Partnership Ties Shape Friendship Networks: A Dynamic Social Network Study

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Partnership ties shape friendship networks through different social forces. First, partnership ties drive clustering in friendship networks: individuals who are in a partnership tend to have common friends and befriend other couples. Second, partnership ties influence the level of homophily in these emerging friendship clusters. Partners tend to be similar in a number of attributes (homogamy). If one partner selects friends based on preferences for homophily, then the other partner may befriend the same person regardless of whether they also have homophilic preferences. Thus, two homophilic ties emerge based on a single partner's preferences. This amplification of homophily can be observed in many attributes (e.g., ethnicity, religion, age). Gender homophily, however, may be de-amplified, as the gender of partners differs in heterosexual partnerships. In our study, we follow dynamic friendship formation among 126 individuals and their cohabiting partners in a university-related graduate housing community over a period of nine months ($N = 2{,}250$ self-reported friendship relations). We find that partnership ties strongly shape the dynamic process of friendship formation. They are a main driver of local network clustering and explain a striking amount of homophily.

Introduction

Partnership ties and friendship ties are the two most important types of choice-based[1] ties in personal social networks. Individuals profit from both types of relations in a number of dimensions. At the same time, the dynamics of partnership and friendship formation are tightly interlocked. In this article, we study how partnership ties shape friendship networks. In a dynamic social network study within a university-related housing community, we investigate how partners who move into a new social context seek agreement in their friendship choices, how they tend to befriend other couples, and how these mechanisms amplify the level of homophily in their friendship networks.

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Partnership ties and friendship ties have been widely studied. Both are known to be main sources of social support (Wellman and Wortley 1990; Dehle, Larsen, and Landers 2001; Agneessens, Waege, and Lievens 2006), to have a positive influence on subjective well-being, such as life satisfaction and happiness (Burt 1987; Diener et al. 2000; Soons, Liefbroer, and Kalmijn 2009), and to be associated with mental and physical health (Berkman et al. 2000; Hughes and Waite 2009). In all these (partly overlapping) dimensions, individuals strongly benefit from having a partner[2] and from having friends. Burt (1987), Berkman et al. (2000), and Agneessens, Waege, and Lievens (2006) argue, however, that the positive effect of a single partnership tie is stronger than that of a single friendship relation. Leaving aside the qualitatively different nature of partnership and friendship ties, one can argue that a partnership tie is more intimate and thus more valuable for an individual than a single friendship tie.

Partnership ties and friendship ties often connect individuals who are similar. Partner ties thus tend to be structurally homogamous. This means that partners are often more similar than expected from the variety in a particular marriage market. Homogamy is found in many attributes, such as ethnicity, religion, age, occupation, socio-economic status, and level of education (Kalmijn 1998; Blau 1977, 37). Friendship ties tend to be homophilic. This means that the emergence of ties between similar individuals is more likely than expected by the level of homogeneity in a certain population (Lazarsfeld and Merton 1954; Marsden 1988; McPherson, Smith-Lovin, and Cook 2001). Individual attributes for which homophily is commonly observed are those mentioned in the context of homogamy plus gender.

Despite a number of similar features, however, the partnership tie is unique. Partnership ties are generally monogamous in most cultures and therefore do not by themselves form large social networks at a given point in time. Nevertheless, partnership relations matter for the dynamics of friendship networks. We observe this, for example, as friends become partners, friends of partners become friends, couples befriend other couples, or friends of a partner are a matter of discussion in partnerships.

In this article, we do not study the emergence of partnership ties or their dissolution in the context of friendship networks. Rather, we investigate how pre-existing, stable partnership ties affect the formation, dissolution, and maintenance of friendship ties. We further discuss and explore how this interplay affects the shape of friendship networks. We argue that partnership ties are one of the main drivers of adult friendship formation and serve as nuclei in the emergence of complex structures in friendship networks. In particular, levels of clustering and homophily are strongly influenced by partnership ties.

In a longitudinal social network study, we investigate different clustering mechanisms and their interplay with homophily and homogamy in the formation of an adult friendship network among cohabiting couples. The individuals live in a university-related housing community with a high turnover of residents ($N = 2{,}250$ self-reported friendship ties between 126 individuals over 9 months who are connected by 62 pre-existing, non-changing partnership ties[3]). The data that we collected are unique in several ways. First, we are not aware of a comparable complete, longitudinal network data set consisting of adults *and* their part-

ners. Second, very detailed information on individual attributes is available that allows us to test homophily in five different attributes (age, gender, race/ethnicity, having children, religion) and its interplay with homogamy and clustering mechanisms around partnership ties. Finally, the data are collected in an emerging social context: the couples in our study come from different places around the world and rarely know each other beforehand. Of these couples, 44.6 percent moved in the same year our study began, and 87 percent did so within the past two years. Therefore, we observe a highly dynamic, evolving friendship network.

We find that although only approximately 13.3 percent of all positive relations in our study are partnership ties (86.7 percent are friendship ties), these partnership ties are nuclei that drive the dynamics of friendship formation. We find that friendship ties tend to emerge around partnership ties, embedding one or more partnership ties in dense local clusters. The fact that partnership ties tend to be homogamous amplifies the level of homophily in the friendship network. This amplification is found in the homogamous attributes of race/ethnicity, having children, and religion. In contrast, the strong tendency of individuals to choose friends of the same gender is almost hidden by the fact that through clustering around heterosexual partnership ties, many mixed-gender ties emerge that are not based on mixed-gender friendship preferences. In our study, religious homophily would be seriously overstated, whereas gender homophily might have been overlooked without controlling for clustering around partnership ties. These findings suggest that partnership ties are strong forces that shape the level of clustering and homophily in friendship networks.

Previous Studies on How Partnership Ties Shape Friendship Networks

The effect of stable partnership ties on the formation, dissolution, and maintenance of friendship relations has been theoretically discussed and empirically investigated in earlier studies. In the following, we present a brief overview.

Blau (1977) notes that "social associations depend on opportunity for social contact" (79, assumption 9) and "are more prevalent among persons in proximate … social positions" (36, assumption 1). The partnership tie may therefore create opportunities for contact and communication with friends of the partner, which may eventually lead to the creation of new friendship ties with friends of the partner—a mechanism that is often described as triadic closure. A related outcome is discussed by the *dyadic withdrawal hypothesis* (Johnson and Leslie 1982; Milardo 1982; Kalmijn 2003), which states that the friendship networks of partners tend to shrink over time and to increasingly overlap. Milardo (1982) argues that these mechanisms are explained by the fact that both partners increasingly perceive themselves as a unit, as do friends of the partners. Investment in friendship relations are made as a unit. Johnson and Leslie (1982) state that individuals need to invest time in a partnership, which forces them to dissolve certain time-consuming friendship relations in which the partner is not involved. Another solution to lack of time may be to foster friendship relations

together with the partner, again creating opportunities for friendship formation between the partner and the friend. Gerstel and Sarkisian (2006) conclude that withdrawal from friendship networks may be related to the emotional and social demands of marriage, which may therefore be called a "greedy institution." Parks, Stan, and Eggert (1983) link the emergence of transitive structures that incorporate a partnership tie with the psychological arguments of balance theory (Festinger 1957; Heider 1958). To become friends with the friends of the partner or to dissolve a friendship tie with someone with whom the partner is not friends may be strategies to reduce the stress associated with imbalanced friendship relations.

