any two persons, and their perceptions of the *quality* of their relationship. Respondents were asked to report their frequency of contact using a clearly defined seven-point scale (see Appendix A for wording). They also reported (in "yes/no" form) whether they were in phone or mail contact, and whether they considered each other member a friend or a close friend.

We are able to compare these measures of the relationship at time 2 to the relationship at time 1. We have detailed information on the ways in which participants characterized

their relationship at time 1. In particular, we select three measures of positive intensity of the relationship. Our intent was to examine indicators that would point to variations in the quality of a positive relationship. First of all, we examine reports that the relationship was a *loving* one as an indication of relationships that tend towards mutuality (while A may love a B who hates A in return, A is unlikely to characterize this relationship as "loving"). Second, we examine reports that the relationship was *exciting*; such reports are better able than those of "loving" to tap asymmetric relationships, for it is entirely plausible that A would find some B exciting when B does not find A so. Indeed, such asymmetric attributions may be a very good indicator of "admiration" as opposed to friendship. Third, we examine whether ego reported that alter was one of up to five persons (inside or outside the group) that each respondent could name as *significant* in her life, which allows for a measure of strength of tie unaffected by possible ambivalence (for example, the quality of a relationship between ex-spouses still in the same social sphere). For each of these variables, we construct two dummy variables: one which is 1 if *either* member of the dyad gave a positive report, and 0 otherwise, and a second which is 1 if *both* members of the dyad gave a positive report, and 0 otherwise.

Respondents also answered a wide array of belief and attitude items. Of these, 50 that referred to matters of external fact (as opposed to self-conception) were used to measure the general agreement in beliefs between respondents. This was measured as the percentage of those items for which both respondents gave data which they answered in the same direction (both agree, both disagree, or both neutral). Respondents reported on their marital status, number of children, and when they had left the group (assuming that they had by the time of interview). This last was used to determine the time in months since they had exited the group. Finally, their home zipcode was used to create a spatial location measure in latitude and longitude; an algorithm was then used to determine the distance in miles between any two persons.

We determined whether persons were currently married to another group member by scrutinizing the cases in which respondents reported that they were married, and we found that they were in the same zip code as another group member; we also had information on marriages and partnerships over the years that allowed us to resolve every case satisfactorily. Like our respondents, we did not distinguish between legal marriage and committed partnership to someone in the same residence when categorizing respondents as "married to group member," since we expected the results for network tie retention to be similar.

3. Methods

As we shall see below, the reports to our question on frequency of contact appear to be more or less Poisson-distributed. While the underlying events on which the participants report (number of contacts) may have a different distribution, transforming the observed variables to a linear scale (by giving each response category its mean value) produced abnormal clusterings. Further, it seems likely that the actual response process is better approximated by a Poisson process (in which persons progressively move up categories until they find one that seems right) than a threshold-process (which would require that people estimate their frequency of contact first, and then determine which category it fell into).

Accordingly, we model frequency of contact using Poisson regression. When examining data that have a dichotomous response (e.g. phone contact), we use logistic regressions.

However, a complication enters in that our units are dyadic observations, and there is no reason to expect that errors are not correlated across dyads that share the same participants. For this reason, we employ a permutation version of the QAP (Baker and Hubert, 1981; Hubert, 1985; Hubert and Schultz, 1976; Krackhardt, 1987, 1988, 1992) test for dyadic data (we use the non-linear QAP test routines for multiple groups in DAMN (Martin, 1999)). Unlike the case of linear regression, for which OLS regression provides unbiased estimates for network data (although the significance tests are inapplicable), the correlation of errors in network data means that the conditions under which the maximum likelihood estimates are unbiased are not met. But the logic underlying the QAP permutation test is still reasonable—the levels of statistical significance indicate the probability that a value of any particular coefficient this large or larger would be observed if there were no dyadic effects coming from this particular network structure.

There is an additional complication. Because we have multiple groups, and test some variables pertaining to group-level variables, we are in effect testing multi-level models, which have their own correlation-of-errors problems, especially for the contextual (in this case, group-level) variables (DiPrete and Forristal, 1994; Mason et al., 1983). Because the QAP test does not produce a covariance matrix, it is quite difficult to employ existing procedures for incorporating random group-level effects (Bryk and Raudenbush, 1992). Accordingly, we make conservative tests for such group-level variables by employing a fixed-effects model as a final control.[3]

4. Contact

4.1. Distribution and agreement of contact reports

We begin by analyzing reports as to frequency of contact at time 2, because we believe that the nature of the item is relatively unambiguous, and the measurement instrument relatively precise, affording us the best opportunity to test our hypotheses. Fig. 1 displays the marginal results regarding frequency of contact in terms of the number of reported dyads at any level of frequency of contact; each person contributes more than one observation. As we can see, the overall rate of contact is rather low—the median is "a few times since leaving, but less than yearly," and the mean slightly above this category (scored 1). The distribution is somewhat akin a Poisson distribution in that there is a sharp fall off from zero, but the variance is greater than the mean (2.05 versus 1.18).[4]

[3] There are some reasons to expect that maximum likelihood estimations for certain non-linear (e.g. logistic) regressions using dummy variables to estimate fixed effects are inconsistent (Hsiao, 1986, p. 159). Fortunately, this is not true of Poisson regressions (Allison and Waterman, 2002, p. 249), which are used for our most important analyses; further, the problem seems to be minimal as long as there are a reasonable number of cases per clustering unit (Paul Allison, personal communication), which is the case for these data.

[4] While this overdispersion might suggest the applicability of negative-binomial regressions, we have used Poisson regressions for reasons both of convenience and statistical consistency of the fixed effects models. Provisional analyses were repeated with negative binomial regressions and no differences found in the pattern of coefficients.

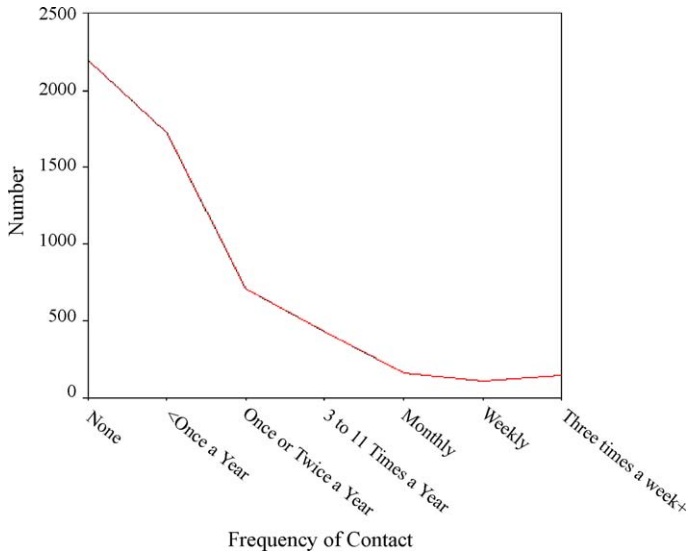

Fig. 1. Distribution of responses to question on frequency of contact.

