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ORIGINAL ARTICLE

Networks, Space, and Residents' Perception of Cohesion

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Abstract Community scholars increasingly focus on the linkage between residents' sense of cohesion with the neighborhood and their own social networks in the neighborhood. A challenge is that whereas some research only focuses on residents' social ties with fellow neighbors, such an approach misses out on the larger constellation of individuals' relationships and the spatial distribution of those relationships. Using data from the Twin Communities Network Study, the current project is one of the first studies to examine the actual spatial distribution of respondents' networks for a variety of relationships and the consequences of these for neighborhood and city cohesion. We also examine how a perceived structural measure of cohesion—triangle degree—impacts their perceptions of neighborhood and city cohesion. Our findings suggest that perceptions of cohesion within the neighborhood and the city depend on the number of neighborhood safety contacts as well as on the types of people with which they discuss important matters. On the other hand, kin and social friendship ties do not impact cohesion. A key finding is that residents who report more spatially dispersed networks for certain types of ties report lower levels of neighborhood and city cohesion. Residents with higher triangle degree within their neighborhood safety networks perceived more neighborhood cohesion.

Keywords Cohesion · Neighborhoods · Space · Social Networks

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Introduction

Given that residents spend so much time in their own neighborhoods, it is not surprising that social science studies have frequently examined the extent to which residents might perceive a sense of attachment to, or cohesion with, the local neighborhood and why some residents feel a stronger sense of such attachment than others (Friedkin 2004). Community scholars also increasingly focus on the linkage between residents' sense of cohesion with the neighborhood and their own social networks in the neighborhood (Felton and Shinn 1992; Moody and Paxton 2009). A challenge is that whereas research often focuses only on residents' social ties with fellow neighbors, such an approach misses out on the larger constellation of individuals' relationships. Individuals' relationships extend beyond their fellow neighbors, and the relationship between ties to fellow neighbors and ties more generally is not well understood.

There is also reason to suspect that the spatial distribution of networks may impact the structure of neighborhood networks, which then may have consequences for residents' sense of cohesion and attachment with the neighborhood (Butts et al. 2011). Broadening the lens to

focus on social ties beyond those explicitly among neighbors also implies the need to focus on various types of social relationships, given that different relationships may differentially affect the spatial footprint of residents' social networks. This spatial pattern arguably has consequences for the level of attachment and cohesion among residents in a neighborhood, and explicitly linking the structural characteristics of networks to individual perceptions of cohesion is needed.

We address this need by examining a variety of relationships to understand which ties are important for a resident's sense of cohesion while simultaneously accounting for the geographic distribution of those ties. Using data from the Twin Communities Network Study (TCNS), this project moves beyond individual and dyadic conceptualizations of networks to examine how higher order perceived structural network measures, such as triangle degree, impact a resident's perception of cohesion with their community. We also assess whether these structural network properties differentially affect their attachment to the local neighborhood compared to their attachment to the broader city.

Networks and Perceptions of Neighborhood Cohesion

The community psychology literature has long explored the determinants of neighborhood cohesion and attachment on the part of residents. An important concept in the community psychology literature is "sense of community" as advanced by McMillan and Chavis (1986). This concept of *sense of community* is broader than the notion of *cohesion*, and they proposed four dynamically interrelated elements: (1) membership; (2) influence; (3) integration and fulfillment of needs; (4) shared emotional connection. These dimensions are often measured using behavioral measures, rather than asking residents to report on their own perceptions. Numerous studies have empirically assessed this perspective including an entire special journal issue (Chavis and Pretty 1999). Research has studied sense of community in low income, predominantly Black communities in Baltimore (Brodsky et al. 1999), a sample of white middle- to upper-middle class neighborhoods (Chipuer and Pretty 1999), neighborhoods in Baltimore (Martinez et al. 2002), in community organizations (Peterson et al. 2008a, b), and various communities in southeast Queensland (Obst et al. 2002). Although these studies have shown empirical support for sense of community, one of the few studies subjecting the sense of community index to a confirmatory factor analysis found that it did not exhibit a satisfactory fit (Long and Perkins 2003), and instead proposed a briefer version with just three dimensions: (1) social connections; (2) mutual concerns; (3) community values. More recently, Peterson et al. (2008a, b) developed and validated a brief sense of community measure that more closely aligns with McMillan and Chavis (1986) four element approach.

Although the community psychology literature has largely focused on sense of community, a body of literature in social psychology has focused on the notion of a sense of cohesion within groups or communities, and the related notion of place attachment. A consistent theme that emerges from this literature are the twin key concepts of cohesion and social satisfaction. For example, McDougall noted that "The development of the group spirit consists in two essential processes, namely, the acquisition of knowledge of the group and the formation of some sentiment of attachment to the group" (McDougall 1920, p. 86). Indeed, Hogg (1992) points out that a factor analysis of 19 different measures of cohesiveness by Hagstrom and Selvin (1965) yielded the distinct factors of social satisfaction and cohesion (measured sociometrically based on within group ties). Bollen and Hoyle (1990) followed this notion and proposed that cohesion is composed of two dimensions: a sense of belonging towards the group, and feelings of morale towards the group. These two dimensions approximate cohesion and satisfaction, respectively.

At least two challenges are apparent from these conceptualizations. First, there is a need to identify the geographic unit to which the resident feels attached: is it a local neighborhood, or a broader community? Second, there is a need to distinguish between perceived cohesion on the part of residents in neighborhoods and the possible role that social ties among residents may play in fostering this cohesion. Here, we are suggesting that these are distinct constructs, and ties are not a measure of cohesion. We turn to each of these issues next.

As to the first issue, of identifying the geographic unit to which residents feel attached, although studies frequently explore the determinants of residents' sense of cohesion and attachment to the local neighborhood, fewer studies have simultaneously explored attachment to the broader community (or, city). Kearns and Forrest (2000) posited three spatial levels: (1) interurban; (2) city and city-region; (3) neighborhood. They posited that individuals who identify more strongly with the local neighborhood may not share values with the wider society. However, one study of residents of a single neighborhood in North Carolina did compare residents' cohesion with the neighborhood to their cohesion with the broader community and found that stronger cohesion with the neighborhood did not in fact reduce cohesion with the broader community (Hipp and Perrin 2006). Of particular interest, this study did find differences in how the pattern of network ties in the neighborhood related to cohesion with the neighborhood as opposed to cohesion with the broader community (Hipp and Perrin 2006). Although the findings from this earlier

study are suggestive, the failure to explore social ties beyond those among neighbors leaves open the question whether the spatial footprint of social ties impacts how residents perceive their cohesion with the neighborhood and broader community.

