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New on the Block: Analyzing Network Selection Trajectories in a Prison Treatment Program

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Abstract

Personal network change is largely driven by transitions between the groups and organizations where people spend their day-to-day lives. But, how do entrants choose which relationships to pursue among the numerous possibilities a new environment offers? We expect newcomers will use the same mechanisms as longer-tenured members, although this will take time as they acclimate and form initial relationships that support future ties. Thus, our goal is to understand how the network selection processes used by new organizational members shift in importance as time in the organization grows. We focus on network selection via homophily, propinquity, formal relations, and endogenous network processes. For each mechanism, we distinguish between change in the strength of the mechanism and opportunities to enact the mechanism. We evaluate expected changes using network data from a prison-based therapeutic community (TC). This setting is ideal because the structured nature of TC entry and exit generates regular membership turnover and removes confounds present in studies of more familiar contexts (e.g., schools). Results show that the relative importance of network selection mechanisms varies over tenure, with homophily dominating early on and endogenous network processes catching up later. We discuss implications of these findings for new member socialization and broader patterns of inequality.

Keywords

social networks, group dynamics, organization integration, dynamic network analysis, prisons, incarcerated populations

Organizations are of inherent interest to network scholars because they are systems reliant on member cooperation to achieve shared goals (Kadushin 2011). Within the network literature, scholars have paid particular attention to the evolution of internal social structures within organizations such as unions, factory floors, and schools. Micro-level network mechanisms, including homophily (e.g., connecting to others with similar characteristics), triadic closure (e.g., connecting to others who share a tie with an existing contact), and shared interactional foci (e.g., connecting to co-participants in a shared activity), have been consistently shown to explain member clustering, social segregation, and community substructures across organizational settings (Dahlander and McFarland 2013; Kleinbaum 2018; Kossinets and Watts 2006; Moody 2001; Wimmer and Lewis 2010).

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For example, Kossinets and Watts (2009) found that connections in the email network of a university community were driven by individuals' sociodemographic homophily and shared social foci, such as taking the same academic courses or sharing extracurricular activities. System-level network research such as this has been essential for understanding, sustaining, and maximizing organizational cohesion and goals. However, missing from these studies—focused on the organization as a whole—are the distinct relational experiences of *new members entering established organizations*. For instance, first-year college students are motivated to meet new people and replenish their networks (diminished after leaving the high school context), whereas upper-level students engage more in rituals that promote solidarity within ongoing relationships (Wolburg 2016). Furthermore, new students entering as part of a first-year cohort—with the accompanying orientations, first-year seminars, and Greek life designed to ease their social and academic integration—encounter very different opportunities than upper-level students transferring from another institution with little in the way of institutional support and left to integrate into an established network. Given this, we propose that the specific relational needs and opportunities of organizational newcomers will differentially shape their relational strategies or "logics of attachment" compared to incumbents (Powell et al. 2005).

More generally, any context with a revolving membership (i.e., many of the places where people spend their lives) must periodically absorb new members. At the individual level, moves between schools, workplaces, neighborhoods, and voluntary associations severely alter one's relationship opportunities, making organizational transitions a leading cause of network turnover (Feld and Carter 1998; Marsden, 2018; Wrzus et al. 2013). We know that organizational entry and exit drive network change, but we know far less about the network selection mechanisms in operation during such transitions, particularly at the level of individual new members. A handful of studies of "social network formation" offer some insight to the relational processes newcomers use (Newcomb 1961). However, as we will detail, such cohort-based network emergence is qualitatively distinct from the solitary new member experience common across many organizational settings.

Research shows that network selection rules can shift over time as a network develops and actors learn about others and receive feedback from their environment (Ingram and Morris 2007; Powell et al. 2005; Schaefer 2012; van Duijn et al. 2003). Our goal is to understand the network selection processes used by organizational newcomers and how those micro-mechanisms change in importance as organizational tenure grows. In pursuing our questions, we distinguish two forms of change: (1) the strength of selection mechanisms (e.g., preferences for homophily) and (2) opportunities to enact selection mechanisms. We examine these two levels of change within the context of a prison therapeutic community (TC).

TCs are substance abuse treatment programs built on principles of social integration and peer influence to enhance treatment engagement and long-term recovery (De Leon 2000). Although not a typical setting for studying network dynamics, the TC has unique features that overcome limitations with conventional network study designs that either capture insufficient newcomers or confound changes in tenure, preferences, and opportunities. We examine change across 10 observation waves, during which TC membership turned over multiple times. Results show how growing tenure in the TC was accompanied by changes in the strength of selection mechanisms, opportunities to enact them, and their overall impact, with these often following different trajectories. We conclude by discussing broader implications for facilitating new member integration and understanding how organizations reproduce social segregation.

BACKGROUND

Transitioning into a new environment poses several challenges in meeting fundamental

needs for security and accomplishing goals (Kadushin 2011): "Newcomers enter organizations with relatively unstructured cognitive maps, experience some degree of disorientation and reality shock, and need to make sense of the new environment and their place in it" (Allen 2006:239). Relationships within the new setting ease organizational transitions (Hays and Oxley 1986; Small 2017) and have a strong effect on successful adjustment (Bauer et al. 2007). Efficiently integrating new members also benefits organizations by increasing outputs and maintaining group stability, both of which are concerns if more tenured or experienced members are simultaneously departing (Wanberg 2012). Given the importance of integration for individual well-being (Bauer et al. 2007; Dupere et al. 2015) and organizational goals (Wanberg 2012), we ask how the network formation process unfolds for the individual joining an established network.

Network Selection Mechanisms

In their review of network selection processes, Rivera, Soderstrom, and Uzzi (2010:108) call for more attention to "the changing role of different mechanisms as networks emerge and evolve," but they offer no specific pathway. Research on "social network formation" provides some direction. Pioneered by Newcomb's (1961) study of college housemates, the prototypical network formation study observes a group of strangers entering a common setting where relationships spontaneously develop (e.g., classrooms, an entering school cohort, new employee training). Individuals in such situations tend to connect with others who are physically proximate (Conti and Doreian 2010; Newcomb 1961), belong to the same organizational subgroups (Kleinbaum 2018), share similar backgrounds and interests (Boda et al. 2020; Newcomb 1961; van Duijn et al. 2003), or with whom they have friends in common (Doreian et al. 1996; Schaefer et al. 2010; van Duijn et al. 2003). Combined, these studies suggest that emergent social structures have "stages of development," whereby these mechanisms shift in importance as individuals become acquainted (Doreian et al. 1996; van Duijn et al. 2003) and early relations scaffold more complex network structures (Schaefer et al. 2010).