Of course, these are individuals' reports, and it is reasonable to question the validity of the measure. One way of beginning to examine this question is simply to compare the reports of both members of a dyad for the cases in which both members responded. Table 1 presents this information in a redundant but clear form, giving a cross-tabulation of ego's and alter's responses to the contact question; the table is necessarily symmetric, including both members' reports. First of all, 57.5% of the dyads fall on the diagonal, in that both members gave the same response. Even more impressive, 93.7% of the cases are either on the diagonal or adjacent categories. Thus the overwhelming bulk of responses are in substantial agreement, though the degree of agreement varies, with the least disagreement at the lowest point of the scale and an apparently increasing difficulty of determining contact rates as contact increases.[5] Nevertheless, there are a few cases of serious disagreement where ego and alter did not give the same or adjacent categories in their response; we eliminate these from further analysis in this paper, and go on to examine the factors that predict contact in those dyads in which there is substantial agreement.

4.2. Individual characteristics

We begin by examining whether the individual level characteristics discussed above affect overall contact patterns. We make, for each person, a simple average of her or his contact frequency treated as a seven-point scale. While this is somewhat arbitrary, it turns out that this is strongly associated with intuitively plausible factors, and hence this average is a workable dependent variable. We exclude from this average the contact with a fellow

[5] We thank a reviewer for bringing this point to our attention.

Table 1
Agreement on frequency of contact

Ego's report	Alter's report							
	Never	<1/year	1–2/year	3–11/year	Monthly	Weekly	3+/week	Total
Never	762	292	36	4	2	2	5	1103
Row (%)	69.1	26.5	3.3	.4	.2	.2	.5	100.0
Column (%)	69.1	27.0	7.6	1.2	1.5	2.4	4.5	33.2
Total (%)	23.0	8.8	1.1	.1	.1	.1	.2	33.2
<1/year	292	618	141	26	0	1	2	1080
Row (%)	27.0	57.2	13.1	2.4		.1	.2	100.0
Column (%)	26.5	57.2	29.6	7.9		1.2	1.8	32.5
Total (%)	8.8	18.6	4.2	.8		.0	.1	32.5
1–2/year	36	141	192	95	6	2	4	476
Row (%)	7.6	29.6	40.3	20.0	1.3	.4	.8	100.0
Column (%)	3.3	13.1	40.3	29.0	4.4	2.4	3.6	14.3
Total (%)	1.1	4.2	5.8	2.9	.2	.1	.1	14.3
3–11/year	4	26	95	162	36	3	2	328
Row (%)	1.2	7.9	29.0	49.4	11.0	.9	.6	100.0
Column (%)	.4	2.4	20.0	49.4	26.7	3.6	1.8	9.9
Total (%)	.1	.8	2.9	4.9	1.1	.1	.1	9.9
Monthly	2	0	6	36	64	20	7	135
Row (%)	1.5		4.4	26.7	47.4	14.8	5.2	100.0
Column (%)	.2		1.3	11.0	47.4	23.8	6.3	4.1
Total (%)	.1		.2	1.1	1.9	.6	.2	4.1
Weekly	2	1	2	3	20	38	18	84
Row (%)	2.4	1.2	2.4	3.6	23.8	45.2	21.4	100.0
Column (%)	.2	.1	.4	.9	14.8	45.2	16.1	2.5
Total (%)	.1	.0	.1	.1	.6	1.1	.5	2.5
3+/week	5	2	4	2	7	18	74	112
Row (%)	4.5	1.8	3.6	1.8	6.3	16.1	66.1	100.0
Column (%)	.5	.2	.8	.6	5.2	21.4	66.1	3.4
Total (%)	.2	.1	.1	.1	.2	.5	2.2	3.4
Total	1103	1080	476	328	135	84	112	3318

member with whom the respondent lived as a committed partner or spouse, as well as the few people still residing in a group that had not dissolved.[6]

We enter variables for age and the square of age (since the effects of age are often curvilinear), and a set of dummy variables for current marital status. We combine separated, divorced and widowed into one category, as these turned out to have similar effects. We distinguish between those who are married to a non-commune member (MARRIED OUTSIDE) and those who are married to a commune member (MARRIED INSIDE). We also include a dummy variable for having children. (We alternatively tried a measure of the

[6] Eliminating all of those from groups that survived into the second wave, and not only those members who had not left these groups, does not change our results.

number of children; this made no difference.) Finally, we include a measure of the time (accurate to the month, though the coefficient's scale is years) that the person has been out of the group (TIME OUT), and a second measure of the length of time that person spent in the group (TIME IN). Because the effects of family might be expected to vary by gender, we split the sample and examine men and women separately (models 1 and 2, Table 2).

As we can see, there is no evidence that having a family decreases contact with former members. Indeed, being married to a former member dramatically increases contact with *other* members. While it is true that in general those who have been out of the group for a longer time have decreased contact with other members in the bivariate relation, further analysis demonstrates that this is a spurious result of the fact that those out sooner have in general been in the group for a shorter period. What is significant is the effect of the total length of stay in the group—those who were group members for longer spells later have higher levels of contact with other members.

We can also see that there are no significant differences between men and women, including the difference between slopes (this is ascertained by fitting a single model with interaction coefficients). But as we recall, previous research suggested that the effect of family formation was greatest in terms of decreasing cross-sex friendship ties for women. Accordingly, models 3 and 4 replicate models 1 and 2, but only treating cross-sex contact. The results are unchanged.

Finally, we also suggested that the effects of family formation might be different among religious groups. Model 5, Table 2 pools men and women and replicates models 1 and 2 but only for members of the groups that were religious (Eastern religious or Christian). Once again, the results are unchanged. In sum, for these data, we must reject our hypotheses (HI-1–HI-5) pertaining to the effects of aging and family formation. There is no reason to believe that these are not generally important factors in tie retention, but for these groups, they seem to make no difference. This is not because our measure of average tie strength is invalid; we see that it is strongly associated with the amount of time people spent in their groups.[7]

4.3. Dyadic characteristics

With this understanding of the individual factors associated with contact, we go on to test our hypotheses that pertain to the dyadic level. Here we are examining only the 94% of dyads in which respondents were in substantial agreement as to frequency of contact. In the cases in which there was some difference between members' reports, we took the higher of the two adjacent categories. Since our dependent variable is thus symmetric, all independent variables were converted to a symmetric form. Thus for each item pertaining to relationship quality (e.g. LOVE), we have two dummy variables, one indicating that at least one member characterized the relationship in this way, and another indicating that both members characterized the relationship in this way. We also exclude those groups that had not dissolved at the time of the second wave, as well as any dyads in which the members were currently married or cohabiting as committed partners.