As to the second issue, that of distinguishing between social ties and actual feelings of cohesion, we follow the tradition viewing social networks not as a measure of neighborhood cohesion, but a possible determinant of cohesion in neighborhoods. For example, a study of over 2,400 residents in a Northeastern US city found that a measure of neighboring behavior had too little intra-class correlation to be a reasonable neighborhood-level measure (Kingston et al. 1999). Scholars outside of the community psychology literature have also posited that place attachment and social networks are separate sub-dimensions of social cohesion (Forrest and Kearns 2001). Thus, studies of social networks and neighborhood cohesion typically find a positive relationship, including a study of households from large city in Israel (Mesch and Manor 1998), a study of residents in Rome (Bonaiuto et al. 1999), and a study of residents in urban areas in the UK, Ireland and Greece (Christakopoulou et al. 2001).

The relationships between people likely serve as the basis for their perceptions of their neighborhood and community (Entwisle et al. 2007; Hipp and Boessen 2013). In other words, for a "neighborhood effect" to exist outside of individual experiences implies a relational aspect (Entwisle et al. 2007). Although networks and neighborhood researchers often focus on the presence of neighbor social ties, there is a need to explore the processes that occur through networks and their consequences for cohesion (i.e., gossip between friends). For example, information received from neighbors, friends, kin, and other relationships might provide individuals numerous insights: a better understanding of the area, an awareness of the core values of neighbors, an assessment of the support and trust provided by neighbors, and possibly more awareness of crime events which could even increase one's sense of fear (Hipp and Boessen 2013).[1] Indeed, gossip, rumors, and other aspects about the area may inform residents' attitudes towards their neighborhood, or offer insight during a time of need (Richardson et al. 1979). In addition, neighborhood cohesion might also result from residents coordinating to solve a problem through a neighborhood block organization (Unger and Wandersman 1983).

What Ties are Important for Cohesion?

To understand how networks impact a sense of community requires distinguishing the relationships of importance (Butts 2009). In other words, what type of social ties are most important for increasing neighborhood cohesion? This theoretical question has largely been ignored. Instead, neighborhood research almost exclusively focuses on friends and kin (Barone et al. 1998; Birkel and Reppucci 1983; Kazak and Wilcox 1984; Sampson et al. 1997; Seidman et al. 1999) and often implicitly suggests that all ties should be equally likely to solve neighborhood problems and create core neighborhood values. Friends and family ties might inform individuals through gossip, rumors, and experiences with their neighborhood, and this may give an individual more information on how to address problems with the nearby area. While this information may lead to group cohesion, rumors and gossip might also play a role in group conflict. Furthermore, kin and friendship ties may not be the key ties for understanding what brings about neighborhood cohesion, and other social tie dimensions may have important consequences. It is not at all clear that responses to collective action problems would utilize kin and friendship ties. For example, when residents know more neighbors, they have increased participation in neighborhood associations (Oliver 1984). Participation in voluntary organizations has been shown to increase neighborhood satisfaction (Jagun et al. 1990), and this pattern is suggestive of neighbor ties increasing cohesion. Some neighborhood problems, such as neighborhood crime problems, may be better solved with other relationships.

Different relationships likely have varying utilities for accomplishing distinct tasks. For example, when concerned about a crime in their neighborhood, residents may contact neighbors rather than their friends and family. Addressing other problems such as schools, roads, parks, and troublesome neighbors may be best accomplished with other ties such as work comrades, business acquaintances, parents of children's friends, and many other relationships. This is all to suggest that many ties might be task specific and these different roles may each have their own distinct impact on perceived cohesion. For example, kin who live outside the home are not necessarily spatially nearby to help with a neighborhood issue. Many neighborhood tasks require others to be spatially present in and around the home. Although rarely tested, different relationships imply spatial differences in the utility of various ties as well as access to information or task resources that may or may not be available in other channels.[2]

[1] More disorder might also lead to more social ties through a common basis for fear and an understanding of neighborhood values (Ross and Jang 2000).

[2] Some research examines the different roles that a single tie might entail, such as kin being simultaneously a family member, someone who offers social support, and someone with whom one engages in social activities (Barone et al. 1998; Fischer 1982; Hirsch 1979; Skjaeveland et al. 1996).

Cohesion and the Spatial Distribution of Ties

Given the existence of different types of social ties it is possible that they may have different spatial distributions. For example, kin and social friendship ties likely have different spatial distributions and are likely not equally accessed in time of need (Fischer 1982). Although some scholars posit that distance is dead and massive technological advancements make individuals accessible at all times of day regardless of how far apart they live (Friedman 2005; Wellman 2002), a growing body of research in the social network literature emphasizes that much of social network structure may in fact be adequately represented by propinquity (Butts 2002). For example, one simulation study suggests that a simple model based on propinquity (ties more likely to form with nearby persons) adequately explains much of the overall network structure (Butts et al. 2011). These scholars also used such simulations to predict actual crime rates in several cities (Hipp et al. 2013), finding that several network measures of cohesion were associated with lower crime levels. Such simulation studies are informative in a field where the data collection challenges are substantial, but the present project is one of the first to provide crucial information on the actual spatial distribution of respondent's networks for a variety of relationships.

There are competing perspectives on how the spatial distribution of social ties will impact cohesion. On the one hand, more spatially dispersed ties may be most important. For example, residents might acquire information through social ties (regardless of their spatial location) on how to address neighborhood problems, and solving such problems would likely increase sense of attachment to the neighborhood. Social ties outside the neighborhood might provide unique information that would be particularly useful for solving the problem, or provide access to resources to solve the problem. This implies that spatially dispersed networks would increase one's sense of satisfaction and cohesion with the neighborhood. On the other hand, to the extent that residents travel outside of their neighborhood for interaction with other people or services (e.g., a restaurant) not in their home neighborhood, residents with more spatially dispersed ties might have fewer contacts with others in their local neighborhood. Indeed, scholars have suggested a *community of limited liability* where residents might leave a neighborhood to the extent that it does not provide all of the needs for its residents (Janowitz 1967). If residents spend the majority of their time in locations outside of their neighborhood, including a friend's house, with kin, or former residences, these spaces may impact their perception of cohesion with their home location, particularly as a function of how far these spaces are away from their home and to the extent that their needs are met. At a minimum, these residents are also less likely to be spatially present to help solve local neighborhood problems and perform social control nearby their home, and thus more distant ties may actually reduce the level of cohesion in the home neighborhood.