Many aspects of the solitary new member integrating into an established organization mirror this network formation context: individuals enter a strange setting replete with new faces and unknown norms. Hence, we expect the solitary newcomer to rely on the same relational processes observed during network formation (e.g., propinquity, homophily, triad closure). However, we also expect their experiences to differ in essential ways. In a network formation situation, *all* actors are newcomers and, as such, face the same novel and uncertain circumstances and motivation to build relationships. Furthermore, there is the joint task of developing group structure, including a status hierarchy, local norms, and interactional routines (Newcomb 1961). By contrast, when a newcomer enters an established setting, a social structure is already in place. The newcomer's task is to discover the informal aspects of the group and how to tap into existing social networks. This can be difficult because current members already have relationships and may not be motivated to build new ones. Finding the right persons to offer information and entrée into the informal social structure is simultaneously crucial and potentially challenging.

Non-cohort based organizational entry carries one other distinction: greater variability in organizational tenure among members. This heterogeneity allows tenure to become a differentiating individual-level characteristic that can inform newcomer network selection processes (Blau 1977). This may take the form of homophily, whereby newcomers develop ties to recent entrants and benefit from their similar statuses and associated activities. Such homophily is common when populations change via cohort substitution, such as in schools, where students tend to have same-grade friends (Goodreau, Kitts, and Morris 2009). However, newcomer homophily could be suboptimal for many organizations if dyads or groups composed

strictly of newcomers are disconnected from more experienced and knowledgeable longer-term members. Many organizations thus explicitly foster newcomer connections with experienced members via mentorship programs. Mentors offer access to the kinds of organizational information newcomers need, and the codified nature of the role encourages mentees to take advantage of this access. Network formation studies, however, have not focused on mentors because their design relies on all members being newcomers. Other research, however, has found mentors have strong effects on successful organizational integration (Bauer et al. 2007; Darwin and Palmer 2009; Kram and Isabella 1985; Ostroff and Kozlowski 1993; Savage, Karp, and Logue 2004), pointing to the need to move beyond network formation studies when examining newcomer network dynamics.

In light of the preceding discussion, we cannot simply extrapolate network-level trajectories or "stages of development" to explain how a single new member integrates into an organizational context. Instead, we ask how the selection processes at work during network formation apply to the solitary newcomer experience. We focus on four prominent mechanisms: (1) *homophily*, which is the tendency to choose people who are similar (e.g., same ethnoracial background), (2) *propinquity*, which captures choosing people who are near in social or physical space (e.g., neighbors), (3) *entrainment*, which represents how other types of relationships or role relations (e.g., formal mentorship) facilitate ties in the network of interest (e.g., friendship), and (4) *network endogeneity*, which captures how the network itself enhances the likelihood of particular ties (e.g., reciprocity, triad closure). These foundational processes are echoed in seminal works on social network selection and evolution (Dahlander and McFarland 2013; Kadushin 2011; Kossinets and Watts 2009; Rivera et al. 2010; Wimmer and Lewis 2010).[1]

For each relational mechanism, we distinguish between the mechanism's *strength* and *opportunities* to enact the mechanism. We define strength as the likelihood a tie will form given the opportunity is present (i.e., the conditional likelihood). For any given mechanism, an individual may have many opportunities but rarely take them. For instance, a member of the majority ethnoracial group has many opportunities for same-race friendship ties but may establish very few. By contrast, an individual may have few opportunities to enact a mechanism but pursue those she has with vigor (i.e., one may lack familial ties but treasure the idea of kinship). Examining strength and opportunities separately allows for their distinct network trajectories. Additionally, we can analyze strength and opportunities in combination to assess how consequential each mechanism is for overall network development (Indlekofer and Brandes 2013).

Sources of Change in Mechanism Strength

We begin by discussing how the strength of relational mechanisms (e.g., homophily, propinquity, entrainment, and network endogeneity) changes over tenure, net of changes in opportunities. Initially, newcomers are motivated to reduce uncertainty, alleviate loneliness, and accumulate information about the new context. Many relationships can meet these needs and, as such, we expect ties to form somewhat indiscriminately. Newcomers will explore relations with individuals who are near (propinquity), people they interact with in various roles (entrainment), and others who appear similar (homophily). We also expect newcomers will disproportionately develop ties with other recent newcomers due to their propinquity and the relevant support such peers provide (Small 2017). If available, newcomers will also pursue endogenous network opportunities (e.g., through reciprocity, triad closure).

As individuals' needs shift, the benefits accrued from relationships developed via various network mechanisms are likely to change. For example, on the first day of class, the person sitting in the next chair may be sufficient to answer the question: "Am I in the

right room?" However, propinquity may not be the best way to find a study partner with the same level of academic motivation. Similarities on things like motivation, values, or attitudes are often desired but cannot necessarily be discerned by surface appearance. In general, relations that primarily offer information on the new environment lose their initial value once that information is acquired. Likewise, relations with others going through the same transition (i.e., homophilous on tenure) are initially useful for their shared perspective and support (Small 2017; Thoits 2011) but may become less necessary over time.

As tenure grows, we expect some of the aforementioned relational mechanisms to weaken. Consistent with prior research, we expect decreasing strength for propinquity (Conti and Doreian 2010; van Duijn et al. 2003), foci (Boda et al. 2020; Godley 2008), and homophily on observable attributes (Godley 2008; van Duijn et al. 2003). These mechanisms serve as filters that can help target viable relationships, but they can be so inclusive that one must be selective in which relationships to pursue more deeply. By contrast, other mechanisms lead to relatively few people. For instance, some role relations only include one other person (e.g., a roommate or mentor). We expect the pursuit of such relationships to occur soon after the opportunity presents itself. Role relations that only address a newcomer's initial needs (e.g., orienting information) will weaken, with those that better meet ongoing needs persisting (e.g., support, relatedness, career development). As a consequence, the strength of entrainment will be strongest when the opportunity avails itself; it will persist or weaken but not increase.

This logic leads us to also expect endogenous network processes (e.g., reciprocity, triad closure) to weaken over time. This expectation departs from prior research suggesting these structures increase in importance as networks form. The evidence is equivocal; some network formation studies have argued that reciprocity peaks early, with Schaefer and colleagues (2010) and Doreian and colleagues (1996) finding it remains relatively stable, and van Duijn and colleagues (2003) observing a slight decrease across waves. Structural and cognitive perspectives agree that transitive structures should emerge gradually (Newcomb 1961; Schaefer et al. 2010), with corresponding analyses showing steadily increasing transitivity throughout the network formation period. However, these studies do not account for the fact that as ties form and a network coalesces, opportunities for reciprocity and transitivity increase as well, thereby confounding opportunities and mechanism strength.