[7] We do, however, note that the lack of variance in age may prevent us from finding a moderate age effect, should it exist.

Table 2
Models for individuals' average contact

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Sample	Female	Male	Female	Male	Religious
Type of tie	All but spouse	All but spouse	Cross-sex only	Cross-sex only	All but spouse
AGE	−.019 (.056)	−.025 (.052)	.045 (.060)	−.030 (.062)	.079 (.066)
AGE-SQUARED	−.000 (.001)	.000 (.001)	−.000 (.001)	.000 (.001)	−.001 (.001)
MARRIED OUTSIDE	−.127 (.133)	−.026 (.113)	−.133 (.143)	−.109 (.135)	−.149 (.123)
REMARRIED	−.149 (.156)	−.156 (.155)	−.141 (.167)	−.045 (.186)	−.144 (.166)
DIV/WID/SEPARATED	−.238 (.132)	−.106 (.136)	−.213 (.128)	−.116 (.164)	−.232 (.139)
MARRIED INSIDE	5.833*** (1.028)	4.643** (1.325)	4.218** (1.497)	5.000** (1.583)	5.914*** (1.602)
HAVE CHILDREN	.005 (.104)	.025 (.102)	.055 (.111)	.033 (.122)	.015 (.110)
TIME OUT	.022 (.036)	.063† (.035)	.031 (.039)	.054 (.042)	.052 (.039)
TIME IN	.129*** (.031)	.141*** (.030)	.129*** (.033)	.132*** (.036)	.123** (.036)
SEX					.137 (.084)
CONSTANT	−.001	.607	−.570	.833	−1.101
R^2	.290	.150	.176	.107	.149
N	267	336	267	336	297

OLS two-tailed tests.
** $p < .01$.
*** $p < .001$.
† $p < .10$.

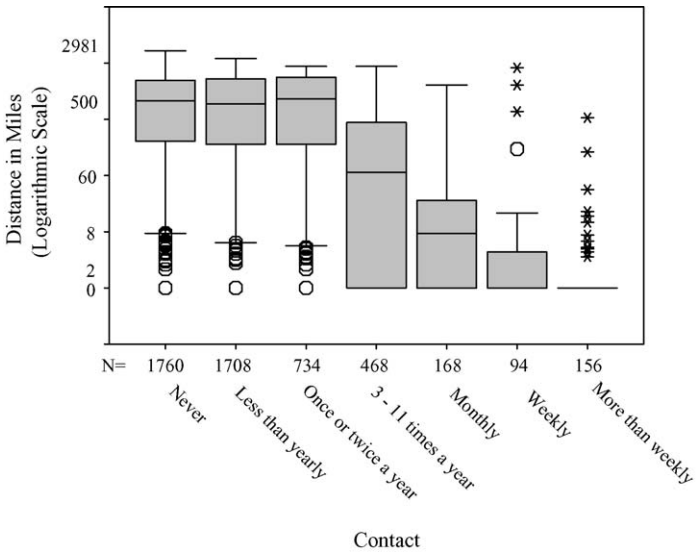

Fig. 2. Contact by distance.

Model 1, Table 3, is a QAP Poisson regression for frequency of contact at time 2 on the quality of the tie at time 1.[8] As we can see, there is indeed evidence that relationship quality at time 1 affects tie retention 12 years later: dyads in which at least one member saw the relationship as loving, or saw the other person as significant in his or her life have significantly higher levels of contact 12 years later. Interestingly, "exciting" is not significant, although other results (not presented) demonstrated that this is significant where persons do *not* agree as to the frequency of contact, a point to which we shall return later. Model 1 demonstrates that these effects of relationship quality at time 1 persist when we control for a past committed (romantic) relationship; thus we are not simply tapping "ex-es" who stay in contact.

Model 2 tests hypotheses HD-1–HD-5 pertaining to status homophily. There are terms for sameness of marital status, childbearing status, gender, and education. Here we enter sameness of education as a simple dummy variable which is 1 if the members of the dyad are in the same educational category[9]; we also examined the absolute value of the difference in education, treating our educational categories as an interval scale, but this simpler form had a stronger relationship to the dependent variables. We also include spatial distance in miles, which turns out to be quite strongly associated with contact. As might be expected, it is quite possible *not* to be in contact with someone close, but very difficult to be in regular face to face contact with someone far away. Fig. 2 shows the distribution in terms of distance for all dyads depending on the contact frequency. (This is a "boxplot" in which the center band is the median, the box encompasses the central 50% of cases, with the "arms" reaching to

[8] The routine we used runs a variable number of permutations until estimates of p-values have "converged"; the number of permutations is reported in our tables.

[9] The categories were none, some elementary, completed elementary, some secondary, completed secondary, some college, completed college, some graduate school, completed graduate school.

Table 3
Models for dyadic contact (non-married, out of commune, in agreement only)

Cluster	Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Relationship quality	LOVE	.073*			.039*	.045*
		[$p = .010$]			[$p = .045$]	[$p = .035$]
	EXCITE	.236			.188	.212
		[$p = .289$]			[$p = .730$]	[$p = .642$]
	SIGNIFICANT	.224*			.096	.079
		[$p = .017$]			[$p = .111$]	[$p = .156$]
	MUTUAL LOVE	.066				
		[$p = .578$]				
	MUTUAL EXCITE	−.014				
		[$p = .131$]				
	MUTUAL SIGNIF	.063				
		[$p = .184$]				
	PAST COMMITTED	.411**			.449**	.416*
		[$p = .003$]			[$p = .009$]	[$p = .014$]
Status homophily	SAME EDUCATION		.041		.065	.065
			[$p = .312$]		[$p = .231$]	[$p = .238$]
	BOTH MARRIED		−.130*		−.188**	−.192**
			[$p = .015$]		[$p = .010$]	[$p = .008$]
	BOTH SINGLE		.306†		.327†	.336†
			[$p = .063$]		[$p = .075$]	[$p = .072$]
	BOTH SEP/WID		−.052		−.398	−.421
			[$p = .577$]		[$p = .111$]	[$p = .103$]
	BOTH HAVE CHILD		.230		.089	.083
			[$p = .116$]		[$p = .556$]	[$p = .551$]
	DISTANCE (×100 miles)		−.031***		−.029***	−.028***
			[$p < .001$]		[$p < .001$]	[$p < .001$]
	BOTH MALE		.103		.137†	.143†
			[$p = .175$]		[$p = .073$]	[$p = .068$]
	BOTH FEMALE		−.027		.034	.028
			[$p = .727$]		[$p = .125$]	[$p = .137$]