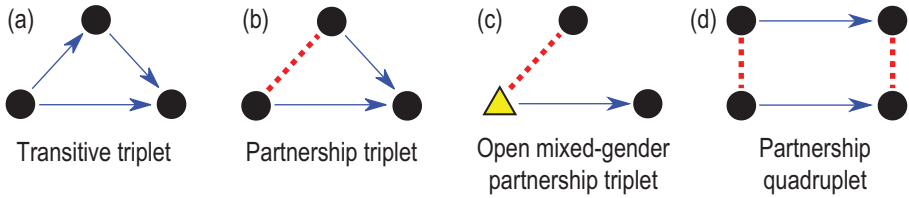
Kalmijn (2003) empirically investigates the predictions of the dyadic withdrawal hypothesis based on longitudinal, ego-centered social network data and finds evidence for partners' increasing overlap and shrinking of friendship networks over the life course.

The cited studies theoretically argue that the change of personal friendship networks of two partners is expected to be interdependent, and specific social mechanisms (e.g., triadic closure, dyadic withdrawal) are described. In the following, we develop a related set of mechanisms about how friendship ties may change depending on the friendship ties of a partner. We take a dynamic social network perspective that builds on and goes beyond a personal network perspective (as taken in Kalmijn 2003). It accounts for the role of individuals and ties that are farther away from individuals, for example, the partner of friends and the partner of friends of the partner. At the same time, we propose hypotheses about how these social mechanisms differ from related mechanisms in friendship networks (e.g., triadic closure) and how they may influence the general shape (e.g., clustering, homophily) of an evolving friendship network.

Theory and Hypotheses

A typical pattern in the formation of friendship networks is the closure of transitive triplets: if person A considers B a friend and B considers C a friend, then there is a high probability that, eventually, A will consider C a friend as well. This recurring mechanism results in an empirical over-representation of transitive structures in social networks (Davis 1970; Newman and Park 2003). A *transitive triplet* is shown in figure 1(a). Granovetter (1973, 1362ff) argues that transitive closure may be driven by three processes.[4] First, there is an increased likelihood of interaction between A and C because they have a common friend. This may eventually result in a friendship tie from A to C. This idea relates to focal closure (Kossinets and Watts 2009; Feld 1981), the increased likelihood of interaction between individuals who share a social context, and to the concept of propinquity (Festinger, Schachter, and Back 1974[1950]), the increased likelihood of interaction of those who are physically close. We may summarize these processes as *opportunity-related transitive closure*. Second, the two initial friendship ties may indicate a certain similarity of individuals that increases the chance of A and C also liking each other. Transitive closure would then be a byproduct of shared homophilic preferences on certain individual attributes (Moody 2001; Kossinets and Watts 2009; Wimmer and Lewis 2010) or of other shared preferences.

Figure 1. Four structures hypothesized to be relevant in the friendship formation process. Arrows indicate directed friendship ties (friendship nominations), dashed lines are partnership ties, and circles and triangles are individuals. A tie between a triangle and a circle is a mixed-gender tie. Ties between two circles can be either mixed- or same-gender ties.



We may summarize these mechanisms as *transitive closure due to shared preferences*. Third, transitive closure may be enforced by the three individuals involved, because only a closed triplet assures that the individuals' perception of the social situation is in *balance* (Heider 1958; Cartwright and Harary 1956; Newcomb 1961; Hummon and Doreian 2003).

The partnership tie allows the creation of a similar transitive structure: the *partnership triplet* emerges if individuals become friends with a friend of their partner or friends with the partner of a friend. The first case is shown in figure 1(b). The underlying social mechanisms are expected to be similar to the three closure mechanisms of transitive friendship triplets. First, the closure may be a matter of opportunity. Given that partners spend considerable time with each other, and share many social contexts and places, the likelihood of opportunity-related friendships between one partner and a friend of the other partner is high. In comparison to friendship triplets, opportunity-related closure can be expected to be even more prevalent because partners tend to share more time, social contexts and places, than average friends do. Second, partners tend to be similar in a number of dimensions, including their preferences. Transitive closure due to shared preferences is likely in the case of partnership triplets. In general, partners can be expected to have more similar preferences than average friends have, so again, the closure mechanism might be more prevalent than in the case of friendship triplets. Given the observation that homogamy is stronger than friendship homophily, triadic closure as a byproduct of a combined homophily/homogamy mechanism can be expected to be more prevalent where a partnership tie is part of the triplet. Third, the closure may be motivated by psychological balance arguments. Because the partnership tie is more intimate and more valuable on a number of dimensions compared with friendship ties, we can speculate that open partnership triplets are perceived as even more imbalanced than open friendship triplets. It can be expected that partners strive for balanced partnership triplets by either arranging a friendship tie between the partner and the friend or weakening or dropping the imbalanced friendship relation. From these observations, we derive two hypotheses:

> **Hypothesis 1.** *People have a preference to close and maintain partnership triplets (figure 1(b)); they are likely to be friends with friends of their partner and to be friends with their friends' partners.*

Hypothesis 2. *The preference to close and maintain partnership triplets is stronger than the preference to close and maintain friendship triplets (figure 1(a)).*

Parks, Stan, and Eggert (1983, 118) state: "communication with the partner's network might preserve … romantic involvement by reducing the amount of time available for the pursuit of alternative partner." Hence, triadic closure can additionally serve as a control mechanism to protect the partnership tie. Because the partnership tie is particularly valuable due to its intimacy, situations that may harm it will be avoided. Imagine that A and B are partners and A is friends with C, who is a potential new partner of A. If B is not friends with C—and therefore is not in a "controlling" position—then this situation may be perceived as imbalanced and stressful for B. Assuming that different gender is a necessary precondition of a potential romantic relationship,[5] we call such an imbalanced triplet an *open mixed-gender triplet*. This structure is shown in figure 1(c). The imbalanced situation in this triplet can be avoided in different ways. Actor A, who is interested in the stability of the partner tie, may not maintain the friendship tie with C in the first place. Alternatively, B may either influence A to drop the friendship relation or become friends with C as well, to be in a controlling position. Therefore, open mixed-gender partnership triplets are expected to be rare structures; they are unlikely to emerge and are closed quickly.

Hypothesis 3. *People avoid friendship relations with others of the opposite sex with whom their partner is not friends (open mixed-gender triplets; see figure 1(c)).*

We furthermore expect the emergence of dual friendship relations between two couples. The resulting structure is called a *partnership quadruplet* and is shown in figure 1(d). These structures may emerge similarly to opportunity-related transitive closure and as a byproduct of shared preferences. We do not expect, however, partnership quadruplets in which the friendship relations are between individuals of different genders. Such a structure would incorporate two open mixed-gender triplets. These structures are assumed to be highly imbalanced following the arguments of the open mixed-gender triplet.

Hypothesis 4. *People have a preference to close and maintain partnership quadruplets (figure 1(d)); they are likely to be friends with the partner of their partner's friend.*

Hypothesis 5. *People avoid being embedded in partnership quadruplets in which the two friendship relations are mixed-gender ties.*

We identified a number of mechanisms that lead to clustering of friendship networks around partnership ties. This clustering can amplify the level of homophily in the network. The homogamous partnership tie plays a critical role.

Imagine that both A and B and C and D are connected with two partnership ties. Religious homogamy may result in each of the four actors having the same

religion as his or her partner. If, additionally, both couples have the same religion (for example, they are all Catholic), religious homophily in A's friendship preferences may drive an initial friendship tie from A to C. Three subsequent friendship ties (B to C, A to D, B to D) may then partly be explained by preferences for partnership triplets and quadruplets (hypotheses 1 and 4) and may be independent of religious-homophilic choices. Eventually, four friendship ties between Catholic individuals are observed, but only the creation of the first one was solely based on *choice homophily*. The apparent homophily of the other three ties is *induced* (McPherson and Smith-Lovin 1987, 371), which we understand as the level of homophily that is above a population expectation without originating from homophilic choices. Schaefer (2012) describes a similar induction of homophily through non-reciprocity. Individual preferences are not exactly additive, as suggested in the example about homophily amplification above. The reason is that each individual will maintain only a limited number of friendship ties.