We argue that when strength is decoupled from overall network growth, reciprocity and triadic closure will weaken over time (i.e., have a lower conditional likelihood). This logic is similar to that for other mechanisms. New entrants are motivated to embrace those who help them integrate socially, open avenues for needed support and resources (i.e., build social capital), and offer reputational information or other assurances to overcome relational risks (Burt 2001; Raub and Weesie 1990). But, given cognitive and logistical limits on network activity (Hill and Dunbar 2003), one cannot reciprocate everyone who befriends oneself, and not every friend-of-a-friend can become a friend.[2] As newcomers assimilate to their new setting, relational mechanisms become secondary to more salient selection criteria to filter relationships.

In summary, the relational mechanisms we discuss help newcomers cast a wide net and meet early, transition-driven needs. However, as a newcomer's organizational tenure grows, relational needs shift from emphasizing security and belongingness to efficacy and performance (both individually and collectively) as the new context becomes familiar and transition-induced uncertainty subsides. Thus, we expect that with few exceptions (e.g., homophily on attributes like deeply-held values; Newcomb 1961), the network mechanisms we discussed will weaken as organizational tenure increases. As Biancani and McFarland (2013:164) put it, "as collaborators know each other better, they make choices to work together or not based on more than relatively

superficial, homophilous traits." Growing tenure should widen new members' social networks as they increasingly learn about their environments and other members, take greater relational risks, and rely less on fundamental network selection processes.

Sources of Change in Mechanism Opportunities

Opportunities for each relational mechanism vary greatly and can change for several reasons. Many opportunities are determined by organizational routines and practices that bring people together or otherwise create conditions that foster relationship development. For example, universities organize students into classes, assign roommates, and organize learning communities, thereby creating shared social foci and propinquity that affect peer selection behavior (Brouwer et al. 2018; Kossinets and Watts 2009; Newcomb 1961). Similarly, complex organizations often recognize the challenge of being a newcomer and assign longer-tenured members the role of mentor or group leader to help build relationships and facilitate the integration process (Bauer et al. 2007).

Organizational turnover will affect these types of role relations: organizational departures dissolve formal relations, thereby reducing the opportunities those structures provide. By contrast, new organization members are housed closer to some peers than others, and the formal and informal roles they inhabit create opportunities for both the newcomer and existing members. Even when membership is stable, organizational routines may alter opportunities. For instance, Conti and Doreian (2010) observed that it was not until police recruits were assigned to squads that squad co-membership became predictive of friendship. Hence, opportunities for entrainment exist to the extent newcomers are more proximate to some peers than others, differentially share foci, or formal roles dictate interaction with some peers more than others.

Some opportunities may be less available initially but change over time. For instance, when newcomers enter an organization with no ties to current members and no knowledge of their new peers, there are no opportunities to form ties via endogenous network mechanisms wherein existing ties prompt new ties (Schaefer et al. 2010). As new organizational members begin to form relationships, network opportunities increase through structural cascading (Schaefer et al. 2010). Even one new relationship can lead to several indirect relationships, setting the stage for triadic closure. By contrast, the departure of one's peers dissolves network structures, thereby reducing the opportunities those structures once provided.

Opportunities for homophilous selection can exist when newcomers enter, but only on known or visible attributes, and only to the extent the population contains peers who are similar on salient attributes (van Duijn et al. 2003). Any change in membership, whether additions or departures, affects the organizational-level availability of peers with similar attitudes or behaviors and, hence, opportunities for homophily. Moreover, some attitudes or values may not be visible to the outside observer but become known through interaction (Newcomb 1961). Homophily on such "hidden" attributes cannot operate unless those attributes are manifest and individuals can detect one another's values (van Duijn et al. 2003). Relational opportunities effectively increase with greater environmental awareness and knowledge of others.

Tenure itself has unique properties that affect opportunities. Time in an organization can only increase; it increases at the same rate for everyone; and one's position in the tenure distribution can only move up over time.[3] Membership turnover necessarily alters the tenure distribution within an organization. From the newcomer's perspective, opportunities for tenure homophily can only increase. For instance, as first-year students become sophomores, opportunities for ties to graduating seniors wane, while the incoming first-year class provides new opportunities. For the rising sophomores, this demographic shift replaces a set of members three-years

different in age with a set one-year different in age. However, at some point in one's tenure, opportunities for tenure homophily can only decrease. Once a person reaches the midpoint of the tenure distribution, any newcomers will necessarily be further in tenure than any departing members. Thus, opportunities for tenure homophily will display an inverse U-shape.

These sources of opportunity change may interact in complex ways. For instance, Newcomb (1961) explains how people jointly evaluate other group members. Over time, such evaluations become balanced, such that sentiments and relations are aligned (e.g., close friends agree on who they like and dislike). Strong enough sentiments can lead to changes in the network and ensuing opportunities, for instance by creating disparate factions (Zachary 1977). Another example is elective differentiation (McFarland et al. 2014), such as occurs when students choose roommates, enroll in classes together, or join the same club (Lomi and Stadtfeld 2014). The organization creates or sustains these foci, but individual choice based on relational processes determines which relationship opportunities these foci will support.

Current Study

The current study examines the relational mechanisms at work as new members join an established organization, and how these processes change throughout their tenure. We focus on a fairly unique context—a prison-based therapeutic community (TC)—that offers several advantages. First, new members independently enter this particular TC on a rolling basis, providing many cases of newcomer integration over time (i.e., sufficient sample size). Second, because members enter individually and at different times, their membership tenures are not confounded with one another or overall network growth, meaning individual development is isolated from system development. And third, because the TC strives for maximum occupancy, network size remains relatively stable, thereby avoiding changes in global network structure or process related to size.

Our analysis distinguishes between changes in the strength of selection mechanisms and changes in opportunities to enact those mechanisms. We expect both will vary in predictable ways, with some decreasing and others increasing. What remains unknown is the *cumulative effect* of these changes on the importance of each mechanism in explaining network structure. A mechanism may be weak but have so many opportunities that it explains more of an observed network than a strong mechanism with few opportunities. Thus, as a final step, we compare mechanisms based on their overall impact (i.e., opportunities plus strength). This analysis of "relative importance" (Indlekofer and Brandes 2013) evaluates micro-mechanisms in relation to one another to assess how consequential each is for explaining the unfolding network structure.