Value homophily	AGREE BELIEFS			1.319 [$p = .132$]		
Individual controls	ONE MARRIED IN				.156 [$p = .386$]	.153 [$p = .394$]
	BOTH MARRIED IN				.507*** [$p < .001$]	.549*** [$p < .001$]
	MEAN TIME-IN				.012*** [$p < .001$]	−.005 [$p = .187$]
	DIFFRNT TIME-IN				−.005*** [$p < .002$]	.003 [$p = .270$]
	TIME TOGETHR					.018* [$p = .027$]
CONSTANT		−.210	.332	−.622	−.217	−.213
−2LL		4786.190	3632.892	2864.882	2677.027	2669.551
N		1751	1255	1003	996	996
Permutations		1250	2550	400	6300	3850

QAP one-tailed tests.
* $p < .05$.
** $p < .01$.
*** $p < .001$.
† $p < .10$.

the 5th and 95th percentile.) While there are some dyads that claim regular contact though separated by thousands of miles, these are quite rare.

Other than this distance, which has an eminently practical interpretation, there is no evidence for any of the homophily effects. Indeed, the effect for both members being married is negative. (We do not add terms for individuals' status since we have previously found no evidence of an individual-level effect.) Model 3 regresses contact on dyadic agreement on the belief items in wave 1; there is no evidence of an effect. Since other research with these data have found this measure to have internal validity (e.g., Martin, 1997), this absence of an effect does not seem to be because of excess noise in the measure. Because incorporating this variable substantially decreases the number of valid cases, we omit it from further consideration.

It is worth emphasizing that the lack of explanatory power of homophily on tie-retention in no way should be taken as indicating that the ties do not themselves tend towards high homophily, indeed, towards high value homophily. Given the self-selective nature of these groups, we may expect an extremely high floor for homophily across all dyads. But it seems that homophily here (and perhaps elsewhere) has more of an effect on tie creation than on tie retention.

Thus so far we have seen evidence that the quality of the relationship at time 1 is related to tie retention, though homophily is not. Model 4 now enters both these sets of terms, as well as controls for the factors we have found to be related to contact at the individual level, namely being married to a group member, and time spent in the group. Since we have two reports, we have two variables for each of these. (We omit the variables tapping mutuality of relationship from further consideration, because they lack any predictive power.) The effects of marriage to another group member is parameterized like the relationship variables: we have one dummy variable indicating that at least one of the members was married to another group member (ONE MAR-IN) and a second indicating that both members were married to another group member (BOTH MAR-IN).[10] We parameterize the effects of time spent in the group through an average of the two's membership duration, and an absolute value of the difference between their two scores. As we can see, including these terms does not affect our previous results (with the exception that SIGNIFICANT is no longer significant in the statistical sense), though the importance of these individual level variables is confirmed. It appears that being married to a group member is most likely to increase contact with *other* members who are married to group members; we may envision a small but dense clique of contact among the ex-members who have involuted social relationships.

Turning to the effects of time spent in the group, we find that the greater the average time in the group, the greater the contact, but the greater the *difference* between the two, the less the contact. This suggests that what we may be picking up is actually a dyadic effect whereby those who had a greater degree of *overlap* in terms of their membership duration are more likely to remain in contact. Model 5 enters the number of months during which both members were in the group, and confirms that this is the case: this measure is significant, while the previous individual controls were not. (Accordingly, future models use this TIME TOGETHER variable instead of the MEAN TIME-IN and DIFFERENT TIME-IN variables.)

[10] Recall that the two members cannot be married to each other; these dyads are eliminated from analysis.

4.4. Structural characteristics

Our hypothesis HS-1 holds that members of dyads that are embedded in high-contact subnetworks will be more likely to be in contact. Thus if A has high contact with C, and C has high contact with B, A is more likely to be in contact with B. We computed a measure of the "embeddedness" of each dyad as follows: If x_{ij} is the contact between persons i and j, then the "embeddedness" of the (i, j)th dyad is simply $\sum x_{ik}x_{kj}$ over all k. This multiplicative form gives those cases in which i and j are in very regular contact with some k a much higher degree of embeddedness than cases in which i and j are in sporadic contact with many k's, which seems theoretically quite reasonable. We consider this quantity a fixed dyadic level attribute for the purposes of the permutation test; that is, like the other independent variables, it is not recomputed for each permuted matrix. Further, because a single missing value will make an entire row or column missing given the nature of matrix multiplication, we recode missing values to zero here; results were not appreciably different when we excluded dyads with missing values and ran the analyses for the subset of cases that remained.[11]

Model 6, Table 4, enters this term (EMBEDDEDNESS) and finds it highly significant. But it is quite possible that it is not being embedded in triads of frequent contact that brings two members together—it is simply having mutual friends (whether or not they are in frequent contact). Accordingly, model 7 adds terms for the number of common friends, and the number of common close friends, that ego and alter have.[12] Both these terms are related to the frequency of contact; the number of common close friends having a stronger relationship. But the EMBEDDEDNESS coefficient remains significant: it appears that, even controlling for distance (in model 8) and the number of mutual friends, there are strong triadic effects of contact itself. Person A is likely to be in more frequent contact with person B for every C whom both A and B see regularly.

4.5. Group characteristics

Of course, it is still entirely possible that these structural effects are a spurious recasting of the importance of group *size*: since larger groups will have more persons with whom one *can* be in contact, if larger groups also tended to have members who remained in contact, we might see the structural effects above (though see Louch, 2000). Accordingly, model 8 adds group size to all the other variables previously employed. We also add measures of the group's lifespan, and the time since the dissolution of the group.

Size, as we can see, has no effect, but the date of group death is significant: the longer it has been since the group dissolved, the less likely people are to remain in regular contact. Group lifespan has a negative relationship with contact: longer lived groups have members who have lower levels of contact, not higher levels. While this might first seem surprising, it is worth emphasizing that this negative effect is *net* of the time the two persons overlapped in the group, which is the most reasonable mechanism that would connect group lifespan

[11] The only difference pertained to the effect of the term for the number of friends the members of the dyad have in common, discussed below.