The Structure of Ties and Cohesion

When considering how structural cohesion might relate to perceived cohesion in the neighborhood, we suggest that there are at least four possible conceptualizations of structural cohesion that can be employed. The most simple is to count the number of social ties of a particular type of relationship ("degree"). In this view, having more ties to other members of the group will increase one's sense of attachment to the group. Neighborhood researchers most frequently utilize this measure, though arguably this is due to data collection challenges in which this is the easiest survey question to pose to residents. A limitation is that it does not incorporate information about the ties among other residents in the neighborhood.

For example, one study created a measure of the centrality of an individual in the neighborhood network and found that more central residents had higher levels of neighborhood cohesion (Hipp and Perrin 2006), and another study viewed the relationship between structural measures of cohesion and perceived cohesion among sorority members (Paxton and Moody 2003). Although this is informative, it fails to capture other possibly important dimensions, and we briefly discuss three additional approaches that all suggest fundamentally different research questions and processes.

A second approach to measuring structural cohesion captures the proportion of ties within the social group of interest. One example is measuring the proportion of a resident's ties that are to fellow neighbors, as opposed to ties to persons outside the neighborhood (Hipp et al. 2013). Another example would focus on the composition of the network based on various possible social tie dimensions that could be identified (e.g., kin). By focusing on the composition or location of ties, this approach captures the idea that external ties represent competing time and cognitive energy demands and therefore reduce cohesion to the group.

A third approach focuses on the density of ties: the extent that people within an individual's network are socially tied. In this view, it is not the number of ties that matter, but rather one's sense of cohesion will be increased when one is enmeshed in a social group that is tightly tied (i.e., experiences closure). In network terminology, this is the density of the network, or network closure (Burt 2001). In individuals' reported networks we can assess the extent to which their social ties are connected: this implies a

cohesive subgroup that likely increases neighborhood cohesion among the members of this subgroup. Such measures move beyond an individual person or dyad, and instead focus on at least three actors, which are missed when only focusing on degree.[3] A notable conceptual limitation to egocentric network density is that it is undefined for persons with <2 social ties, and it is therefore uncertain what to do with such cases.

A fourth approach, and the one we take here, examines the number of cohesive subgroups to which a resident belongs (ego's triangle degree). This structural measure presumes that each cohesive subgroup to which a resident belongs will increase their sense of attachment to the neighborhood. Thus, it is not simply the number of social ties that matters (degree), and it is not necessary that one must belong to a single large group with dense ties (ego density). Instead, the idea is that each triangle one belongs to (three persons that all are tied to each other) will increase a sense of perceived cohesion. This presumes that ties embedded in triangles will more strongly impact perceptions of cohesion than other ties that are not as embedded. This cohesion may stem from more trust, norms, and a stronger social identity as a result of participating in a subgroup. The present study is the only one of which we are aware that explores the possible relationship between ego's perceived participation in cohesive subgroups and perceived neighborhood cohesion.

Methods

Sample and Procedure

The present study explores these ideas by using residents' reports of a variety of network relationships to examine how different relationships, the spatial distribution of those relationships, and different perceptions of structures within those relationships, impact an individual's reported sense of belongingness and morale to the local neighborhood and broader city. Using data from the TCNS, we explore two communities in Southern California that are very different along demographic and socio-economic dimensions. For example, in 2010, the poverty rate for Irvine was 6.72 % compared to 16.6 % for Santa Ana. Whereas 57 % of residents from Irvine had a Bachelor's degree, just 9 % in Santa Ana did so. According to the FBI Uniform Crime reports in 2011, Irvine reported only 55 violent crimes per 100,000 people, whereas Santa Ana reported 399 per 100,000 people.

[3] Other researchers have created measures for cohesion, including the E–I Index (Krackhardt and Stern 1988) and Moody and White's measure of structural cohesion (Moody and White 2003).

The TCNS is a mail recruitment with an online survey of residents in Southern California from six spatially clustered census tracts in Santa Ana (N = 116) and seven spatially clustered census tracts in Irvine (N = 158). It is a random sample of residents within each community's (Irvine or Santa Ana) set of spatially clustered tracts. The TCNS collected full egocentric network data for a variety of relationships. The distinguishing feature of the TCNS is that geographic information was obtained for ego and all of the alters.

Following the lead of Dillman (2000), participants received a letter in the mail with a unique identification number that they could use to log into the online survey. This initial mailing contained a $2 incentive, and participants were told they would receive an additional $10 for completing the survey. To further elicit responses, participants received a postcard reminder 1 week after the initial mailing and another follow-up letter 1 month after the initial mailing (Dillman 1991). All study procedures were approved by the university's Institutional Review Board.

Given the complex skip patterns, obfuscation requirements, strain to respondents, and cost savings for collecting egocentric network data with spatial information, the TCNS used an online survey instrument. Participants could take the survey in English or Spanish. The overall response rate was 17 %, which is on par with other mail recruitment and online surveys (Messer and Dillman 2011). Once logging into the survey, over 95 % of respondents finished the entire survey, and the survey took approximately 30 min. Each network generator question was presented one at a time, and participants were allowed to nominate as many people as they would like (free response). Once an alter was listed for a question, a box was placed on the bottom of the screen where participants could check if they wanted to nominate this person for any of the following network generator questions. The TCNS asked respondents to report the geographic information of the respondent and all alters using Google Maps. Finally, the survey ends by asking participants to indicate demographic information about their alters and the ties between the alters for two network generator questions: neighborhood safety and core discussion.

We report how the TCNS compares to the Census for these tracts. For the % white, the TCNS reported 67 % (Census = 58 %) for Irvine, 20 % white for Santa Ana (5 % for Census). For the % Asian, TCNS reported 21 % for Irvine (Census = 27 %), 37 % for Santa Ana (19 % for the Census). The TCNS reported 9 % Latinos for Irvine and 41 % for Santa Ana, while the Census reported 7 % for Irvine and 48 % for Santa Ana. For residential tenure, TCNS reported 9.8 years for Santa Ana (Census = 11) and 12.2 for Irvine (Census = 11). For the % with a bachelor's degree, the TCNS reported 44 % for Irvine (Census = 57.6) and 12.6 % for Santa Ana (Census = 9.3).