DATA AND METHODS

Setting

Data come from the Therapeutic Community Prison Inmate Networks Study (TC-PINS), a longitudinal network study of prison-based treatment processes (Kreager et al. 2018; Kreager et al. 2019; Schaefer et al. forthcoming). The facility is a medium-security men's state prison in Pennsylvania that houses many short-sentence prisoners previously assessed as substance dependent while they complete substance abuse treatment near the end of their sentences. Prisoners are eligible to enter the TC if, during prison intake, they exhibit signs of drug dependence, evidenced by a score of six or higher on the TCU Drug Screen II (Texas Christian University Institute of Behavioral Research 2014). Prisoners who successfully complete the program typically become eligible for early parole.

We focus on one of the five TC units operating within the selected prison, which had 62 beds distributed among two-person cells and stands alone from the rest of the prison. TC

residents may be enrolled in classes to obtain a GED (high school diploma equivalent) or have other treatment groups (e.g., violence prevention), but they do not hold jobs during their TC stay, instead spending the majority of their day inside the unit in treatment-related activities.

TC residents complete an average of four months of TC treatment programming, with some remaining longer based on bed availability elsewhere in the prison. Their stay in the TC is organized into three phases of treatment and recovery. Movement through phases is hierarchically structured, with more senior residents completing and graduating from the program as new residents enter, generating a population that is continuously in renewal. During Phase 1 (induction – one month), residents receive a clinical diagnosis and are introduced to the objectives, structure, and rules guiding TC treatment. During Phase 2 (primary treatment – two months), participants acquire additional responsibilities by increasing their involvement in TC activities and assuming leadership roles. During this intense treatment phase, residents are encouraged to actively monitor and assess other members' behaviors and adopt formal roles as "big brothers" to Phase 1 residents. During Phase 3 (re-entry – one month), residents begin planning their exit from the program and likely prison release. Phase 3 residents are expected to transition out of their leadership roles (which are assumed by new Phase 2 residents).

Data Collection

Following Institutional Review Board (IRB) approval, data were collected over 10 consecutive months from August 2016 to May 2017. Each of the 10 waves of data collection lasted two to three days. Due to time-varying prison conditions (e.g., lockdowns), data collection did not occur at exactly one-month intervals, with an average of 28 days between waves. Data collection targeted all current unit residents (M = 61.5; see Table 1). A total of 210 men resided on the TC during at least one wave, of whom 177 (84 percent) participated in at least one data collection and are included in our longitudinal sample.

Of residents on the unit and able to participate, the average response rate over waves was 77 percent (see Figure 1). Participants were administered a computer-assisted personal interview (CAPI) survey consisting of a variety of open- and closed-ended questions about their background and several network measures. To ensure confidentiality, the CAPI was administered one-on-one in a private setting. Survey data were supplemented by administrative data from the Pennsylvania Department of Corrections (PADOC).

Measures

Network. Incarcerated individuals are often cynical of the notion of "prison friendships" (Crewe 2012). We thus asked which other TC residents respondents "get along with most," an indicator of positive affiliation akin to friendship (Schaefer et al. 2017). Respondents were also asked to identify their cellmate, TC-assigned "big brother" and "little brother" mentorship relations, and anyone they knew prior to entering the unit.

Attributes. Sociodemographic data come from PADOC records and include race (Black, Hispanic, White, Other), age, and religious background (Catholic, Jewish, Muslim, Protestant, None, Other). Treatment engagement was measured during each wave using the Client Assessment Summary (CAS), a validated TC treatment engagement scale (Kressel and De Leon 1997). We compute unit tenure by comparing interview dates to TC entry dates provided by PADOC. Tenure is measured as the number of days a resident had spent on the unit as of each wave's interview and, unless otherwise indicated, is divided by 10 to make coefficients more easily interpretable.

Homophily. For categorical attributes, homophily in a dyad is coded as "1" if *i* and *j* are in the same category and "0" otherwise. For continuous attributes, we calculate the difference between *i*'s and *j*'s scores and square the result; for this effect, lower values

Table 1. Summary of Unit-Level Descriptive Statistics over Observation Waves

	Mean	SD	Min.	Max.
Unit Occupancy (N)	61.5	.7	60	62
Study Participants (N)	47.2	2.3	43	50
Phase 1	11.2	3.9	5	16
Phase 2	23.3	3.3	17	28
Phase 3	12.7	1.5	10	14
Race (N)				
Black	15.1	2.8	12	20
White	28.0	2.8	25	32
Hispanic	3.8	1.3	2	6
Other	.3	.5	0	1
Religion (N)				
Catholic	10.1	3.4	6	14
Christian (other)	21.0	4.8	14	28
Muslim	9.0	3.7	3	14
Other	3.0	1.3	1	6
None	13.6	2.8	10	19
Age (M)	35.6	1.2	33.8	37.6
Tenure (M)	45.3	4.9	42.5	54.5
Treatment Engagement (M)	7.8	.1	7.7	7.8
Degree (M)	4.5	.8	2.6	5.2
Jaccard Index	.28	.03	.22	.32

Note: Statistics summarize unit-level sums (N) or means (M). All measures except treatment engagement come from official PADOC data and include all unit residents.

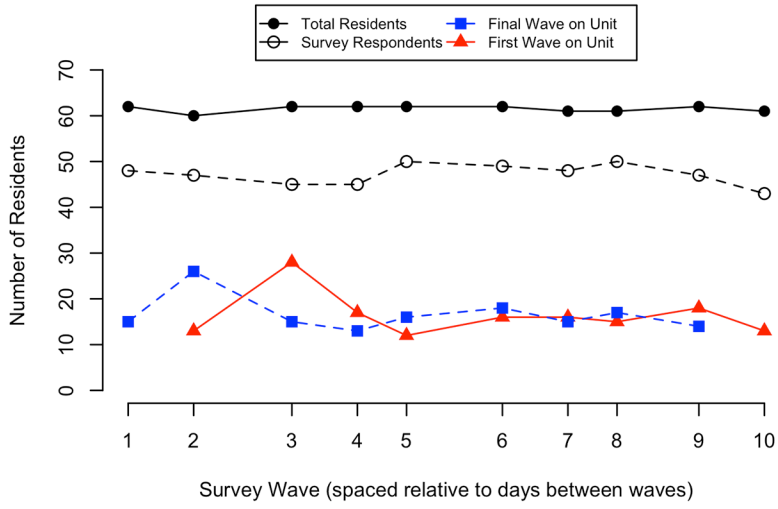

Figure 1. TC Population Size, Response Rate, and Turnover Rates by Wave

correspond to greater similarity. To analyze the opportunity pool, we created a dichotomous measure for each attribute such that two residents are similar on the attribute if their absolute difference is less than or equal to (1) five years for age, (2) two weeks for unit tenure, and (3) .5 for treatment engagement.[4] The opportunity pool is calculated as the number of fellow residents currently on the unit classified as the same.