[12] Here we treat any two members as friends or close friends if either gives such a report.

Table 4
Models for dyadic contact (non-married, out of commune, in agreement only)

Cluster	Variable	Model 6	Model 7	Model 8	Model 9
Relationship quality	LOVE			.120**	.106
				[$p = .004$]	[$p = .190$]
	EXCITE			−.027*	.054
				[$p = .045$]	[$p = .302$]
	SIGNIFICANT			.107†	.153†
				[$p = .084$]	[$p = .052$]
	PAST COMMITTED			.550***	.391*
				[$p < .001$]	[$p = .022$]
Status homophily	SAME EDUCATION			.030	.029
				[$p = .223$]	[$p = .357$]
	BOTH MARRIED			−.195	−.138
				[$p = .009$]**	[$p = .172$]
	BOTH SINGLE			.153	.088
				[$p = .292$]	[$p = .250$]
	BOTH SEP/WID			−.332	−.273
				[$p = .109$]	[$p = .182$]
	BOTH HAVE CHILD			−.140	.074
				[$p = .189$]	[$p = .309$]
	DISTANCE (×100 miles)			−.020***	−.020***
				[$p < .001$]	[$p < .001$]
	BOTH MALE			.124†	.145†
				[$p = .088$]	[$p = .081$]
	BOTH FEMALE			.059	.018
				[$p = .153$]	[$p = .418$]
Individual controls	ONE MARRIED IN			.215	.243*
				[$p = .211$]	[$p = .046$]
	BOTH MARRIED IN			.827***	.644**
				[$p < .001$]	[$p = .004$]
	TIME TOGETHR			.007***	.007**
				[$p < .001$]	[$p = .003$]
	EMBEDDEDNESS	.025***	.019***	.022***	.022***
		[$p < .001$]	[$p < .001$]	[$p < .001$]	[$p < .001$]

Structural	COMMON FRIENDS		.064***	.047	.098**
			[$p < .001$]	[$p = .294$]	[$p = .005$]
	COMMON CLOSE FRIENDS		.248**	.107	.116*
			[$p = .002$]	[$p = .320$]	[$p = .042$]
Group	GROUP SIZE			−.012	−.044
				[$p = .872$]	[$p = .283$]
	GROUP DEATH (×100 months)			−.024**	−.518
				[$p = .002$]	[$p = .743$]
	GROUP LIFESPAN (×100 months)			−.173***	−3.014
				[$p < .001$]	[$p = .754$]
Fixed effects coefficients					Suppressed
CONSTANT		−.378	−.518	−.273	1.409
−2LL		5396.912	5235.220	2418.971	980.509
N		2138	2138	1001	1001
Permutations		500	500	4450	9250

QAP one-tailed tests.
* $p < .05$.
** $p < .01$.
*** $p < .001$.
† $p < .10$.

and later dyadic contact. (The zero-order correlation between lifespan and contact is weakly positive, $r = .049$.) The other effects are largely unchanged.

We noted above that our data were actually collected in clusters (groups), but that the estimation procedure did not correct for this. Our only recourse is a "fixed-effects" model that enters a dummy variable for every group. Such a model might demonstrate that results previously considered to be indicative of dyadic or triadic phenomena are really indicative of group-level phenomena. For example, the "embeddedness" effect might simply be due to certain groups having, for whatever reason, a very high degree of average contact. They would contribute dyads that both had a high degree of contact, and were embedded in triadic structures of high contact.

We thus attempt to determine whether our findings are truly *dyadic* effects by fitting such a model. While our three group-level variables (size, date of dissolution, and lifespan) are no longer likely to have any particular meaning, we retain them to maximize comparability across models (this requires dropping three group-level dummies). Model 9, Table 4 presents the results from such a fixed effects model, though suppressing the many coefficients pertaining to group-level effects. As we can see, our main results are not greatly changed. While the effect of LOVE is no longer statistically significant, it does not change in magnitude; the coefficient for SIGNIFICANT actually increases. The anomalous finding regarding the negative effect for BOTH MARRIED decreases to the point at which it is not significant, but DISTANCE remains significant. The effect of TIME TOGETHER remains, and, most importantly, the coefficients for the structural effects remain large and statistically significant. Evidently, it is not the case that the structural effects are really due to group-level heterogeneity.

To summarize, we have found that probability of contact depends chiefly upon two factors. The first is prosaic: ease of contact (the inverse of distance). The second is more theoretically interesting, and this is the embedding of the relationship in past and present social contexts. Regarding the past, we find that those who had a *previous* committed partner relationship were far more likely to remain in contact than those who did not. Further, the longer the time the members of the dyad were in the group together, the greater their subsequent contact.

Regarding the present, we find that those who are married to group members are far more likely to be in contact with one another than those who are not. We also find significant triadic effects: those with common contacts are far more likely to be in contact with one another than those who lack such common contacts. We do not know whether each network sheds peripheral members, or whether they disintegrate into multiple islands of contact, but we get the impression of a tendency towards clustering, perhaps around the most "group identified" ex-members: those whose spouses or partners were also from the group.

4.6. Alternate measures

We saw that there was some disagreement between dyad members as to their frequency of contact (on differences in tie reporting, see recently Feld and Carter, 2002). Could it be that the results above are affected by this response error due to difficulties in answering a question about frequency of contact? We replicated these models using a different measure

of contact, namely the dichotomous response to the question, "do you and X ever get together by plan?" The results were, somewhat surprisingly, basically identical (analyses available upon request).

Even with this alternate item, we are still investigating interpersonal contact between people who have been dispersed in geographical space; we have, understandably, in both cases found distance to be a strong factor predicting contact. But it might be that in addition to spatial dispersal making distance an important factor in contact, it affects other aspects of tie retention. In this case, our results might not be generalizable to situations in which contact does not require face to face copresence. We were fortunately able to replicate these analyses with telephone contact as a dependent variable (analyses available upon request). Certainly we might expect to see the effects of distance being zero or even positive, as people were more likely to call those far away than see them in person. In fact, the results are substantially unchanged, including the strong negative effect of distance. This should not be surprising: as Fischer (1992) has emphasized, contrary to claims that the telephone is a substitute for, or even weakens, face to face contact, the phone is quite frequently used to coordinate face to face contact.

Thus the results here do not seem to depend on the precise way in which contact is specified. However, we have only been examining contact. Frequently network researchers are interested in the persistence of ties even in the absence of contact. Most importantly, friendship as subjectively perceived may be somewhat independent of contact. We go on to investigate friendship at time 2.