Table 1 Summary statistics

	Santa Ana Mean	Santa Ana SD	Irvine Mean	Irvine SD
Belong to my neighborhood	5.73	2.61	6.70	2.50
Member of my neighborhood	5.57	2.70	6.64	2.63
Happy to live in my neighborhood	6.75	2.67	8.32	1.87
My neighborhood gives me pleasure	5.88	2.69	7.90	2.12
Belong to my city	5.69	2.70	7.05	2.37
Member of my city	5.29	2.73	6.62	2.47
Happy to live in my city	6.11	2.53	8.53	1.65
My city gives me pleasure	5.54	2.75	8.05	1.83
Age	45.82	16.04	54.38	16.41
Male	.60	.49	.54	.50
Married	.53	.50	.64	.48
White	.20	.40	.67	.47
Asian	.37	.49	.21	.41
Latino	.41	.49	.09	.29
Other race/ethnicity	.03	.16	.03	.18
Education	2.95	1.09	4.04	.93
Income	4.86	3.48	12.08	6.73
Residential tenure	9.83	8.92	13.25	11.17
Neighborhood average residential tenure	11.00	2.44	11.00	3.20
Neighborhood ethnic heterogeneity	40.73	16.77	54.83	8.61
Neighborhood % poverty	24.00	11.84	9.90	5.89
Neighborhood population density	347.50	110.89	223.07	71.78
Count of all alters (degree)	6.34	5.69	11.25	8.74
% kin	72.90	32.17	64.53	29.61
% social friendship	53.60	32.57	65.64	26.44
% neighborhood safety	42.90	32.45	33.62	25.13
% core discussion	41.28	28.24	51.08	26.58
Median distance to all alters (KM)	473.58	1,082.09	389.21	907.65
Median distance to kin (KM)	762.12	1,275.61	694.19	1,192.57
Median distance to social friendship (KM)	303.13	968.13	257.63	620.65
Median distance to neighborhood safety (KM)	463.94	1,114.79	165.91	575.95
Median distance to core discussion (KM)	405.47	999.69	416.89	906.10
Triangle degree neighborhood safety	3.73	11.70	3.87	9.08
Triangle degree core discussion	2.42	7.22	6.23	15.66

Measures

Neighborhood and City Cohesion: Dependent Variables

To measure each individual's perception of cohesion in the city and the neighborhood, we use a modified version of Bollen and Hoyle's (1990) scale of belonging and morale (see also Hipp and Perrin 2006), which is a series of four items ranging from 1 to 10 with higher values indicating more cohesion. The belonging aspect of neighborhood cohesion was assessed with two questions: (1) "I feel a sense of belonging to my neighborhood." and (2) "I feel that I am a member of my neighborhood community." The morale aspect was assessed with two questions: (1) "I am happy to live in my neighborhood." and (2) "Being in this neighborhood gives me a lot of pleasure." The questions for city cohesion were the same except *city* was substituted for the word *neighborhood* in the four questions. All summary statistics are presented in Table 1.

Ego Characteristics

All of the wording for the questions about the characteristics of ego were taken directly from the 2000 long form Census. We include several demographic characteristics of ego, including age and gender. Race/Ethnicity was measured with a dummy indicators for white and Asian, with Latino and Other Race as the reference group. Marital

status was included as an indicator (0/1) for whether or not ego was married. We include a measure of education with five categories, which are less than high school (6.3 %), high school degree (9.26 %), some college (27.78 %), bachelor's degree (32.96 %), and more than a bachelor's degree (23.7 %). Higher values indicate more education. Respondents reported their income in one of 16 categories, ranging from less than $10,000 to greater than $200,000. We also include a measure of the residential tenure of the respondent as the number of years that a respondent has lived at their current address.

Neighborhood Characteristics

We represent neighborhoods with Census tract boundaries in 2000. Given the various issues regarding how to represent neighborhoods, we also tested models using Census block groups. The results were substantively similar, except ethnic heterogeneity was no longer significant. The data was collected from the 5-year averages for the American Community Survey in 2005–2009. We capture the residential stability of the neighborhood with a measure of the average length of residence in years. We capture the ethnic heterogeneity of the neighborhood with a Herfindahl index. We also include a measure of the percent of residents in poverty and the population density per square kilometers.

Network and Space Measures

For each of the four relationships (kin, social, neighborhood safety, core discussion of important matters), we created measures of the percent of a respondent's network for a particular relationship out of all of their possible unique alters listed (e.g., the percent of a respondent's network that is kin). We also tested models that replaced our percent of network by relationship measures with the count of a relationship (i.e., degree). The results were substantively similar. The actual wording for all of the network generator questions are presented in "Appendix".

For two relationships, core discussion and neighborhood safety, respondents reported the relationships between the alters. Given that measures capturing ties between alters take considerable survey space and time, we chose to focus on these two relationships. The core discussion question was chosen because of its enduring position in the literature, which is in part due to its presence on the General Social Survey (GSS) and International Social Survey Programme (ISSP). The neighborhood safety question is entirely novel to this study and therefore was of focal interest. Although the literature implies that neighborhood safety relationships impacts residents' cohesion, this has not been directly measured. To represent perceived structural cohesion, we created a triangle degree measure for these two relationships. This measure is the count of the number of triangles that ego belongs to and does not include triangles comprised entirely of alters. This measure captures ego's participation in cohesive subgroups. Note that this is distinct from measures such as transitivity, which captures the proportion of ties among ego's alters, or density, which captures the proportion of ties among alters out of all possible ties. These alternative measures focus on the ties among the alters as the proportion of possible ties. Triangle degree instead measures the number of cohesive reference groups that ego views themselves a member, which better maps onto our theoretical expectation that each such closed triangle increases cohesion, rather than the proportion of closed triangles out of all possible ones.

For our spatial measures, we computed the distance between ego and and the alters. We measured this in two manners. One computed travel distance between ego and alters using Google Maps. The second computed distances between points using Austin Nichols' vincenty program in Stata, which uses an ellipsoid model of the earth. The median distance was approximately three kilometers longer for Google Maps' travel distance compared to the Vincenty distance measure. Notably the correlation between these two distance measures across dyads was .99, and thus are essentially identical. We chose to use travel distance, and for each ego computed the median travel distance to their alters in kilometers for each of the different relationships, and natural log transformed (+1) these measures.