> **Hypothesis 6.** *If partnership-related clustering mechanisms are prevalent, homophily will be amplified by clustering around homogamous partnership ties.*

In friendship networks of heterosexual couples, we may observe the opposite effect regarding gender homophily. Partner clustering mechanisms may *de-amplify* the level of gender homophily. In heterosexual partnership triplets and partnership quadruplets, half of the friendship ties are between individuals of opposite genders, even if the initial gender choice homophily is high.

> **Hypothesis 7.** *If partnership-related clustering mechanisms are prevalent, gender homophily will be de-amplified by clustering around heterosexual partnership ties.*

Study Design

The role of partnership ties in the evolution of friendship networks and the interplay with different dynamic social forces—homogamy, homophily, and different types of clustering around partnership ties—have not yet been studied. The interplay of the mentioned mechanisms is dynamic, multi-mechanistic, and complex in nature. An empirical must consider all of these aspects. It is essential to study longitudinal data in complete social networks. The stepwise formation of the partnership quadruplet and other local clustering effects, for example, cannot be analyzed using ego network data (because information on some ties in quadruplets and other structures would be missing) or static network data (because this does not allow one to model different processes that lead to similar static outcomes). Finally, methodological tools for dynamic social network analysis that are tailored to multi-mechanistic problems have become available only recently and still need to be extended for specific research questions such as those presented in this paper.

In this study, we follow the evolution of self-reported friendship ties between 126 individuals who are all in a cohabiting and long-lasting partnership.

Approximately half already have children (49.6 percent). The data stem from a mobile-phone-centered data collection and are used for the first time to examine partnership ties. Friendship network data were collected with an online questionnaire in which each participant was asked to evaluate her relationship with each other participant in the network study. There were no restrictions regarding the number of friendship nominations. The participants in our study lived in a graduate housing community for married and long-term-cohabiting couples of a US university. The study spanned more than nine months starting in September 2010. Of the study population, 29.2 percent had moved to the location immediately before or shortly after the study began. Another 15.4 percent had moved earlier in 2010, and 19.2 percent and 23.1 percent, respectively, had moved in 2009 and 2008. Approximately 13 percent of the participants had moved earlier than this.

Participants often moved from other cities and countries after one of the spouses started a research-related appointment or graduate studies. Friendship ties were partly established at the time when the study started, but due to the high turnover in the community, we observed a highly dynamic, emerging friendship network. During the study period, friendship was measured four times among a subset of 126 participants who participated in at least one of the four waves. Descriptive statistics of the four waves are shown in table 1. Measurements took place in the academic year 2010–2011 in September, December, March, and May. Response rates varied from 92.9 percent (September, 117 participants) to 72.2 percent (March, 91 participants). The resulting one-phase missings can partly be imputed with friendship ratings of a preceding period according to the procedure described in Ripley et al. (2011, sec. 4.7). We therefore have two-phase missing rates ranging from only 3.9 percent (first two waves) to 19.7 percent (last two waves), which corresponds to a two-phase response rate of 80.3 percent to 96.1 percent. The friendship network density (before imputation and dichotomized as described below) varies between 3.2 percent and 3.8 percent. A pairwise comparison of the networks results in Jaccard indices of 67.5 percent (wave 1–2), 70.8 percent (wave 2–3), and 75.4 percent (wave 3–4). The Jaccard index is defined as the ratio of ties observed in both waves divided by the number of ties observed in either or both waves.

Table 1. Waves of the Friendship Network (126 participants)

	Wave 1	Wave 2	Wave 3	Wave 4
Month	09/2010	12/2010	03/2011	05/2011
Participants	117	104	91	94
Friendship ties	562	571	511	606
One-phase missings	7.1%	17.3%	27.6%	25.2%
Two-phase missings	3.9%	9.4%	19.7%	
Density	3.6%	3.6%	3.2%	3.8%
Two-phase Jaccard index	67.5%	70.8%	75.4%	

Friendship was measured on a scale from 0 to 7 defined as follows:

0: I don't know this person
1: I know of this person
2: This person is an acquaintance
3: This person is a friend (low ranking)
4: This person is a friend (medium ranking)
5: This person is a friend (high ranking)
6: This person is a close friend
7: This person is family or as close to me as a family member

We transformed the responses into four binary friendship networks over time, with a tie being present if a value of 4 or more was chosen and no tie otherwise.[6]

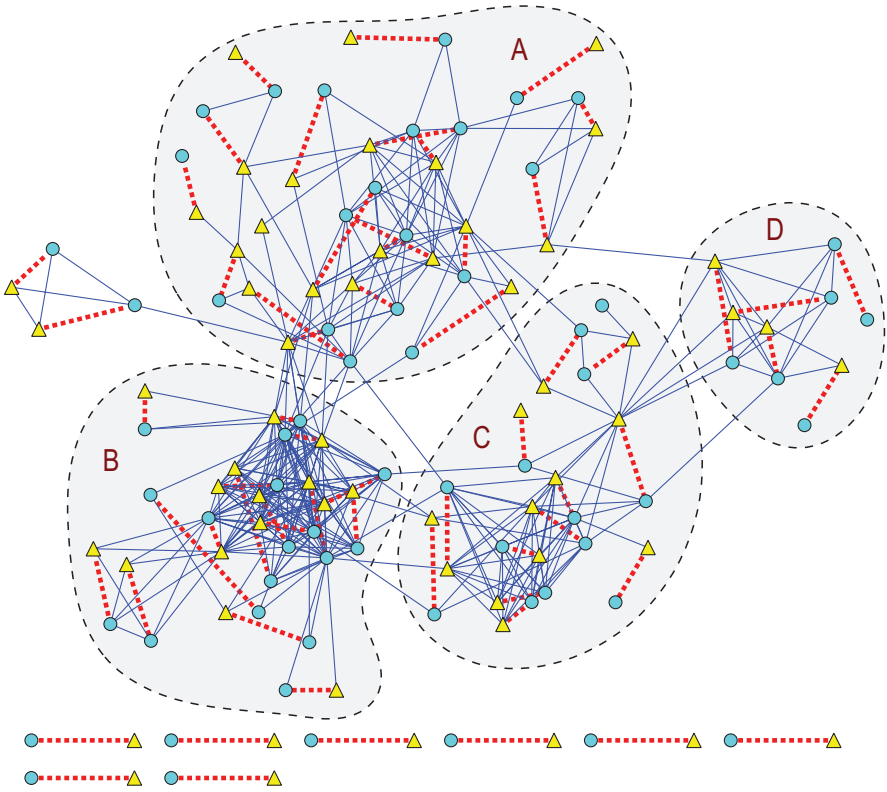
Static Network Descriptions

The study population is homogeneous regarding partnership statuses (100 percent are in a cohabiting partnership) and level of education (98.3 percent of nonmissings have a university degree). The population is heterogeneous regarding age, gender, number of children, race/ethnicity, and religion. The participants are aged 22 to 42, with two outliers at the age of 54 and 60 (mean age: 28.6, standard deviation: 3.9 years, both without outliers). Of the participants, 48.4 percent are female and all but two couples are heterosexual. The five main ethnicities are (in alphabetical order) Asian (38.2 percent), Black (2.4 percent), Hispanic (8.9 percent), Middle Eastern (5.7 percent), and White (24.4 percent). Furthermore, 49.6 percent of the individuals have children. The seven most frequent religious denominations are (in alphabetical order) atheist or no religion (28.7 percent), Buddhist (5.7 percent), Catholic (11.5 percent), Hindu (3.2 percent), Jewish (12.3 percent), Mormon (16.4 percent), and other Christian denomination (20.5 percent).