5. Friendship

5.1. Dyadic effects

Recall that the survey instrument asked each respondent to indicate for each other member whether the respondent considered alter a "friend" or a "close friend". Here we will analyze the latter, though results using the former are similar though weaker in magnitude (analyses available upon request). It is important to note that while all members were in contact at time 1, and hence our time 2 measures were indeed measures of persistence, not all members were friends with each other at time 1, and hence we are not examining persistence of friendship. While a great deal of information was collected on relationship quality at time 1, respondents were not asked about "friendship" (which would probably have struck most as too superficial a term given the context of communal living). Instead of arbitrarily deciding who was and who was not a friend at time 1, we will include all dyads, and replicate our analyses of Tables 3 and 4 to determine whether our results are changed when we examine not contact, but friendship at time 2.

Our first models are presented in Table 5. Since our dependent variable is now an asymmetric dichotomy, we use logistic QAP regressions separating ego's and alter's responses for any dyad. Models 1 and 2 demonstrate that our conclusions for friendship are almost identical to those reached when examining contact. Those in which either member loved the other or found the other significant at time 1 are more likely to be close friends at time 2 (Model 1). Dyads where both are married are less likely to be close friends, and the odds

Table 5
Models for ego reported close friendship (non-married, out of commune, in agreement only)

Cluster	Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Relationship quality	EGO LOVE	.411**			.213*	.151*
		[p = .002]			[p = .023]	[p = .049]
	EGO EXCITE	.533			.670†	.839*
		[p = .107]			[p = .086]	[p = .048]
	EGO SIGNIFICANT	.557*			.401	.028
		[p = .029]			[p = .189]	[p = .563]
	ALTER LOVE	.159*			−.005	.268*
		[p = .035]			[p = .925]	[p = .035]
	ALTER EXCITE	.088			.191	−.129
		[p = .832]			[p = .634]	[p = .160]
	ALTER SIGNIFICANT	.620*			.683*	.726*
		[p = .013]			[p = .018]	[p = .033]
	PAST COMMITTED	.589†			.282	.403
		[p = .068]			[p = .257]	[p = .279]
Status homophily	SAME EDUCATION		.136		.246	.103
			[p = .227]		[p = .177]	[p = .344]
	BOTH MARRIED		−.574**		−1.156***	−1.182**
			[p = .001]		[p < .001]	[p = .001]
	BOTH SINGLE		−.056		−.170	−.195
			[p = .377]		[p = .289]	[p = .280]
	BOTH SEP/WID		−.845		.582	−.892
			[p = .140]		[p = .301]	[p = .228]
	BOTH HAVE CHILD		.425*		.477	.123
			[p = .453]		[p = .271]	[p = .615]
	DISTANCE (×100 miles)		−.032*		−.042**	−.027*
			[p = .034]		[p = .005]	[p = .046]
	EGO MALE, ALTER FEMALE		.181		.035	.144
			[p = .252]		[p = .471]	[p = .291]
	BOTH FEMALE		.408*		.407*	.313†
			[p = .028]		[p = .041]	[p = .061]
	BOTH MALE		.029		.056	.099
			[p = .521]		[p = .428]	[p = .386]

Value homophily	AGREE IN BELIEFS			−7.171 [$p = .221$]		
Individual controls	EGO MARRIED IN					.824 [$p = .185$]
	ALTER MARRIED IN					.347 [$p = .515$]
	BOTH MARRIED IN					.255† [$p = .052$]
	EGO TIME-IN					.002 [$p = .320$]
	ALTER TIME-IN					−.001 [$p = .366$]
	ALTER REPORTED CLOSE					2.406*** [$p < .001$]
CONSTANT		−2.906	−2.071	−1.931	−2.488	−3.258
−2LL		1242.549	1323.528	1127.945	824.257	540.354
N		1737	2019	1485	1186	912
Permutations		5950	750	100	4550	8350

QAP one-tailed tests.
* $p < .05$.
** $p < .01$.
*** $p < .001$.
† $p < .10$.

of being close friends decreases with distance. Interesting, replication using weak friendship ("friend" as opposed to "close friend") does not lead to a significant effect of distance (results available from the authors). It is worth pointing out that it is reasonable to expect the opposite—that old, close friendships are the kinds of things that can weather geographical separation, while weaker ties would snap (see Fischer, 1982, p. 173). Finally, model 3 shows that agreement in beliefs at time 1 does not predict friendship at time 2. Model 4 enters the terms from models 1 and 2 jointly, as well as terms for the sex composition of any dyad, but this does not affect our conclusions.

In model 5, we add individual level controls and a reciprocity effect: that is, alter choosing ego as a close friend. When we do, there is one important result not seen in the models for contact. That is that the coefficient for ego seeing alter as exciting in time 1 increases and is significant. Earlier we made reference to analyses that showed that the term for ego seeing alter as exciting predicted reported contact where the members *disagreed* about their frequency of contact. It seems, then, that this finding is consistent with an interpretation of this item as tapping distinctly asymmetric relationships. In other words, when we consider those dyads where ego nominates alter as a close friend but alter does not reciprocate ego's feelings (by including a term for reciprocation), ego is more likely to see alter as exciting. This dynamic may explain the disagreement seen in contact reports: if alter was a more dynamic and/or likable person than ego, it is reasonable that ego would both over-state (at least in comparison to alter) the amount of time spent together, and report that his or her relationship with alter was exciting, while alter would not. This suggests that we may need to be attentive to a possible vertical hierarchy of the members. We go on to explore this when looking at structural effects.

5.2. *Structural effects*

When examining contact, which was necessarily symmetric, triadic effects were quite simple—any third party could only have a certain amount of contact with either ego or alter. Our structural hypothesis (HS-1) was of a simple form both mathematically and theoretically, as we were unable to separate substantively different triadic effects. For example, there can be very practical reasons why if A and C are both tied to B, A and C may be more likely to retain a tie: each may see the other in B's presence or B may help them to remain in touch. But when we look at structural embedding given a potentially asymmetric relationship such as "nominates as a friend," we are less likely to find practical imperatives explaining triadic effects than for the case of contact, and we have more possible triadic configurations. In fact, there are nine different ways that ego and alter may be joined by relations to a third party, because there are three directions of each of the two relationships, leading to nine possible patterns.[13] Now we cannot rely on a simple idea of a tendency towards triadic closure, but must reconsider the reasons why different configurations might

[13] There are only nine patterns as opposed to the well-known 16 triad types because we are not interested in triads which do not involve a third party to whom both ego and alter are tied. For our purposes, it is not necessary to carry out a complete specification of the dependence structure as might be done with a p^*-type model (since we use a QAP test to determine significance). A p^*-type triadic model was applied to the data (results available from the authors), but there are estimation problems in combining the p^* model with the covariates.