Analytical Plan

We use structural equation modeling for our analytical approach. Using Stata 13, we estimated models using a full information maximum likelihood (FIML), which incorporates information from all cases and assumes the missing data is missing at random (MAR). All of the standard errors in the models are adjusted for the clustering of respondents in Census tracts. Some respondents' Census tracts were missing. To account for these missing tracts, we utilized several approaches. One approach capitalized on the fact that we did know the sampled city (Irvine or Santa Ana) of these respondents. We then created a pseudo tract for these respondents of the sampled city, and estimated models to adjust for this clustering. As another approach, we estimated models that randomly placed respondents in one of the sampled tracts within each city. After that, we joined the neighborhood information within those tracts and again estimated the models. As a final check, we also estimated models that included an observation for each of the potential tracts that a respondent could be located in (e.g., a maximum of six tracts for Santa Ana and seven for Irvine). The results from all of these approaches were essentially

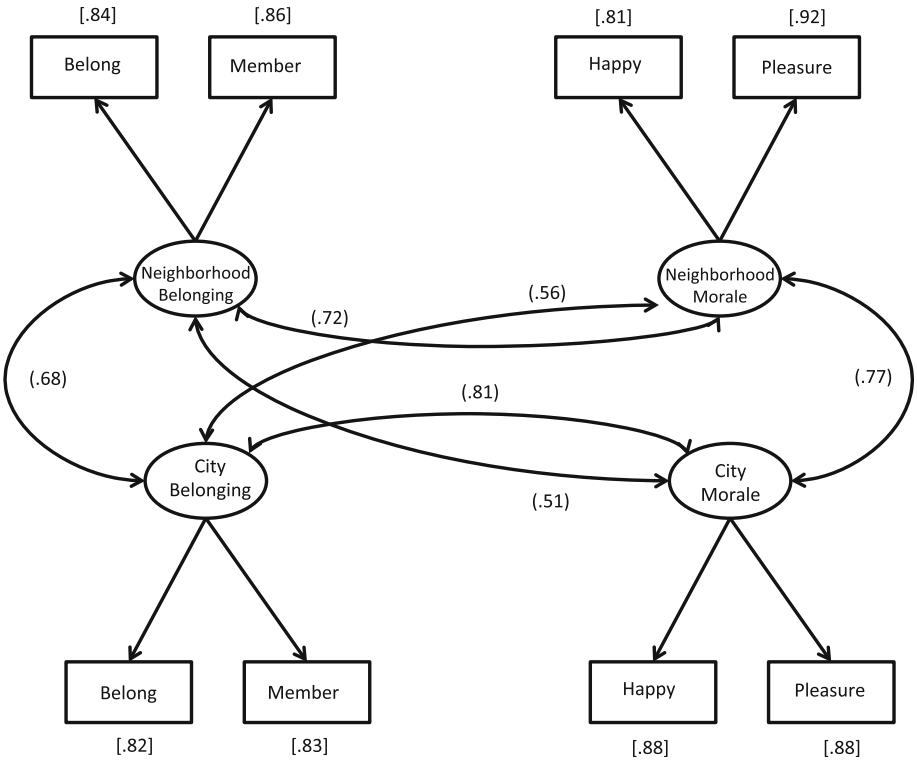

Fig. 1 Confirmatory factor analysis results for neighborhood and city belonging and morale. Correlations between latent constructs shown in parentheses and R^2 in brackets

the same regardless of the technique used to account for these missing tracts.

We begin our analyses with a confirmatory factor analysis (CFA) of our measures of neighborhood and city cohesion. We then estimate full structural models to test how the ego, neighborhood, network, and distance measures explain neighborhood and city cohesion. Given the TCNS is from samples in two cities, all of the models include an indicator for whether a respondent was from Irvine or Santa Ana. We also tested models that included interactions between the Irvine indicator and our various distance and network measures. We found little evidence of slope differences between these two communities for these measures, and we briefly highlight the significant interactions. More distant kin were associated with more city morale for Santa Ana residents, but not Irvine residents. The social contacts of Irvine residents were associated with more city morale and belonging. We did not find any evidence of outliers or multicollinearity.

Results

Confirmatory Factor Analysis

Using confirmatory factor analysis, we tested a four latent construct model: neighborhood belonging, neighborhood morale, city belonging, and city morale. Splitting cohesion into belonging and morale follows Bollen's initial conceptualization (Bollen and Hoyle 1990). The model fit was satisfactory: [$\chi^2(14) = 65.35$, RMSEA = .11; 90 % CI lower bound for RMSEA = .09; CFI = .97, TLI = .95). Although the χ^2 is still significant for this model, the incremental model fit indices indicate a good fitting model (Hu and Bentler 1999). The Cronbach's alpha for the measures for each of the latent constructs are all above .9. As further evidence of the satisfactory model fit, we also tested a two factor model, with a single latent construct for neighborhood cohesion and a single latent construct for city cohesion, and this model fit the data much more poorly than our four factor model distinguishing between the belonging and morale subfactors [$\chi^2(19) = 457.26$; RMSEA = .30; 90 % CI lower bound for RMSEA = .27; CFI = .78;TLI = .68].

The confirmatory factor analysis results are presented in Fig. 1. We find that the correlation between the measures of belonging and morale is .72 at the neighborhood level and .81 at the city level [interestingly, these correlations were .90 and .84 respectively in the North Carolina neighborhood of Hipp and Perrin (2006). The correlation between neighborhood and city belonging is .68, whereas the correlation of the morale measures is .77 (these correlations were lower in the North Carolina neighborhood of Hipp and Perrin: .45 and .54).