Figure 2 presents a visualization of the friendship and partnership network in wave 1. Friendship ties are indicated by blue lines (they were symmetrized for the visualization), and partnership ties are indicated by dashed lines. Females are represented by triangles, and males by circles. Community structure (dense areas with sparse connection to the rest of the network) was discovered based on the modularity criterion with a fast-greedy algorithm (Clauset, Newman, and Moore 2004). These clusters are marked by gray areas with a dashed border. By comparing the attribute compositions of the clusters, we obtain an initial understanding of how homophily may interplay with the clustering of the network. Four clusters have 10 or more nodes, named A, B, C, and D. Other clusters are one of four persons on the left and eight couples below that do not have friendship relations with other couples in wave 1.

The mean age of the clusters is very similar, ranging from 28.1 (cluster A) to 30.4 years (cluster C). There is a bit more variation in the gender variable, ranging from 40 percent females in cluster D to 51.3 percent females in cluster A. These differences stem from two partners not participating in the friendship survey and two homosexual couples in clusters B and D. We find significant

Figure 2. The friendship network in wave 1: solid lines indicate friendship; dashed lines, partnership. Eight couples are not embedded in the main component of the friendship network in wave 1. Circles are male participants, and triangles are female participants. Clusters are indicated by dashed lines.



differences between the four clusters on the three other variables of race/ethnicity, having children, and religion. The main race/ethnicity is Asian (89.4 percent) in cluster A; White (78.1 percent) in cluster B; White, Asian, and Middle Eastern (43.4, 39.1, and 13 percent, respectively) in cluster C; and Hispanic (100 percent) in cluster D. Regarding parental status (having children, yes or no), cluster B (84.4 percent have children) differs significantly from clusters A (34.2 percent) and C (44 percent). The distributions of religion are clearly different. The main religious denominations are none (64.1 percent) and Buddhist (10.3 percent) in cluster A; Mormon (62.5 percent) and other Christian denominations (21.9 percent) in cluster B; Jewish (54.5 percent), other Christian denominations (22.7 percent), and Hindu (9.1 percent) in cluster C; and Catholic (70 percent) and none (30 percent) in the "Hispanic" cluster D.

Table 2 compares the average differences between partners, friends, and all individuals regarding the five attributes of age, gender, race/ethnicity, having children, and religion. Except for gender, partners tend to be significantly more similar than both reference groups. Almost all couples are heterosexual. Friends are, on average, more similar to each other than random individuals on all five

Table 2. Average Similarity of Partners (Homogamy) Compared with Average Similarity of Friends and All Individuals in Wave 1

Attribute	Partners	Friends (W1)	Random pairs
Age diff. (years)	2.0	3.1	5.1
Same gender	3.2%	54.6%	49.7%
Same race/ethnicity	78.3%	75.4%	32.4%
Same parental status	96.7%	68.2%	49.6%
Same religion	84.7%	75.3%	16.3%

attributes. This finding can be interpreted as initial, static evidence for homophily in the friendship network.

Dynamic Method and Model Specifications

In this section, we present a set of models to test the dynamic hypotheses 1–7 from above. We specify stochastic actor-oriented models for longitudinal network data (SAOMs; see Snijders, van de Bunt, and Steglich 2010), which are estimated with the RSiena software version 4 (Ripley, Snijders, and Lopez 2011). The models assume that individuals "optimize" their local friendship network configuration over time by changing the composition of outgoing ties according to dynamic preferences, such as homophily or transitivity. Individuals' choices of whether to create, dissolve, or maintain a friendship tie over time are made "on the basis of their and others' attributes, their position in the network, and their perceptions about the rest of the network" (Snijders, van de Bunt, and Steglich 2010, 6).

Differences between the four observed friendship networks indicate that individuals reconsider their friendship network configurations over time and create, maintain, and drop friendship relations with others.

Whenever an actor considers changing her set of outgoing ties[7] (her personal network configuration), she is assumed to evaluate all possible outcomes of any of the following actions: keeping the network unchanged, nominating a new person as a friend, or dropping an existing friendship relation. This choice is formally modeled as a discrete multinomial choice model (McFadden 1974). The probability of actor i adding a tie to an actor j is, for example, expressed as

$$
\begin{aligned}
P\left(i \rightarrow j; x, \beta\right) &= \frac{\exp\left(\beta^T s(i, x^{i \rightarrow j})\right)}{D_1 + D_2 + D_3} \\
D_1 &= \sum_{k \in A_i^{\rightarrow}} \exp\left(\beta^T s(i, x^{i \rightarrow k})\right) \\
D_2 &= \sum_{l \in A_i^{\rightarrow}} \exp\left(\beta^T s(i, x^{i \nrightarrow l})\right) \\
D_3 &= \exp(\beta^T s(i, x)),
\end{aligned}
\tag{1}
$$

where x is the friendship network before any change is applied, $x^{i \to j}$ if a tie $i \to j$ is added, and if $x^{i \nrightarrow k}$ a tie $i \to k$ is removed from x. $A_i^{\rightarrow}$ is the set of all actors that i is friends with before the decision is made, $A_i^{\nrightarrow}$ are those actors she is not friends with ($j \in A_i^{\nrightarrow}$), and $A = \left\{A_i^{\rightarrow} \cup A_i^{\rightarrow} \cup i\right\}$ is the set of all actors. D_1, D_2, and D_3 are the parts of the denominator that evaluate the possibilities of i adding a tie, removing a tie, or keeping the network unchanged, respectively.

The probability of actor i dropping a tie to actor h and the probability of actor i keeping her personal network unchanged are expressed in a similar way:

$$P(i \nrightarrow h; x, \beta) = \frac{\exp(\beta^T s(i, x^{i \nrightarrow h}))}{D_1 + D_2 + D_3} \tag{2}$$

$$P(i \text{ no change}; x, \beta) = \frac{\exp(\beta^T s(i, x))}{D_1 + D_2 + D_3}. \tag{3}$$

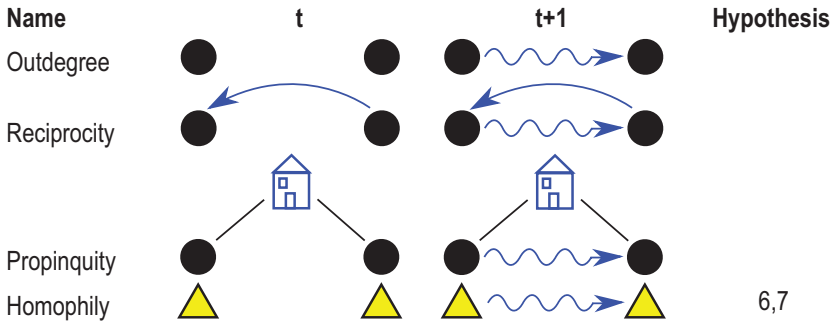
The probabilities share a vector $\beta = (\beta_1, \ldots, \beta_k)$ that weights a vector of choice statistics $s(i,x) = (s_1(i,x), \ldots, s_k(i,x))$. These choice statistics $s(i,x)$ are operationalizations of dynamic preferences, such as the number of homophilic friendship ties that an individual maintains or the number of transitive structures in which she participates. The linear function $\beta^T s(i,x)$ can be interpreted as an objective function of an individual's personal network that she wants to maximize based on her preferences and the given opportunities in the network x. In the results section, we report the estimated parameter vectors $\hat{\beta}$ for models with different sets of choice statistics.