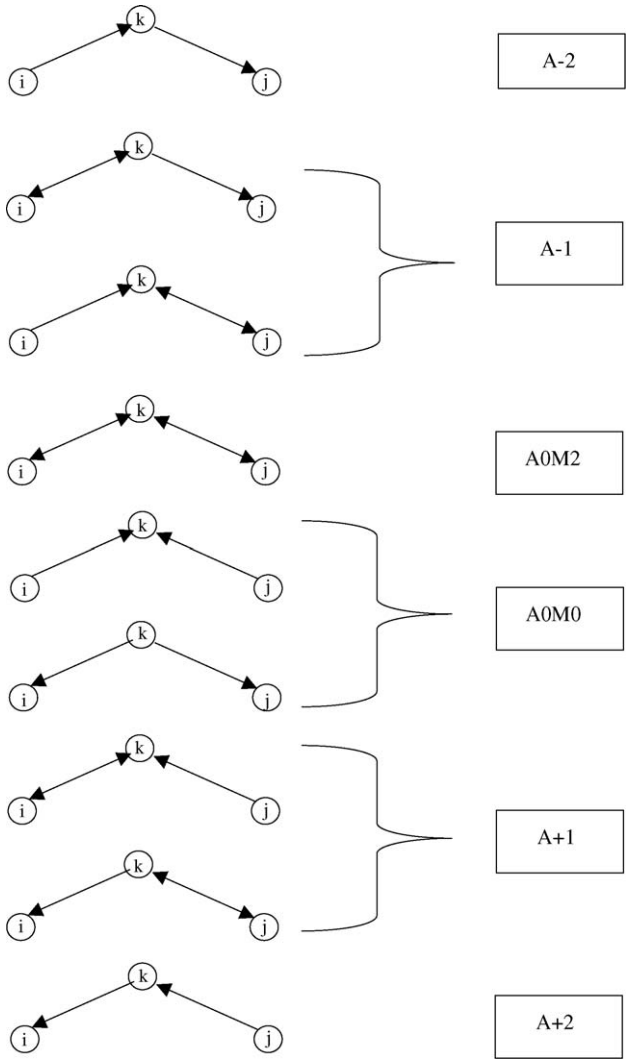

Fig. 3. Triadic configurations.

have effects on the probability of a tie between ego and alter. These different possible third party effects are portrayed in Fig. 3.

But these nine different formations may not have nine different sociological meanings. We propose to consider on a priori grounds which configurations should be combined by focusing on whether the relationships with the third party imply a comparison of the attractiveness of *i* and *j*. Let us take the first pattern: where *i* chooses *k* and *k* chooses *j*. We can see *j* as being "two steps" above *i* by these two unreciprocated choices, implying that *j* is a very attractive person, at least to people like *i*. We would thus imagine *i* very likely to

consider *j* as a friend. We label this A−2 meaning that ego is two steps below alter. In the next two configurations, there is only one unreciprocated relationship, which implies that *j* is only "one step" above *i*. Since we see no reason why one of these configurations would have a different effect from the other, we have collapsed them as a single effect, which we label A−1, meaning that ego is one step below alter.

The contrary occurs when *i* is one or two steps *above j*; we propose that this makes *i* less likely to choose *j*. (These are labeled A+1 and A+2, respectively.) What about when the relationship with *k* does not imply a hierarchical relation between *i* and *j*? There are two ways in which this can occur. First of all, it may be that both *i* and *j* have mutual relationships with *k*. We label this configuration A0M2 meaning that *i* and *j* are 0 steps apart and are connected by two mutual relations. Such a configuration suggests the possibility of a clique, which would make it seem that *i* and *j* are much more likely to each choose one another. The other ways that *i* and *j* can be connected by some *k* without any implication of hierarchy between them are (on the one hand) that both *i* and *j* choose *k*, or (on the other) both are chosen by *k*. We combine these two effects and term them A0M0 since *i* and *j* are 0 steps apart and are connected by 0 mutual relations. We do not expect this to have any effect on *i* and *j*'s likelihood of forming a tie.

Once again, we can use simple matrix multiplication to count up, for any dyad, the number of third parties producing these configurations.[14] We then enter these in model 6, Table 6; model 7 adds the effect for reciprocity. The results are quite strong and clear: the more alter is above ego, the more ego is likely to choose alter as a friend. There is a A0M2 "clique" effect in model 6 – that is, being embedded in a set of mutual relationships – but it appears to be a mutuality effect in that once we take alter's choice of ego into account, it is not significant (see model 7). Thus there is evidence of strong structural effects in these long term friendships.[15]

Of course, it could be that these are really due to earlier relationship quality—for example, some nice persons are really worthy of love, and so it is the former relationship being maintained, and not the structural pattern, that accounts for the effect we attribute to relationships with third parties. But if we now combine the structural effects with the effects in models 1–5 (model 8), we find little evidence of relationship quality at time 1 having any independent weight. (Model 9 is a fixed effects model parallel to model 9, Table 4; again, our results are unchanged.) In other words, the current structure seems to soak up what originally appeared as something specific to this particular relationship.

This has a fascinating implication. Rather than relationship quality at time 1 affecting later friendship because people who were close at time 1 are likely to "remain" close at time 2, it may be that the relation between time 1 relationship quality and time 2 relationship

[14] As before, we treat missing values as 0 to avoid losing too many cases.

[15] It is important to note that while both the dynamics discussed here – hierarchy and cliquing – are compatible with mathematical transitivity (that is, *aRc* if *aRb* and *bRc*), the findings here cannot be subscribed under the single concept of transitivity. One will note that the effects for A+2 and A−2 are stronger than those for A+1 and A−1, respectively, although all are equally transitive triads when ego chooses alter. If we assume that alter does not reciprocate (reasonable, since we later control for this separately), then, for example, A−2 leads to the 030T triad and A−1 leads to either the 120U or the 120D triad, both also transitive. Thus while both strong cliquing due to mutuality and a hierarchical ranking of persons imply a set of relations that possesses transitivity, the reverse is not true (for example, a set of unconnected nodes is vacuously transitive).