Propinquity and entrainment.[5] Upon entry to the TC, new residents were assigned to an open bunk in a cell with one other resident. We operationalize propinquity in each dyad by whether the two residents were assigned to the same cell. Entrainment is operationalized through measures of prior acquaintanceship and big/little brother roles. Cellmates and previous acquaintances are treated as a non-directed relation, with a tie between i and j if either i or j reported the relation. Big brother and little brother are directed ties taken from self-reported nominations. We combine reports of each such that i is coded as j's big brother if i reports j as his little brother or j reports i as his big brother.[6] Each of these measures are coded "0" when the relation is absent, and "1" for the first wave when the relation is reported and all subsequent waves. At each wave, the opportunity pool is calculated for a given resident as the number of fellow residents currently on the unit with the respective relation to him.

Network structure. Reciprocity within a dyad is present when a $j \rightarrow i$ tie is matched by an $i \rightarrow j$ tie. Transitivity is present when ties exist from $i \rightarrow j$, $j \rightarrow k$, and $i \rightarrow k$. To determine the opportunity pool for reciprocity, we calculate each resident i's number of incoming ties. For transitivity, the opportunity pool is the number of two-paths emanating from i (i.e., $i \rightarrow j$ and $j \rightarrow k$ are present, whether or not $i \rightarrow k$ exists).

Analysis

Overview. Our analysis has three distinct components. First, we examine how the strength of selection mechanisms changed as unit tenure increased by estimating a Stochastic Actor-Oriented Model, or SAOM (Snijders 2001; Snijders, van de Bunt, and Steglich 2010). The SAOM is a model of longitudinal network change that predicts which relationships form or persist across time. Key predictors capture homophily, propinquity, entrainment, and network structure. We interact the effects representing these micro-mechanisms with the respondent's tenure to measure change in strength over time. Our second step evaluates change in opportunities to enact selection mechanisms over one's tenure. For this analysis, we calculate the number of relationship opportunities residents had through each micro-mechanism at each observation (see Figure S1 in the online supplement for raw counts). To test for change in opportunities, we regress opportunities at each wave on resident tenure at the wave. Our third step evaluates how the overall impact of a mechanism changed over time. This analysis uses the concept of Relative Importance (RI) developed by Indlekofer and Brandes (2013) in an effort to create standardized SAOM estimates. RI scores are derived from a fitted SAOM and provide an estimate of how much network change predicted by the model is driven by a given selection mechanism, relative to other modeled mechanisms. We use linear regression to examine how RI scores for each mechanism change over time.[7] All analyses use tenure measured as days on the unit and include linear and squared terms.[8]

SAOM specification and estimation. The SAOM conditions on the first observation and fits parameter estimates to a set of effects, such that the model is able to reproduce features of the network observed at subsequent observations. Although the network is measured at discrete time points, the model assumes ties change on an underlying continuous time-scale following a Markov process. Specifically, network change occurs through a sequence of simulated micro-steps in which actors have the opportunity to modify their outgoing ties, either by forming new ties or dropping existing ties. Within a micro-step, a randomly chosen actor evaluates all possible changes to its outgoing ties based on the following objective function:

$$f_i(\beta, x) = \sum_k \beta_k s_{ki}(x)$$

where $f_i(\beta,x)$ is the value of the function for actor (i) given the current set of parameter estimates (β) and network state (x). The k effects, $s_{ki}(x)$, may be based on individual, dyadic, or network attributes. After evaluating all possible changes, the actor makes the

change with the highest positive evaluation (with a small stochastic component). For instance, with a positive reciprocity parameter, changes that would create a reciprocated tie or remove an unreciprocated tie are evaluated higher and hence more likely. If no changes would produce a positive evaluation, the actor maintains the existing set of outgoing ties. Only one actor can change a tie in a given micro-step, preventing actors from coordinating relationships between themselves.

Specifying SAOM effects is accomplished using "short names" within RSiena (formulas available in Ripley et al. 2019). Homophily effects are specified using *sameX* or *diffSqX* depending on whether the attribute is categorical or continuous. Propinquity and entrainment are specified using the *X* effect for each type of relation. Network effects are specified for reciprocity using *recip* and, for transitivity, *transTrip*. The latter effect counts how many transitive triads would exist if the tie in question were present. We also include an interaction between reciprocity and transitivity to account for their tendency to offset one another (Block 2015).

We include additional controls for selection that are not of substantive interest but help ensure model fit (Snijders et al. 2010). An *indegree – popularity* effect estimates how the number of incoming ties predicts the likelihood of receiving future ties; an *outdegree – activity* effect captures whether residents with more outgoing ties tend to send more ties at future time points; and an *indegree – activity* effect captures whether residents with more incoming ties are more likely to send future ties. These effects use a square root transformation to give greater weight to differences in popularity/activity among less popular/active youth.

For age, treatment engagement, and unit tenure we adjust for whether these attributes affect the tendency to send and receive ties (*egoX* and *altX* effects, respectively). To capture possible nonlinearities in these effects, we follow Snijders and Lomi (2019) by also including squared transformations (*egoSqX* and *altSqX*). Finally, the model includes an *outdegree* effect to control for the overall probability of a tie (similar to an intercept in a linear model), and *rate* effects to represent the volume of tie change between each time point. Given that relationship changes are more common closer to unit entry and exit, we allow rate effects to vary by resident treatment phase.

Our first SAOM is a base model that constrains effects to be constant throughout residents' tenures. A subsequent set of models tests for change in strength by introducing interactions between each selection effect and resident tenure (i.e., interacting the mechanism with *egoX* effects for tenure and tenure-squared, the latter omitted if not significant). Due to issues with multicollinearity, we tested change in selection mechanisms separately. We made exceptions for mechanisms with an inherent dependence, which includes (1) big brother and little brother relations and (2) reciprocity and transitivity, because we also included their interaction.

Models constrain parameter values to be equal for forming new ties and maintaining existing ties. We estimated the model using the RSiena package (version 1.2-17, Ripley et al. 2019). We followed recommended procedures for model fitting and ensured convergence met recommended levels (Snijders et al. 2010). All *t*-ratios for convergence were less than .10 and the overall maximum convergence ratios fell below .25. We used the *composition change* option (Ripley et al. 2019) for specifying when each resident joined and exited the TC. During estimation, this ensures ties are only possible between residents concurrently on the unit. Residents who resided on the unit but did not complete the survey in a given wave (i.e., non-respondents) were retained in the analysis because we have information on them (e.g., incoming ties and background data provided by PADOC). We coded their outgoing ties as missing, which allows them to be imputed during model estimation (Huisman and Steglich 2008).[9]

Relative importance. Calculating RI involves taking the parameter estimates from

a fitted SAOM and, for each respective effect, asking how different residents' predicted selection choices would have been if the effect were omitted from the model. This is done separately for each actor and observation wave by comparing the distributions of choice probabilities across all potential ties obtained from applying an objective function with parameters set to estimated parameters for all effects, versus when the effect of interest is set to zero. Differences in the sums of choice probabilities across these two scenarios are themselves summed and rescaled such that RI scores across all effects sum to 1 within each actor for each wave.