In our study, we test seven different models with 16 choice statistics that are grouped into five classes: dyadic effects, higher-order structural effects, homophily effects, triadic partnership effects (partner triplets), and effects involving two couples (partner quadruplets). In the following, we present these classes of effects, going from straightforward to complex effects and from friendship-endogenous to attribute-related to partnership-related effects. At the end of each section, we discuss their relationship with the seven hypotheses.

Dyadic Effects

As three baseline effects in the friendship formation process, we test the outdegree (number of friends nominated per actor), reciprocity (number of reciprocated friendship ties of an actor), and propinquity (tendency to be friends with someone who is a neighbor in the housing community). The families in our study are assigned to apartments by the housing administration. We construct a binary variable: neighbors are defined as those who are living in the same multi-family house or on the same floor of a large apartment building. The three dyadic baseline effects are shown in the first three rows of figure 3. The effect statistics $s_1(i,x) - s_3(i,x)$ count the number of outgoing ties, reciprocated ties, and friends nominated who are also neighbors. Formulas can be found in Ripley, Snijders, and Lopez (2011, 100, 104, no. 1, 2, 32).

Figure 3. Dyadic effects (including an exemplary homophily effect).



Higher-Order Structural Effects

We further control for a number of higher-order structural mechanisms by including four effects. First, *transitive triplets* counts the number of transitive friendship structures in which an actor is embedded, following the idea of "friends of a friend become a friend." Second, we test the effect of circular (non-hierarchical) closure (*three-cycles* effect) in local environments. The third effect counts the number of actors to which the focal actor is only indirectly tied (*distance two effect*). This effect is closely related to transitivity. A negative parameter would indicate that actors tend to befriend friends of friends rather than maintaining open two-paths. Fourth, we test whether individuals with many friendship nominations are more likely to be further nominated (*in-degree popularity* effect). This effect can be interpreted as "preferential attachment" (Snijders, van de Bunt, and Steglich, 2010, 48). All higher-order structural effects are depicted in figure 4. The effect statistics $s_4(i,x) - s_7(i,x)$ count the number of transitive triplets, circular triplets, actors at distance two, and the sum of in-degrees of all nominated friends. Formulas can be found in Ripley, Snijders, and Lopez (2011, 100–102, no. 3, 5, 11, 15).

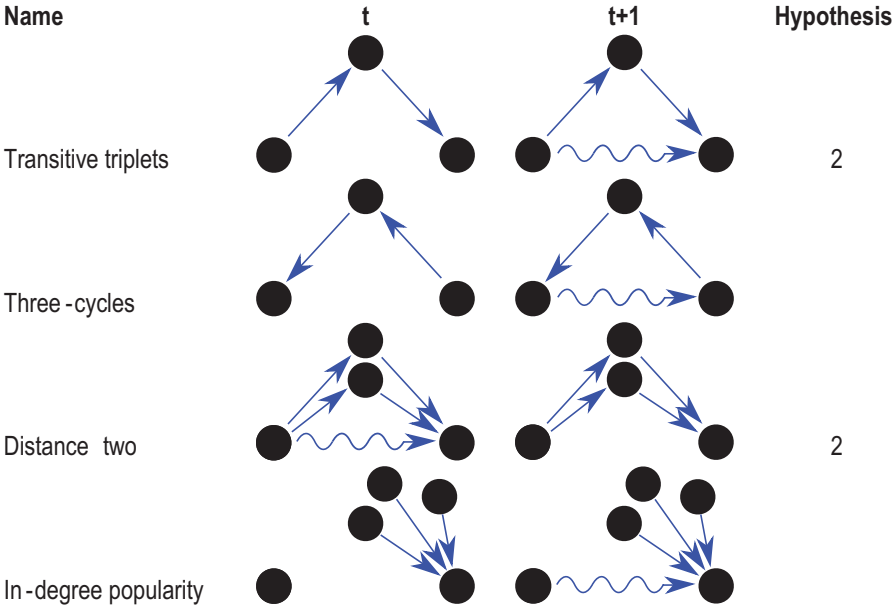
Hypothesis 2 states that we expect the tendency toward partnership triplets to be stronger than the tendency toward friendship triplets. Therefore, the corresponding parameters are expected to be larger than a combination of the transitive triplet effect and the distance two effect.

Homophily Effects

We test five different types of homophily: gender homophily, age homophily, homophily regarding race/ethnicity, parental status homophily, and religious homophily. Exemplarily, the dynamic process of gender homophily is depicted in the fourth row of figure 3 for a tie emerging between two female actors. The five effect statistics are called $s_8(i, x) - s_{12}(i, x)$. The formulas can be found in Ripley, Snijders, and Lopez (2011, 150, no. 40, 42).

Hypothesis 6 states that the level of homophily of homogamous attributes is amplified by partnership clustering. Therefore, we expect that the level of homophily in these attributes (age, race/ethnicity, parental status, religion) significantly decreases after controlling for the corresponding partnership effects.

Figure 4. Higher-order structural effects (structural).



Hypothesis 7 states that gender homophily may be de-amplified by partnership clustering. We expect a significant increase of the gender homophily effect after controlling for the corresponding partnership effects.

Triadic Partnership Effects

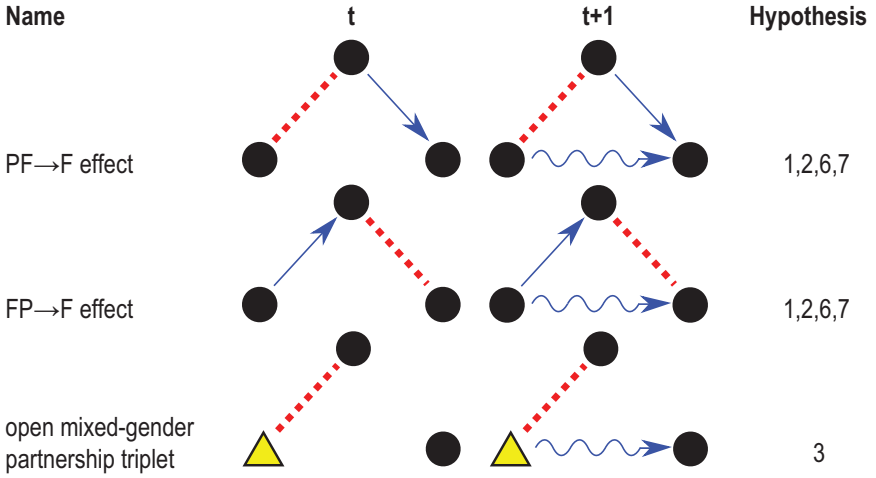
We test whether there is a tendency to form *partnership triplets*. Are friends (F) of a partner (P) more likely to become one's friend (*PF→F* effect), and is the partner of one's friend more likely to become a friend (*FP→F* effect)? Both effects are shown in figure 5. The third effect in figure 5 is what we introduced as an *open mixed-gender triplet*. It tests the tendency to be friends with someone of a different gender without the partner being involved. We refer to this group of three effects as *partner triplet* effects in the following. The mathematical definitions of the first two effect statistics $s_{13}(i, x)$ and $s_{14}(i, x)$ can be found in Ripley, Snijders, and Lopez (2011, 104–5, no. 35, 36). The open mixed-gender triplet effect is newly developed for this paper and is defined as

$$s_{15}(i,x) = \sum_{k,j \in A \setminus \{i\}} x_{ij} w_{ik} (1 - x_{kl}) I\{v_i \neq v_j\},\ k \neq j. \tag{4}$$

The friendship network is denoted by x. Variable w_{ik} equals one if actor i and k are partners and zero otherwise. The indicator function $I\{v_i \neq v_j\}$ equals one if actor i and j have different gender attributes v_i and v_j (female = 1, male = 0). Otherwise, function I equals zero.