Table 2 Models with and without distance to all alters

	Neigh. belong	Neigh. belong	Neigh. morale	Neigh. morale	City belong	City belong	City morale	City morale
Age	.0268*	.0237	.0209*	.0186*	.011	.0077	.0117	.0091
	(.0134)	(.014)	(.0088)	(.0095)	(.0086)	(.0092)	(.0072)	(.0077)
Male	−.6062	−.5139	−.5491	−.4794	−.7425*	−.646	−.7194	−.6378
	(.3455)	(.3742)	(.3675)	(.3906)	(.3698)	(.4069)	(.4039)	(.4365)
Married	.5855	.6331	.4034	.4389	.5733	.6188*	.5266*	.5642*
	(.3506)	(.359)	(.226)	(.2253)	(.3059)	(.3025)	(.2347)	(.2241)
White	−.708	−.6559	−.4956	−.4583	−1.1959**	−1.1459**	−.7151	−.6742
	(.4992)	(.4978)	(.3751)	(.387)	(.4073)	(.4322)	(.3915)	(.4216)
Asian	−1.1726**	−1.1859**	−.9898**	−.9994**	−1.0685*	−1.0825 *	−1.1499**	−1.1603**
	(.3961)	(.4119)	(.3413)	(.3432)	(.5246)	(.5325)	(.3569)	(.3531)
Income	.0389	.0344	.0262	.0227	−.0092	−.0136	−.0143	−.0183
	(.0279)	(.0271)	(.0204)	(.0207)	(.0245)	(.0229)	(.0286)	(.0281)
Education	.1058	.1453	.1795	.208	−.0083	.0324	−.0685	−.0356
	(.1804)	(.1663)	(.1727)	(.1683)	(.2214)	(.1973)	(.2144)	(.2018)
Residential tenure	.0088	.0103	−.0094	−.0083	.0241	.0258	.0009	.0022
	(.0159)	(.0165)	(.0165)	(.017)	(.0196)	(.0202)	(.0187)	(.0194)
Irvine city indicator	1.3053	1.2647	1.8155**	1.7819**	2.1755*	2.1291	3.1234***	3.0845***
	(.6976)	(.7319)	(.6084)	(.6497)	(1.0612)	(1.1225)	(.8462)	(.9162)
Neigh. average residential tenure	.1469	.1437	.0851	.0824	.1112	.1069	.0514	.0482
	(.1667)	(.1697)	(.1309)	(.1328)	(.2046)	(.2066)	(.1644)	(.1679)
Neigh. ethnic heterogeneity	−.0541*	−.0498	−.0476*	−.0441	−.0491	−.0443	−.0428	−.0387
	(.0246)	(.0256)	(.0219)	(.0232)	(.0319)	(.0331)	(.028)	(.03)
Neigh. % poverty	−.011	−.0155	−.0272	−.0311	−.0017	−.0062	−.0166	−.0211
	(.0455)	(.049)	(.0362)	(.039)	(.0597)	(.0642)	(.0455)	(.0497)
Neigh. population density	.0021	.0026	.0016	.002	.0002	.0007	.0014	.0018
	(.0042)	(.0045)	(.0039)	(.0042)	(.0052)	(.0054)	(.0047)	(.005)
Count of all alters (degree)	−.0027	−.0018	−.0295	−.0288	−.0014	−.0004	−.0157	−.0149
	(.0137)	(.0145)	(.021)	(.0217)	(.0209)	(.022)	(.0158)	(.0171)
Log distance to all alters		−.1538		−.1114		−.1582		−.1283
		(.079)		(.0919)		(.1007)		(.1002)

Standard errors are in parentheses

* $p < .05$; ** $p < .01$; *** $p < .001$

Latent Variable Models

We next turn to the structural models, in which we have four outcomes: neighborhood cohesion (belonging and morale) and city cohesion (belonging and morale). Given the consistency of the results across the different latent outcomes for the measures predicting belonging and morale (Tables 2, 3, 4), we discuss the results generally as cohesion and point out when there are differences. Initially, these models had estimation issues, which is expected given that we only have two indicators per construct (Bollen 1989). Accordingly, we set the reliability of our latent outcomes to the R^2 from our CFA models, and the models estimated as expected (for a similar approach see Paxton 2002).

We begin by briefly summarizing the results for the ego characteristics for our four latent outcomes. We find that older residents perceive more neighborhood cohesion, while married people report significantly higher levels of city cohesion. Asians report significantly lower levels of neighborhood and city cohesion when compared to Latinos and other race/ethnicities. Whites report significantly less city belonging when compared to Latinos and other race/ethnicities. No significant effects were detected for level of income, education, or length of residence.

When examining the neighborhood characteristics, residents from neighborhoods with more ethnic heterogeneity perceived significantly less neighborhood cohesion. However, this effect loses significance when accounting for the distance to alters, which may imply that residents

Table 3 Models by relationship

	Neigh. belong	Neigh. morale	City belong	City morale
(1) Log distance to kin	−.2174*	−.2152*	−.2286*	−.2445*
	(.0861)	(.0838)	(.1061)	(.1001)
(1) % kin	−.0055	.0048	−.0048	−.0007
	(.0062)	(.0067)	(.0085)	(.0062)
(2) Log distance to social friendship	−.1769	−.0903	−.1334	−.0487
	(.3963)	(.3829)	(.4557)	(.4359)
(2) % social friendship	.0023	.0024	.004	−.0028
	(.0074)	(.0063)	(.0088)	(.0078)
(3) Log distance to neighborhood safety	−.3712***	−.2826***	−.3154***	−.2933***
	(.0717)	(.0733)	(.0931)	(.0693)
(3) % neighborhood safety	.0203**	.0209***	.0252***	.0203**
	(.0069)	(.005)	(.0065)	(.0063)
(4) Log distance to core discussion	−.1438	−.1004	−.2458	−.1813
	(.2167)	(.218)	(.1981)	(.1967)
(4) % core discussion	.0119	.0106**	.0122	.0102
	(.0069)	(.0039)	(.0068)	(.0055)

All models include all ego and neighborhood characteristics variables from the models from Table 2 (except total degree and distance), an indicator for the sample city, and an intercept. Each relationship was included one at a time in the models: a distance and % term for each relationship. Standard errors are in parentheses

* $p < .05$; ** $p < .01$; *** $p < .001$

Table 4 Models with distance to all alters

	Neigh. belong	Neigh. belong	Neigh. morale	Neigh. morale	City belong	City belong	City morale	City morale
Log distance to neigh. safety	−.3499***		−.2765***		−.303**		−.2893***	
	(.0755)		(.0782)		(.0922)		(.0712)	
% neigh. safety	.0123*		.0192***		.021**		.0198**	
	(.0062)		(.0054)		(.0068)		(.0064)	
Log distance to core discussion		−.1416		−.0987		−.244		−.1798
		(.2167)		(.2189)		(.1995)		(.1984)
% core discussion		.0092		.0096*		.0116		.0098
		(.0072)		(.0044)		(.0078)		(.0063)
Triangle degree neigh. safety	.1056***		.0123		.0606		.003	
	(.0293)		(.0101)		(.032)		(.008)	
Triangle degree neigh. safety squared	−.001**				−.0007			
	(.0004)				(.0004)			
Triangle Degree Core Discussion		.0206*		.0069		.0037		.002
		(.0103)		(.0076)		(.0095)		(.0081)