To illustrate, an actor with no incoming ties, and hence no chance to form a reciprocated tie, would have an RI score of 0 for reciprocity. By contrast, actors whose evaluations of potential ties would change greatly by omitting reciprocity from consideration (e.g., actors with many reciprocated ties) would have an RI score for reciprocity greater than 0; how much greater than 0 depends on how much choice probabilities change when performing these same calculations for other effects in the model. Thus, an actor's RI scores provide a sense of how much each effect swayed their tie choices relative to other modeled effects. We used estimates from the SAOM base model to calculate RI using the *sienaRI* function within R. For a given resident, this provides a series of RI estimates corresponding to the importance of each effect for the waves when he was on the unit. More detail on calculating RI is available in Indlekofer and Brandes (2013).

RESULTS

We begin by examining the strength of selection mechanisms as estimated by the SAOM. To help with model interpretation, we briefly review results from the base SAOM, which holds effects constant across resident tenure (Table 2). In terms of homophily, residents were more likely to select other residents to the extent they were of similar race, age, or unit tenure, although for the latter two effects the strength of homophily varied according to resident age and tenure, respectively (see Figure S2 in the online supplement).

Table 2. SAOM Estimates for Base Model with Effects Held Constant across TC Tenure

	Coef.	SE
Attributes		
Same race	.473***	.048
Same religion	.083	.050
Age alter	–.010***	.002
Age alter^2	.001***	.000
Age ego	–.008	.005
Age ego^2	.001**	.000
Age difference^2	–.001***	.000
Tenure alter	–.079***	.010
Tenure ego	.000	.014
Tenure difference^2	–.007***	.001
Engagement alter	–.008	.025
Engagement ego	.191***	.045
Engagement difference^2	–.019	.010
Propinquity		
Cellmate	1.022***	.101
Entrainment		
Big brother	1.173***	.167
Little brother	.546***	.182
Known prior	1.280***	.070
Network Structure		
Reciprocity	1.363***	.102
Transitivity	.270***	.025
Transitivity · Reciprocity	–.112*	.055
Controls		
Rate (period 1)	47.558***	5.826
Rate (period 2)	28.361***	2.918
Rate (period 3)	28.442***	3.228
Rate (period 4)	40.125***	4.224
Rate (period 5)	48.912***	4.889
Rate (period 6)	42.334***	4.371
Rate (period 7)	44.311***	4.457
Rate (period 8)	56.068***	5.739
Rate (period 9)	51.526***	5.716
Rate · Phase 1 ego	–.063	.067
Rate · Phase 3 ego	–2.975***	.156
Outdegree	.324	.644
Indegree – popularity (√)	.235***	.037
Indegree – activity (√)	–.997***	.190
Outdegree – activity (√)	.096*	.047

*$p < .05$; **$p < .01$; ***$p < .001$ (two-tailed tests).

Parameter estimates can be interpreted in terms of log odds. For instance, in the case of race, the log odds of a tie were .473 greater

for a tie to someone of the same race (same race = 1) versus someone of a different race (same race = 0), assuming all else is equivalent between the two ties in question.[10] Exponentiating this value indicates that the odds of a same-race tie were 1.6 times greater than a cross-race tie. Estimates for homophilous selection on religion and treatment engagement were positive, but not statistically significant at conventional levels ($p_{religion}$ = .097, $p_{engagement}$ = .057). Nonetheless, we keep these effects in our analysis as these attributes are relatively hidden and homophilous selection may have only emerged over time. All effects for propinquity, entrainment, and endogenous network structure were also present.

Our question is "How did the use of these mechanisms change over time?" We organize this presentation around specific mechanisms, and thus discuss changes in strength, opportunities, and relative importance together. Model estimates are presented in Table 3, with panels for (a) mechanism strength, (b) opportunities, and (c) relative importance. To facilitate interpretation and convey the magnitude of effects, we plot predicted values across the range of tenure for each mechanism in Figures 2, 3, and 4. To understand the strength of each mechanism at unit entry, we estimated an alternative SAOM specification that used uncentered measures of tenure. In these models, the main effect for tenure represents the estimated strength of the effect on day 0—the day the person entered the unit (see Table S2 in the online supplement).[11] This is the model we refer to when discussing whether mechanisms were initially present.

Homophily

Results in Table S2 of the online supplement show that homophily on race and treatment engagement were initially present, along with a marginally significant effect for tenure (see Figure 5 for predicted odds). This pattern was expected for race and tenure, but not treatment engagement, which is a relatively hidden attribute. Finding initial homophily on treatment engagement suggests it was more visible to fellow residents than expected and hence did not act as a hidden attribute. We do not find significant effects for homophily on age and religion during unit entry, which is surprising and indicates these were not salient attributes early in residents' tenure.

We next ask how the strength of effects changed over time. Results in Panels a of Table 3 and Figure 2 reveal that homophily on race and treatment engagement decreased in strength with time in the TC. At unit entry, ties to co-residents of the same race were almost twice as likely as ties to someone of a different race, with this effect dissipating by the end of residents' stays. The effects of treatment engagement and tenure homophily were weaker but followed similar downward trajectories. We did not observe changes in the strength of religion and age homophily over time.

Resident turnover was constant throughout the 10-month observation window and is evident in fluctuations in the sociodemographic composition of the unit (see Table 1). Nonetheless, opportunities for ties that were homophilous on race, religion, or age remained fairly constant (Panels b in Table 3 and Figure 2). By contrast, opportunities for treatment engagement and unit tenure homophily changed over time, with both displaying inverse U-shapes. The pattern for unit tenure is a product of resident position in the tenure distribution shifting across time. Residents became increasingly similar to others over the first half of their stay, creating more opportunities for homophilous ties; this reversed and residents became increasingly dissimilar to others over the latter half of their stay. This pattern was not expected for treatment engagement and is all the more surprising given the previously-found stability of engagement within persons across time (Kreager et al. 2019).