Hypothesis 1 states that we expect a tendency for closure of partnership triplets that should manifest in a positive effect. Hypothesis 2 states that this effect is

Figure 5. Examples of triadic clustering with a partnership tie, which is indicated as the dashed tie (partnership triplet). Friendship ties are solid arcs. A tie between a triangle and a circle is a mixed-gender tie. Ties between circles can be either same- or mixed-gender ties. The P in the effect names refers to a partnership tie, whereas the F refers to a friendship tie.



expected to be stronger (in absolute terms) than the tendency toward friendship transitivity (see above). Hypothesis 3 states that open mixed-gender triplets are unlikely structures. We expect a negative effect. Hypotheses 6 and 7 relate to the interplay between partnership clustering and homophily and have been discussed above.

Partnership Quadruple Effects

The final class of effects is related to clustering in the friendship network involving two couples (*PFP→F effects*). The first effect tests whether two individuals are more likely to nominate each other as friends if there is an existing friendship relation between their partners. We use this as a main effect and additionally test an interaction with gender similarity. Both effects are shown in figure 6.

Because we implemented the effects newly for this study, we also report the effect statistics:

$$s_{16}(i,x) = \sum_{k,l,j \in A\setminus\{i\}} x_{ij} w_{ik} x_{kl} w_{lj} I\{v_i \neq v_j\}, \tag{5}$$

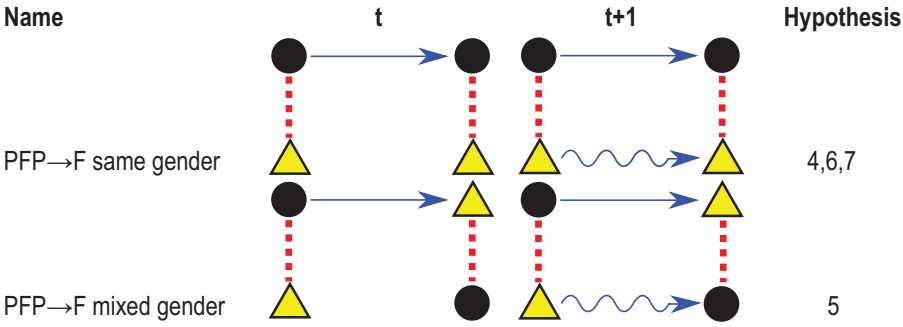
$$s_{17}(i,x) = \sum_{k,l,j \in A\{i\}} x_{ij} w_{ik} x_{kl} w_{lj} I\{v_i = v_j\}, \tag{6}$$

k, l, j are different.

The notation is as described below equation 5.

Hypothesis 4 states that partnership quadruplets are likely to emerge. Therefore, we expect a positive estimate of the *PFP→F same gender* effect. Hypothesis 5 states that a mixed-gender partnership quadruplet is an unlikely structure. We

Figure 6. Clustering involving two couples. Partnership ties are indicated as dashed lines (partnership quadruplet). Friendship ties are solid arcs. The focal actor is on the lower left, and the chosen actor is on the lower right. Gender similarity is indicated by a tie between triangles. The P in the effect names refers to a partnership tie, whereas the F refers to a friendship tie.



expect a negative estimate of the *PFP→F mixed-gender* effect. Both effects further relate to hypotheses 6 and 7 about the amplification and de-amplification of homophily.

Specifications

Above, we introduced five sets of parameters of the dynamic friendship formation process that operationalize the hypotheses discussed earlier as well as additional control mechanisms. To investigate the interplay of these parameter classes, we specify and estimate seven models in which the parameter groups are stepwise exchanged, starting with straightforward baseline models and ending with a fully specified model. An overview is given in table 3.

Results

Seven dynamic network models with different sets of parameter specifications were estimated. The results are shown in table 4. Each model consists of two columns showing parameter estimates and standard errors. A comparison of estimates between different models can reveal the interplay of parameters. Rate parameters (see Snijders, van de Bunt, and Steglich 2010) are reported but not discussed.

Dyadic effects are included in all models. *Reciprocity* and *propinquity* are significantly positive in most models, indicating the tendency of individuals to reciprocate friendship nominations and to nominate those as friends who are spatial neighbors. The probability of nominating a neighbor as a friend (propinquity) is 34 percent[8] higher compared with non-neighbors. The odds of reciprocating a tie compared with non-reciprocation are 3.7 (model 7: $e^{1.31} = 3.7$). The *outdegree* effect is negative, indicating that the number of friendship nominations per actor is limited. It can be interpreted as an intercept because it counterbalances

Table 3. Seven Models (Model 1 – Model 7) Specified with Five Different Classes of Parameters (rate parameters are estimated in all models)

	M1	M2	M3	M4	M5	M6	M7
Dyadic effects	X	X	X	X	X	X	X
Structural effects	X		X	X		X	X
Homophily		X	X		X	X	X
Partner triplet				X	X	X	X
Partner quadruplet							X

against the rest of the model. The directions of these effects remain stable in all models.

The higher-order *structural effects* are significant in most models. *Transitive triplets* is significantly positive in all models, whereas *three-cycles* is negative.[9] In combination with the negative effect for *distance two* structures (avoidance of open two-paths), we infer that there is a strong tendency for triadic clustering in the friendship network: individuals tend to be friends with their friends' friends. Additionally, the *in-degree popularity* effect is positive, which indicates that individuals with a high in-degree tend to attract and keep additional friendship nominations.

Homophily parameters clearly interplay with other parameters. Depending on the other effects in the model, homophily parameters are significantly positive or not. Further, there are remarkable changes in absolute values between the different models, even though we shall only carefully interpret these absolute changes, given that parameter comparisons are critical in log-linear models. Model 2 can be understood as a dyadic baseline model indicating whether homophily is generally prevalent in the friendship network. Positive parameter estimates indicate an overrepresentation of ties between similar individuals relative to the population expectation. A change of homophily estimates after the inclusion of parameters controlling for network clustering suggests the extent to which this homophily is *choice homophily* based on individual preferences and the extent to which it is *induced homophily* caused by other social mechanisms. We find that a large part of the overall homophily is induced by the amplifying effect of clustering, particularly the clustering around homogamous partnership ties.

For example, religious homophily has a significant estimate in the dyadic model 2 (0.73). After the inclusion of clustering and partner effects, however, we find no more evidence for religious choice homophily (the effect of 0.14 in model 7 is insignificant). This finding indicates that static observations of religious homophily are not solely based on choice homophily but, to a large extent, are induced by network clustering around religiously homogamous partnership ties.

Homophily in parental status is also amplified by network clustering around homogamous partnership ties. As with religious homophily, we find that the significant parameters of model 2 are eliminated in model 7, in which we control for all clustering effects.