Standard errors are in parentheses. All models include all ego and neighborhood characteristics variables from the models from Table 2 (except total degree and distance), an indicator for the sample city, and an intercept

* $p < .05$; ** $p < .01$; *** $p < .001$

in more heterogeneous neighborhoods have more distant ties. Furthermore, the other neighborhood measures did not have significant effects. Although it may seem a bit surprising that these common neighborhood covariates did not have many significant effects in the model, it should be kept in mind that we had a relatively small sample size of neighborhoods. This was not a major focus of the analysis, and therefore not too much should be read into such nonfindings. The lack of neighborhood environment effects for individual outcomes is also fairly common. This implies that the non-significance is not necessarily in contradiction to previous findings since non-significance does not mean no effect. More data is needed to establish one way or another. Moreover, the dummy indicator for the sample city likely captures many of the structural differences between the neighborhoods. We find that Irvine residents felt significantly more cohesive with the neighborhood and city than Santa Ana residents. This gap is even wider for perceived city cohesion, which is notable given that Irvine is a large planned community with a particular image/branding.

Notably, the measure of the number of ties a respondent reports did not have a significant effect in any of these models (Table 2). Thus, there is no evidence that a simple count of the number of ties reported by residents is associated with higher levels of cohesion with the local neighborhood or the broader city (in fact, the estimated coefficients are always negative, although not significant). We also see no evidence that the average distance to all ties impacts neighborhood or city cohesion.

Although these initial models are informative, we next assess the importance of distinguishing between the type of ties. Although not shown in the tables, when comparing the R^2 between our first model that only used a measure of the number of ties in Table 2 to an average R^2 for the models in Table 3, we find a 25 % increase in the R^2 for neighborhood belonging, 17 % increase for neighborhood morale, 28 % increase for city belonging, and 12 % increase for city morale. Neighborhood safety has the strongest improvement with an average R^2 over all outcomes of .37, whereas the degree measure that combines all relationships had an average R^2 of .28. This is evidence that decomposing the various relationships is important for understanding neighborhood and city cohesion.

In Table 3, we find that more spatially dispersed networks reduce residents' reported levels of neighborhood and city cohesion for certain types of ties. Residents with more distant ties to kin and neighborhood safety networks report significantly less cohesion for the local neighborhood and broader city. There is no evidence that more distant social friendship or core discussion ties impact neighborhood or city cohesion.

The composition of different types of ties in a resident's network has important consequences for their perceived cohesion. Residents with more neighborhood safety ties consistently report significantly more neighborhood and city cohesion. Indeed, neighborhood safety ties have the strongest effects of the tie types studied. Residents with more core discussion ties have significantly higher neighborhood morale. In these two communities, we have no evidence that having more social friendship or kin ties impacts neighborhood or city cohesion. Given that residents might gain information about their neighborhood and city with other co-habitants, we also estimated models with the percent of ties that ego reported in the home. This measure of percent home ties was not significant in the models, and the results were substantively similar.

Finally, the models in Table 4 incorporate our measures of structural cohesion (triangle degree for the neighborhood safety and core discussion networks). We find that whereas having more distant neighborhood safety ties still reduces perceived neighborhood and city cohesion, the presence of greater triangle degree has an additional effect and results in reporting more neighborhood belonging. This is the case for both safety ties (a slowing positive effect) as well as for core discussion ties. Thus, it is not only the number of ties, but the connections among those ties, that increases levels of neighborhood belonging. Notably, these locally cohesive ties do not affect one's sense of cohesion with the larger city, or even one's sense of neighborhood morale. Thus, they appear to have a very specific impact on sense of neighborhood belonging. We also briefly mention that we estimated models that replaced the percent of ties for each relationship with a measure of the degree of ties for each relationship. The results were similar, except this degree term was not significant in the models for neighborhood safety ties, while the triangle degree term remained significant.

Discussion

This study has offered insight for how a variety of network relationships and their spatial distribution impact residents' perception of cohesion with their neighborhood and city. A key finding is that residents who report more spatially dispersed networks also report lower levels of neighborhood and city cohesion. Importantly, not all relationships similarly impact assessments of neighborhood and city cohesion, and there appear to be important consequences for the structure and spatial distribution of certain networks. Residents from Irvine reported more cohesion with their neighborhood and city compared to Santa Ana residents. The TCNS data allowed us to undertake one of the first empirical examinations of the relationship between the spatial distribution of a variety of social network relationships and neighborhood and city cohesion.

Although the neighborhood and community psychology literatures are unclear on precisely which relationships are most likely to bring about neighborhood and city cohesion, we find that neighborhood safety and with whom residents discuss important matters (i.e., core ties) are associated with higher levels of cohesion. By examining several different types of relationships, we have a better understanding of the kinds of relationships that bring about cohesive communities. When examining the R^2 from the models, we find that breaking out the various relationships in tandem with their spatial distribution (rather than aggregating them together), allowed us to do a much better job explaining neighborhood and city cohesion.

Although it can be risky to read into a non-finding, we did not find any evidence that having more kin and social friendship ties in one's network was related to perceived cohesion. Kin did not appear to increase cohesion, and actually reduced cohesion when they were further away. Given that much of the neighborhoods literature (e.g., see Sampson et al. 1997) measures the extent of ties in the neighborhood by asking about family and friends, our study suggests that these might not be the relationships that are most critical for capturing neighborhood cohesion. When examining perceptions of city cohesion, we had some evidence of differences between the two cities with friendship ties in Irvine indicative of more city cohesion, while kin ties being associated with more city morale in Santa Ana. Social friendship and kin ties may be distinct from neighborhood ties, particularly in their consequences

for neighborhood collective action and because they appear to have distinct spatial footprints. The footprint of these relationships plays a role in how people evaluate the broader city area, particularly for Irvine where the higher incomes might suggest more potential for friendship activities outside of the local area.