Turning to relative importance (Panels c of Table 3 and Figure 2), we see that race, age, and tenure homophily were more consequential for network change relative to religion and treatment engagement. Over time, trajectories of RI should, by definition, parallel

Table 3. Coefficients from SAOM and OLS Models Testing Change in Conditional Likelihood of a Tie, Opportunities, and Relative Importance for Network Mechanisms across Resident Tenure

	(a) Conditional Effect (SAOM)			(b) Opportunities		(c) Relative Importance[b]	
	Main	Main x Tenure	Main x Tenure^2	Tenure	Tenure^2	Tenure	Tenure^2
Homophily							
Race	.415***	−.034**		.208	−.006	−.170***	.099***
Religion	.076	−.002		.274	−.028	−.029***	.015***
Age[a]	−.001***	.000		−.183	.016	−.118***	.062***
Engagement[a]	−.009	.006*		3.203***	−.167***	−.024***	.013***
Tenure[a]	−.006***	.002***	.000*	1.460***	−.154***	−.257***	.194***
Propinquity							
Cellmate	1.011***	−.592***	.040***	.025	−.003	−.047**	.023
Entrainment							
Prior Acquaintance	1.244***	−.408***	.033***	.287***	−.024***	−.149***	.052
Big Brother	.854***	−.124*		−.056**	−.001	−.105***	.052***
Little Brother	.548***	.009		.103***	−.001	.009	.000
Network Structure							
Reciprocity	1.276***	−.112***		1.085***	−.061***	.296***	−.190***
Transitivity	.249***	−.021***		7.413***	−.339**	.231***	−.126***
Transitivity and Reciprocity	−.077	.016		.613***	−.030***	.036***	−.018***

[a]The SAOM effect measures the squared difference, thus homophily is indicated by a negative coefficient.
[b]For scaling purposes, tenure was divided by 100 prior to model estimation.
*$p < .05$; **$p < .01$; ***$p < .001$ (two-tailed tests).

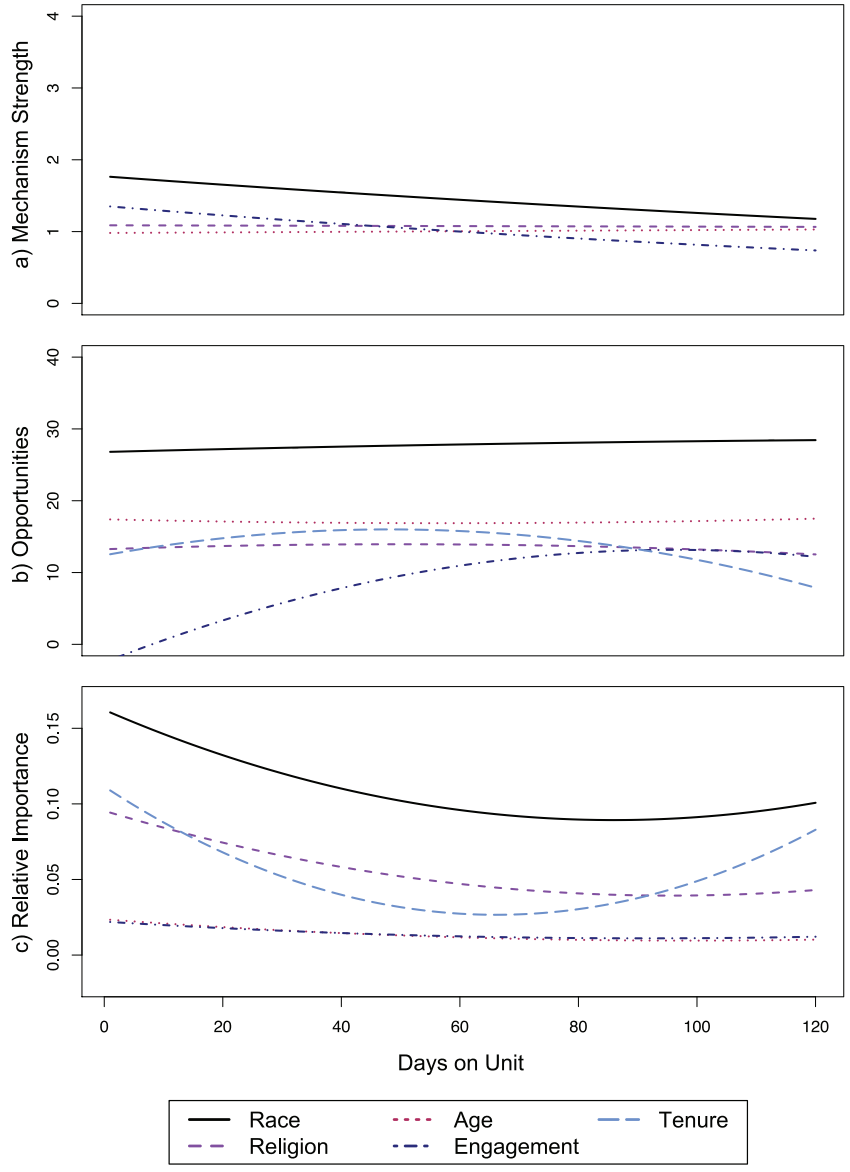

Figure 2. Homophily Effects: Predicted Mechanism Strength, Opportunities, and Relative Importance across Resident Tenure (based on models reported in Table 3)
Note: Predicted strength defined as the odds of a tie if homophily on the attribute is present versus absent. See Figure 5 for predicted strength of engagement homophily.

changes in strength whenever opportunities remain stable. This is what we observe for race and age homophily, where strength and RI both show decreases over time. Religion and treatment engagement homophily show very different patterns, with both having quite low RI. Despite opportunities for both mechanisms being relevant and increasing during some parts of their stay, the weak conditional effects (from the SAOM) mean residents were not drawing on these mechanisms even when given the chance. Thus, both mechanisms were largely inconsequential in shaping network change.