Table 4. Estimates of Seven SIENA Models, Specified with Parameters Out of Six Classes (* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$)

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7	
Parameter	est.	s.e.	est.	s.e.	est.	s.e.	est.	s.e.	est.	s.e.	est.	s.e.	est.	s.e.
Rates														
Period 1	5.19	(0.49)	4.41	(0.38)	5.36	(0.49)	11.51	(1.72)	10.59	(1.54)	11.45	(1.70)	11.38	(1.60)
Period 2	4.19	(0.40)	3.84	(0.35)	4.40	(0.42)	7.59	(1.00)	7.07	(0.89)	7.69	(1.01)	7.89	(1.03)
Period 3	3.69	(0.36)	3.31	(0.30)	3.81	(0.37)	6.12	(0.78)	5.66	(0.70)	6.21	(0.80)	6.38	(0.83)
Dyadic effects														
Outdegree	–2.53***	(0.08)	–2.89	(0.09)	–3.05***	(0.11)	–2.64***	(0.07)	–2.75***	(0.07)	–3.13***	(0.08)	–3.06***	(0.08)
Reciprocity	2.49***	(0.15)	2.17***	(0.12)	2.22***	(0.14)	1.48***	(0.15)	1.10***	(0.13)	1.32***	(0.14)	1.31***	(0.14)
Propinquity	0.53***	(0.14)	0.54***	(0.13)	0.62***	(0.13)	0.26*	(0.13)	0.24	(0.13)	0.29*	(0.13)	0.29*	(0.12)
Structural effects														
Transitive triplets	0.12*	(0.06)			0.11*	(0.05)	0.11**	(0.04)			0.10**	(0.04)	0.10**	(0.03)
Three cycles	–0.17	(0.11)			–0.20*	(0.09)	–0.19**	(0.07)			–0.20**	(0.06)	–0.19**	(0.06)
Distance two	–0.24***	(0.03)			–0.21***	(0.03)	–0.08*	(0.03)			–0.07*	(0.03)	–0.06	(0.03)
In-degree popularity	0.11***	(0.02)			0.11***	(0.01)	0.04**	(0.02)			0.04**	(0.02)	0.04*	(0.02)
Homophily														
Similar age			0.41	(0.23)	0.08	(0.22)			0.19	(0.20)	0.06	(0.21)	0.04	(0.21)
Same gender			0.12	(0.07)	0.19**	(0.07)			–0.15**	(0.06)	0.20***	(0.06)	0.01	(0.07)
Same race/ethnicity			0.71***	(0.08)	0.59***	(0.08)			0.46***	(0.07)	0.43***	(0.07)	0.40***	(0.07)
Same parental status			0.29***	(0.08)	0.13	(0.07)			0.16*	(0.07)	0.12	(0.07)	0.11	(0.07)
Same religion			0.73***	(0.08)	0.39***	(0.09)			0.29***	(0.08)	0.17*	(0.09)	0.14	(0.09)
Partner triplet														
PF→F							0.74***	(0.14)	0.68***	(0.12)	0.76***	(0.12)	1.37***	(0.19)
FP→F							1.39***	(0.07)	1.52***	(0.07)	1.36***	(0.07)	1.52***	(0.09)

open mixed-gender	–0.98***	(0.13)	–1.18***	(0.08)	–0.76***	(0.08)	–0.82***	(0.10)
Partner quadruplet								
PFP→F mixed gend.							–1.62***	(0.33)
PFP→F same gend.							1.69***	(0.27)

There is only weak evidence for age homophily in our data. In the dyadic model 2, we find a borderline significant effect that is, however, eliminated with the inclusion of clustering effects.

We observe a contrary effect with gender homophily. Only after controlling for clustering (models 3 and 6) do we find strong evidence for choice homophily of gender in the friendship network. In the complete model 7, gender homophily is again eliminated, as same-gender preferences are sufficiently explained by the gender-related partnership clustering effects. These effects in combination suggest that, first, partners tend to agree on friendship choices and to befriend other couples. The initial friendship tie, however, tends to be a same-gender tie. Second, individuals avoid mixed-gender friendship relations, as suggested by the effects related to the open mixed-gender triplets and mixed-gender quadruplets. This means that gender choice homophily is prevalent (even though there is no evidence in the dyadic baseline model), but it is partly driven by an *avoidance* of imbalanced mixed-gender ties. In the dyadic baseline model 2, we do not find statistically significant evidence for gender homophily at all because it is suppressed by the many mixed-gender ties induced by clustering around partnership ties. In model 5, we even find a significantly negative gender homophily effect which, however, is a side effect of an incomplete model specification[10] that does not represent clustering very well and focuses only on partly gender-related triadic partnership effects.

Evidence for ethnic choice homophily is prevalent in all models. Net of all other effects, a tie between actors of the same race/ethnicity is 49 percent more likely to be formed than a mixed-ethnic tie (model 7: $e^{0.40} = 1.49$). The probabilities in the dyadic baseline model 2 are higher (a mixed-gender tie is 103 percent more likely: $e^{0.71} = 2.03$). However, we refrain from interpreting these absolute differences, as this is critical in log-linear models. Nevertheless, we may loosely argue that a comparison of the log odds indicates that in the case of ethnicity, the partnership cluster mechanisms also explain a relevant proportion of the observed static homophily.

We find the *partner triplet effects* to be significant in all models. Both types of partner triplets (PF→F and FP→F) are positive: individuals tend to nominate friends of their partners as friends and the partners of their friends as friends. The tendency to close partnership triplets is more than three times stronger than the tendency to close transitive friendship triplets.[11] The parameter relating to the *open mixed-gender triplets* is negative. We infer that individuals avoid nominating friends of different genders as long as the partner does not maintain a "confirming" friendship. If mixed-gender ties are created, this is only after the partner has become friends with the other person. The nomination of a

different-gender friend is 8.9 times more likely if there is "approval" by the partner (PF→F), indicated by a friendship tie (model 7: $e^{1.37}/e^{-0.82} = 8.9$).

The two *partner quadruplet* effects in model 7 are both significant. Net of partnership triplets, we observe a tendency for individuals to nominate same-gender friends if their partner is friends with the new friend's partner. This leads to a situation in which the two men and two women of two heterosexual couples are friends but no mixed-gender friendship ties exist. A similar pattern with mixed-gender friendships only, however, is highly unlikely. These two effects interplay with the PF→F partnership triplet. After the inclusion, the PF→F estimate almost doubles, whereas all other effects (except for gender homophily, as discussed) remain stable.

Discussion and Conclusion

Our study finds that partnership ties strongly influence the shape of friendship networks. We find striking support for our hypotheses of how friendship networks cluster around partnership ties and how this mechanism relates to homophily and homogamy. The very high level of ethnic and religious segregation within the friendship network of the community studied (see figure 2) is explained partly by choice homophily and partly by the amplifying effects of clustering around homogamous partnership ties.

We find strong evidence that individuals strive to close partnership triplets (hypothesis 1). In addition to transitive clustering ("friends of my friends become my friends"), individuals in our study tend to become friends with friends of a partner and with the partner of friends. This effect is approximately three to four times stronger than the closure of transitive triplets (hypothesis 2). This finding supports our argument that opportunity-related closure, closure as a byproduct of similar preferences, and closure based on cognitive imbalance are more likely when a partnership triplet is to be closed. These findings are in line with the theoretical considerations of Heider (1958) and Granovetter (1973).

In addition to the tendency to close imbalanced partnership triplets, we find strong evidence that individuals avoid creating mixed-gender friendship relations if their partner is not also friends with that person (hypothesis 3) and thus is in an approving position. We hypothesized that these "open mixed-gender triplets" are perceived as highly imbalanced by the partner of the friendship tie initiator. Individuals consider their partner's perceptions when making choices about personal friendship networks. We argue that friendship ties may serve as a control mechanism to secure the stability of the intimate partnership tie, which partly explains the particular avoidance of open mixed-gender triplets. This idea is in line with the arguments of Parks, Stan, and Eggert (1983).

We hypothesized that couples befriend other couples: individuals are likely to be friends with the partner of their partner's friends. The emerging structure is called a partnership quadruplet (hypothesis 4). The argument is based on opportunity-related interaction and the likelihood of similar preferences. We find strong evidence for the emergence of such structures with two partnership ties as long as the friendship ties within the quadruplets are between individuals of the same gender. Mixed-gender partner quadruplets are avoided (hypothesis 5) because

they incorporate similar structures as the open mixed-gender triplets. The formation of partnership quadruplets was expected based on an extension of the arguments about triadic closure by Granovetter (1973).