The fact that the spatial distance to various types of ties impacted levels of cohesion with the neighborhood and city highlights the importance of focusing on ties beyond the local neighborhood. Whereas prior research often ignores longer distance ties, they may in fact be important to consider. To the extent that longer distance ties are a cognitive drain on a resident, they would reduce levels of neighborhood cohesion. It may also be that residents do not have their needs entirely met by the home neighborhood and thus may be attracted to and spending time in other neighborhoods, particularly where their other ties are located. We found that the presence of more distant social ties among several social dimensions was associated with residents reporting less neighborhood cohesion. These findings imply that the broader spatial footprint of networks may be important to consider, even when trying to understand perceived cohesion within the more precise geographic unit of a neighborhood.

Even though we find that networks are not spatially concentrated in the local neighborhood, this is not necessarily indicative of distance and geography being dead as suggested by others (Friedman 2005; Wellman 2002). For example, most conversation is still a function of face-to-face interaction, implying a distinct spatial distribution (Grannis 2009). Furthermore, we found that the presence of more distant ties does indeed impact neighborhood cohesion in a negative fashion. Thus, they are not unimportant, but actually have consequences. Ties outside the neighborhood imply that people might leave their local neighborhood to interact with others. While the interaction is at a small local scale, their residence may be more distant. Future research might explore this issue further by examining the distribution of spatial interaction over the day.

We also find a structural effect. Respondents who perceived more triangles in their personal networks consistently reported higher levels of cohesion. These effects were most strongly associated with a greater sense of belonging with the neighborhood. Given that triangles in networks are a way to capture cliques, which are a structural measure of cohesion, this finding suggests that cliques may help to bring about perceived cohesion in the neighborhood and highlights the exciting possibilities for how higher order structural network measures, such as triangles, impact residents' perception of cohesion with their neighborhood. Future work will need to explore these possibilities further.

This study has some limitations. First, similar to other research in this area, we did not examine the process by which social ties are formed, enacted, or activated to lead to neighborhood cohesion. Future work might extend this study by exploring how information travels between residents or how ties are formed. Another approach might examine how problems in the neighborhood such as crime activate relationships in a time of need, particularly when these relationships are spatially distant from the local area. Second, when comparing our TCNS demographics with those reported from the Census, we saw that non-response may be an issue for some of the demographic characteristics. Although we expect there to be some differences between the TCNS and Census estimates given the differences in timing, survey administration mode, and sampling, we attempted to mitigate this issue by including demographic measures in all of the models as controls. We estimated ancillary models with interactions between various demographic measures and all covariates in the model, and these interaction terms tended to be nonsignificant and the remaining terms were substantively similar, suggesting no impact of this issue for the findings. Third, we do not have any measures of the saliency of the different ties, or in other words, the strength and importance of the different relationships (Granovetter 1973). Yet, we do show that a variety of relationships might lead to cohesion, and this suggests that the thickest or strongest relationships likely have multiplex relationships. Whereas some relationships are weaved together for a variety of reasons, future research will want to more explicitly test the consequences of this multiplexity for cohesion and more extensively examine the extent of overlap for these relationships.

Nonetheless, we found that the spatial distribution of relationships shapes how people feel about their neighborhood and city. Drawing from Granovetter, the literature often suggests that people who live closer in geographic space have stronger relationships (e.g., see Bellair 1997). The fact that we see ties well outside of the neighborhood for numerous relationships is suggestive of strong ties outside the local area. This patterning of the spatial footprint of networks might be indicative of residents not spending all of their social lives within the boundaries of their local neighborhood, or necessarily only within one neighborhood. As a next step to this line of research, we might explore these footprints further by examining how this pattern relates to the underlying social similarity of nearby residents, and more explicitly capturing *where* different ties are spatially situated, rather than just how far away. We might also make a distinction between ties that are located inside vs. outside the neighborhood or city (Hipp et al. 2013) and actually modeling the probability for interaction across space (Butts 2002).

Taken as a whole, the findings speak to the community psychology literature by suggesting that the spatial footprint of relationships appears to be critical for understanding how residents perceive the cohesion in their neighborhood. The fact that residents' local ties were not the only important ones, and that ties outside the local area impacted residents' perception of cohesion with the neighborhood and city suggests that researchers need to account for this in future work. Relatedly, different types of ties had varying spatial footprints and impacted perceived cohesion differently in this study, which suggests that the community psychology literature may benefit from further theoretical and empirical examination of when, where, and how different relationships matter for neighborhood cohesion. While much of the community psychology literature often only focuses on processes and relationships within one neighborhood, these findings suggest a need for theoretical and empirical progress for how nearby and far away areas affect the local community. For example, whereas our structural measure of triangle degree was related to increased neighborhood cohesion, future research might extend these findings by capturing the spatial distribution of such cohesive subgroups. The spatial distribution of social ties also emphasizes a final key point of this study: the importance of distinguishing the geographic unit to which residents perceive attachment. We found differences in the determinants of perceived cohesion with the neighborhood versus that with the city, suggesting that this is a direction worthy of additional research. The findings from this project suggest an understanding of community and cohesion that is more spatially broad than just the confines of one census unit: communities can be understood as being explicitly spatial and network based, thereby making communities interdependent.

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Appendix: Network Generator Questions

The questions are ordered here the same way they are asked in the survey:

- Kin
  - Family ties are important for many people, and we'd like to learn about your family. The following questions will ask you about living relatives with whom you are in at least occasional contact.
  - Do you currently have a spouse or partner?
  - Do you currently have any children with whom you are in at least occasional contact? Please list your children one-by-one below (this includes step-children, adoptive or foster children, and adult children, whether or not they are living with you.)
  - Thinking of the living relatives with whom you are in at least occasional contact, which of the following ties do you currently have?
    - Select from: mother; father; spouse/partner's mother; spouse/partner's father
  - Do you have additional parents who are currently living and with whom you are in at least occasional contact? (This includes step-parents, foster or adoptive parents, or guardians.)
  - Do you currently have any brothers or sisters with whom you are in at least occasional contact? (This includes step-siblings, or brothers and sisters within a foster or adoptive family).
- Social friendship
  - Which of the following people do you engage in social activities with, such as going out for a meal, visiting, going out socially, etc.?
- Neighborhood safety
  - Imagine that you personally observed a crime or other event taking place near your home which made you concerned about the safety of your neighborhood. Which of the following people would you seek to contact to discuss this issue?
  - We ask about ties between alters for this question at the end of the survey.
- Core discussion of important matters
  - From time to time, most people discuss important matters with other people. Looking back over the last 6 months, who are the people with whom you discussed matters important to you?
  - We ask about ties between alters for this question at the end of the survey.
  - This item is from GSS and International Social Survey Programme (ISSP).

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