Table 6
Models for ego reported close friendship (non-married, out of commune, in agreement only)

Cluster	Variable	Model 6	Model 7	Model 8	Model 9
Relationship quality	EGO LOVE			−.011	−.082
				[$p = .877$]	[$p = .739$]
	EGO EXCITE			.864†	.850†
				[$p = .060$]	[$p = .063$]
	EGO SIGNIFICANT			.325	.340
				[$p = .185$]	[$p = .151$]
	ALTER LOVE			.333*	.267†
				[$p = .022$]	[$p = .065$]
	ALTER EXCITE			−.125	−.149
				[.169]	[$p = .160$]
	ALTER SIGNIFICANT			.501	.523
				[$p = .128$]	[$p = .100$]
	PAST COMMITTED			.517	.404
				[$p = .198$]	[$p = .261$]
Status homophily	SAME EDUCATION			.207	.175
				[$p = .287$]	[$p = .362$]
	BOTH MARRIED			−1.255***	−1.353***
				[$p < .001$]	[$p < .001$]
	BOTH SINGLE			−.285	−.229
				[$p = .259$]	[$p = .240$]
	BOTH SEP/WID			−1.569	−1.705
				[$p = .999$]	[.999]
	BOTH HAVE CHILD			.035	.062
				[$p = .667$]	[$p = .628$]
	DISTANCE ($\times$100 miles)			−.030*	−.027*
				[$p = .038$]	[$p = .049$]
	EGO MALE, ALTER FEMALE			.058	.063
				[$p = .402$]	[$p = .409$]
	BOTH FEMALE			.360†	.315†
				[$p = .071$]	[$p = .088$]
	BOTH MALE			.042*	.053
				[$p = .434$]	[$p = .469$]
Individual controls	EGO MARRIED IN			.594	.551
				[$p = .301$]	[$p = .325$]
	ALTER MARRIED IN			.435	.406
				[$p = .424$]	[$p = .433$]

Table 6 (*Continued*)

Cluster	Variable	Model 6	Model 7	Model 8	Model 9
	BOTH MARRIED IN			.777**	.899**
				[$p = .001$]	[$p = .003$]
	EGO TIME-IN			.003	.007
				[$p = .257$]	[$p = .110$]
	ALTER TIME-IN			−.003	.001
				[$p = .232$]	[$p = .379$]
	ALTER REPORTED CLOSE		3.349***	2.618***	2.527***
			[$p < .001$]	[$p < .001$]	[$p < .001$]
Structural	A−2	1.723*	1.890*	2.026***	2.014**
		[$p = .016$]	[$p = .021$]	[$p < .001$]	[$p = .003$]
	A−1	1.585**	1.834***	1.932***	1.875***
		[$p = .008$]	[$p < .001$]	[$p < .001$]	[$p < .001$]
	A0M0	.724	.487	.747†	.768
		[$p = .189$]	[$p = .402$]	[$p = .078$]	[$p = .178$]
	A0M2	1.924**	1.021	.991	.982
		[$p = .002$]	[$p = .441$]	[$p = .513$]	[$p = .473$]
	A+1	.338	−.941***	−.856*	−.867*
		[$p = .964$]	[$p < .001$]	[$p = .019$]	[$p = .016$]
	A+2	−.245†	−1.704*	−1.816	−1.723
		[$p = .086$]	[$p = .015$]	[$p = .991$]	[$p = .901$]
Group	GROUP SIZE				.025†
					[$p = .053$]
	GROUP DEATH (×100 months)				−.060
					[$p = .284$]
	GROUP LIFESPAN (×100 months)				−.658†
					[$p = .085$]
CONSTANT		−2.585	−3.131	−3.580	−3.362
−2LL		1829.733	964.545	478.748	474.280
N		3102	1934	912	912
Permutations		1800	1350	4050	10000

QAP one-tailed tests.
* $p < .05$.
** $p < .01$.
*** $p < .001$.
† $p < .10$.

status is due to time 1 relationship quality being a rough indicator of ego's and alter's later feelings about each other, simply because *both* sets of measures regarding relationship quality were really based on the positions of ego and alter in a hierarchical structure. To the extent that their positions in this hierarchy have not changed, earlier relationship quality will appear to be related to later relationship quality. And yet what we began understanding in terms of the content of relationships may be more parsimoniously understood as a structural effect.

6. Conclusion

Let us summarize our main conclusions. We have examined the persistence of long-term relationships among persons who formed themselves into communities. First of all, contrary to our expectations, we did not find these relationships to be eroded by family formation. Even cross-sex friendships seemed to survive ex-members getting married and having children.

Second, distance matters. It not only decreases the regularity of contact, it makes people less likely to consider themselves close friends. Since it does not affect weak friendship, we may presume that while some very strong ties may survive all sorts of geographical barriers, in general, repeated contact is necessary for people to feel that they are maintaining a close friendship. It is important to stress that we expected the opposite—that weaker friendships would be affected by distance, while true old friendships would survive. Of course, that might still be true, but it is more parsimonious to imagine that contact is needed to maintain strong friendships.

Third, while it seems that groups that lasted longer produce ex-members with more ties – perhaps they were happier, more successful groups – this seems to be reducible to an extremely prosaic dyadic effect. The longer two people were in co-residence, the more likely they are to retain ties afterwards. Long-lived groups are just good environments for people to have the time to form lasting friendships.

Fourth, structural embeddedness matters—and it matters even when we taking homophily and distance into account, as Burt (2000) has also found (though also see van de Bunt et al., 1999). There seems to be a fundamental non-independence of ties: ties are more likely between people already implicitly connected via third parties who are in contact. Structural embeddedness increases contact, as does reciprocity.

Most interestingly, when we consider relationships that have an asymmetric component, we cannot understand this structural embeddedness without allowing for the presence of hierarchy among the members. We can envision our triadic structural effects in two ways. First of all, they may refer to constellations of interaction which may affect ties by affecting behavior. According to this scenario, person i visits person k frequently and sees person j there repeatedly, cementing a relationship between i and j. But second, these may be indicators of a more global patterning to the position of persons—i chooses j, j chooses k, and i chooses k because k is a more attractive person than i or j and everyone knows it. It is easy to imagine such global arrangements when persons are close together (living in the same group, working in the same office). It is fascinating to find evidence that they exist among persons spread out in many cases over hundreds of miles.

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Appendix A

The wording of the variable used to measure time 2 contact was as follows:

"For each of the people you lived with communally, please indicate how often you see each other. We see each other . . .

Category	Score
1. Not since we lived together in the communal house	0
2. OCCASIONALLY	
a. Less than once a year	1
b. Once or twice a year	2
3. FREQUENTLY	
a. Three times a year or more BUT not usually every month	3
b. Usually at least once a month BUT not every week	4
4. VERY FREQUENTLY	
a. Once or twice a week	5
b. Usually three or more times each week"	6

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