Partnership ties in our study are characterized by high homogeneity regarding race/ethnicity, religion, and age. Homogamy is a typical characteristic of partnership ties (Kalmijn 1998). Additionally, partners in our study mostly have common children and different genders. We argue that the high level of homogamy amplifies the level of homophily in the friendship network through its interplay with clustering around partnership ties (hypothesis 6). Indeed, we find strong evidence for this dynamic interplay in our study. By comparing models in which we selectively control for different types of partnership clustering, we are able to investigate the amplifying effect of these mechanisms. McPherson and Smith-Lovin (1987) discuss the difference between choice homophily (homophily based on homophilic preferences) and induced homophily. We find strong support for choice homophily in the race/ethnicity attribute.

However, the level of homophily is amplified by clustering around ethnically homogeneous partnership ties. We find no evidence for choice homophily in parenting, religion, and age in a fully specified model. However, potentially small preferences of individuals are significantly amplified through these clustering mechanisms, so we find flawed evidence for homophilic preferences when we do not control for partnership clustering. We conclude that a significant proportion of this homophily is potentially induced.

Gender homophily is a special case: we find strong evidence for gender choice homophily only *after* controlling for partnership-related clustering. The mainly heterosexual partnership ties in the community studied induce a large number of mixed-gender ties (hypothesis 7). If a heterosexual couple has a common friend, then one of the two friendship ties will be a mixed-gender relation. Only after including triadic partnership effects in our model do we find clear evidence of gender choice homophily. Interestingly, this gender homophily is eliminated when controlling for the two partnership quadruplets that *amplify* gender homophily: same-gender friendship relations lead to additional friendship ties between the two partners of the friends—a tie that is again a same-gender tie. Another part of gender homophily is explained by the *avoidance* of imbalanced mixed-gender structures (gender heterophobia). These findings are in line with and extend Kossinets and Watts (2009) and Goodreau, Kitts, and Morris (2009), who discuss the potential interplay of general network clustering and homophily.

Our study has certain limitations. First, we investigate the influence of partnership ties on friendship ties, but there is certainly also an influence of friendship ties on partnership ties. For example, friends may become partners or introduce potential partners. We do not investigate the effect of friendship on partnership ties because no partnership ties emerge or dissolve in our study. Second, we could not study the effect of choosing friends who are not in a partnership because only individuals in stable relationships participated in our study. However, having a few "single" friends in a personal social network may provide a type of social capital that friends who are in a relationship cannot provide. The amplifying effect of partnership ties on homophily may be weaker in a population consisting of singles and couples. The hypothesis of friendship agreement as

a matter of control might, however, be more relevant in a mixed single-couple context. Third, we have no information on friendship ties prior to moving into the graduate housing community. There are good reasons to assume that most couples do not know anyone else when joining the community because the cultural and geographical background of the tenants is very diverse. However, there may be previously existing friendship ties that induce homophily (e.g., by two befriended couples moving from a different country together). This situation would be misinterpreted as choice homophily in our dynamic results. Fourth, the community studied is atypical in other ways. Couples decided to live in a graduate community of partners in the first place (and to work in a university environment), so there are certainly self-selection effects in the community composition that might affect the generalizability of the results. Furthermore, all individuals are new to the place and therefore may have few local friendship ties. As such, the friendship network is likely to be more dynamic than an average friendship network. Further, the level of heterogeneity in religion and race/ethnicity is higher than in many other residential networks that were, for example, formed over several generations. However, we believe that these particularities of our study are a fascinating feature. They allow us to study a variety of concurrent partnership- and attribute-related network mechanisms in a relatively small environment for which we could collect unique complete, longitudinal social network data. The effects that we find are very clear, and we believe that they are generalizable to a certain degree. Finally, there are methodological limitations and assumptions in the SIENA framework (Snijders, van de Bunt, and Steglich 2010, section 2). We loosely interpret large changes of parameter estimates and changes of parameter significance between models as an indication that both choice homophily and induced homophily are present. However, we refrain from interpreting the absolute changes, as this is considered critical in log-linear models. Further, the different estimates of rate parameters make model comparisons in terms of log odds critical. However, because the model differences are quite unambiguous (e.g., highly significant versus insignificant estimates), we are confident that our approach of model comparison is valid. The SIENA framework is the most advanced statistical tool for the analysis of multi-mechanistic social networks hypotheses. It allowed us, for the first time, to test hypotheses on the influence of partnership ties on the dynamic formation of friendship networks. In particular, we could investigate the interplay of homophily, homogamy, and a variety of theoretically motivated partnership-related clustering mechanisms.

We show that partnership ties work as nuclei in the formation of clusters in the friendship networks. A high level of homogamy between partners amplifies the level of homophily regarding race/ethnicity, religion, and parental status. It is, however, not mainly individual preferences (choice homophily) that explain the formation of ties between similar individuals. Rather, weak homophilic preferences and a tendency to cluster around (mostly homogamous) partnership ties are the origin of highly "homophilic" clusters. In a dyadic baseline model, we find, for example, evidence of homophily in religion but no evidence of same-gender preferences. After controlling for partnership clustering, the effects swap: we find

no more evidence for religious choice homophily but significant effects for a preference for same-gender relations.

These findings imply that not controlling for partnership ties and their level of homogamy may result in an overestimation, incorrect reporting, or overlooking of homophily effects. Partnership ties are crucial in the formation of adult friendship networks. Although our study finds 6.5 times more friendship dyads than partnership ties, the partnership ties work as nuclei in the friendship formation process. Our research suggests that the effect of partnership ties should be considered when studying the evolution and shape of friendship networks.

Notes

1. Family ties, for example, are less based on individual choices.
2. We refer to stable partnership ties, such as marriage and long-term cohabiting partnerships.
3. The partner of two individuals did not participate in the network survey.
4. Granovetter argues from an undirected network perspective that does not explicitly capture the idea of individual choices.
5. For reasons of simplicity, we now consider the case of heterosexual actors by using gender differences as a proxy for potential romantic involvement.
6. We tested the robustness of this dichotomization threshold by additionally conducting all subsequent dynamic analyses on a friendship network in which a friendship tie was defined as present when a value of 5 (high-ranking friend) or more was chosen. In that case, the estimates related to the hypotheses change in absolute size, but the directions and significance of the effects are robust.
7. The continuous-time model of these change considerations is explained in Snijders, van de Bunt, and Steglich (2010).
8. Based on model 7: the increase of the objective function in case of a propinquity choice is 0.29×1. The odds of this choice are $e^{0.29} = 1.34$ compared with a nonneighbor choice assuming all other effects constant.
9. A negative three-cycle parameter in combination with a positive transitivity parameter is a common finding in stochastic actor-oriented models and usually is interpreted as an indicator of either hierarchy in transitive relations or a lower relevance of reciprocation in small groups (Block 2015).
10. Because higher-order structural effects are missing, choices about ties within friendship triplets are assumed to be conditionally independent. In transitive friendship structures, the closing tie is—net of other effects such as the open partnership triplet in this particular model—empirically more often a mixed-gender tie. That leads to a false detection of heterophilic preferences.
11. We calculate this as follows: closure of one friendship triplet in model 7 increases the probability of a corresponding choice by times $e^{(0.10+0.06)} = 1.17$, as one triplet is created and the number of open two-paths is reduced by one ($-1 \cdot -0.06$). Closure of a PF→F triplet increases the likelihood of the corresponding choice by times $e^{1.37} = 3.94$. The odds of these probabilities are 3.35. If an individual has the choice between closing one friendship triplet or one PF→F partnership triplet, she would 3.35 times more often close the partnership triplet (3.9 times more often in case of the FP→F effect). The ratios are only a rough comparison because they assume two alternative choices that close exactly one triplet each. However, one new friendship tie may close multiple triadic structures but can close a maximum of one partnership triplet of each type.

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