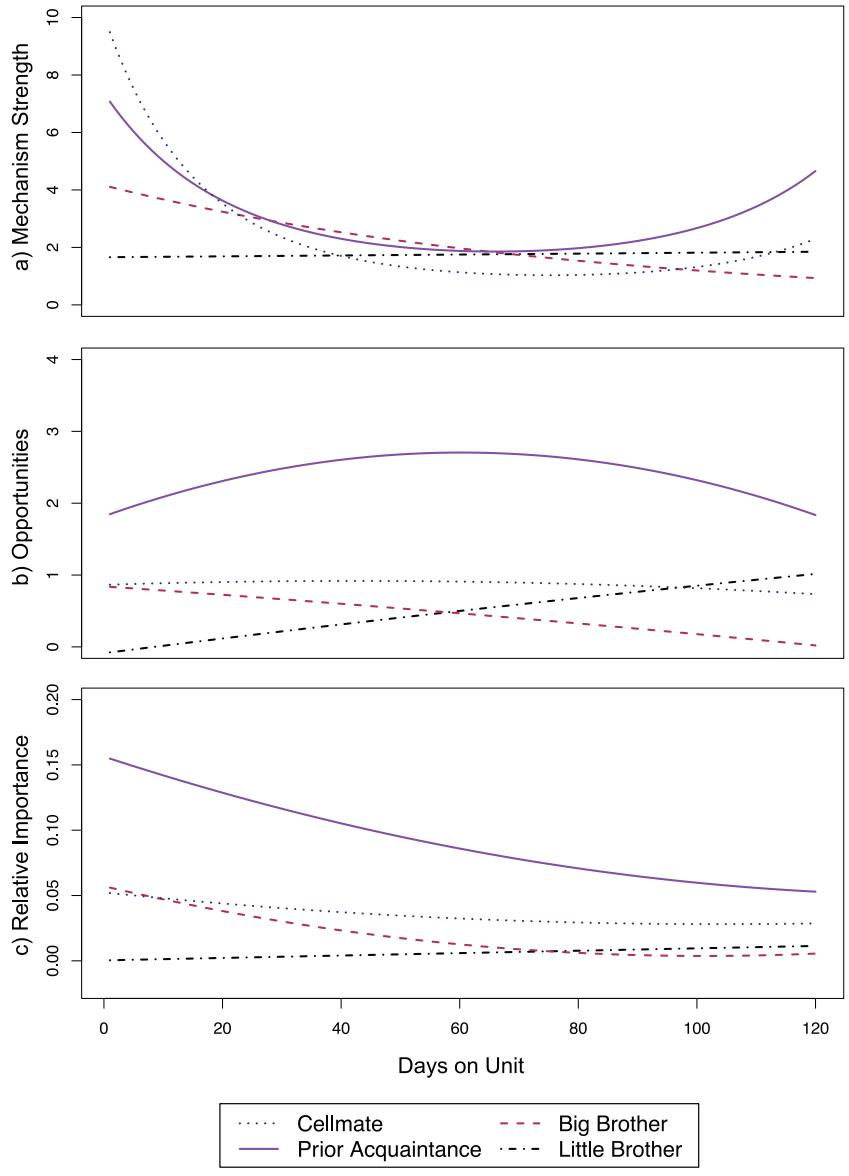

Figure 3. Propinquity and Entrainment Effects: Predicted Mechanism Strength, Opportunities, and Relative Importance across Resident Tenure (based on models reported in Table 3)

Note: Predicted strength defined as the odds of a tie if the given relation is present versus absent.

Finally, results for tenure homophily indicate a curvilinear pattern for RI, decreasing for the first half of residents' stays, as expected, but increasing after that. This pattern suggests that, despite fewer opportunities, residents early or late in their stay preferentially sought others of similar tenure (e.g., residents in the same phase; see Figure 3). These results align with our expectations with respect to newcomers seeking fellow newcomers during network entry. Finding greater RI for tenure homophily approaching TC departure was surprising and we return to this in the discussion.

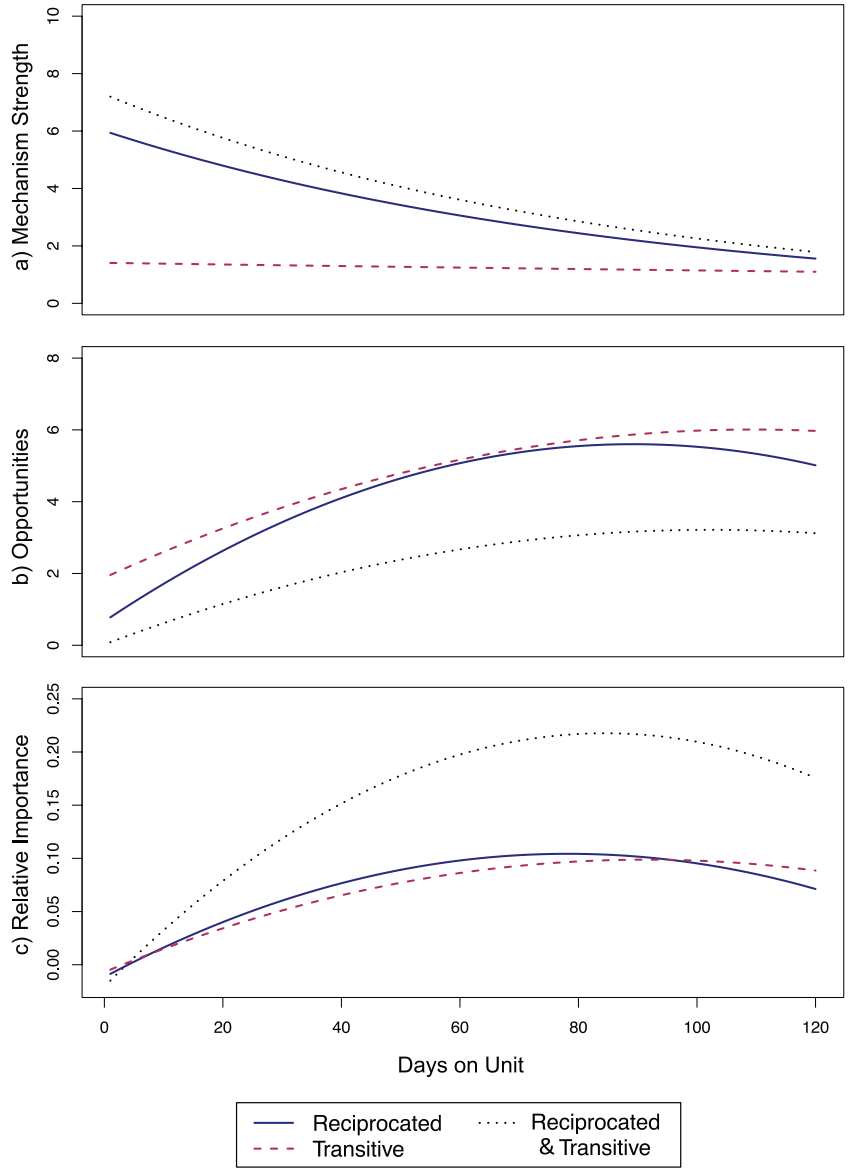

Figure 4. Propinquity and Entrainment Effects: Predicted Mechanism Strength, Opportunities, and Relative Importance across Resident Tenure (based on models reported in Table 3)
Note: Predicted strength defined as the odds of a tie if the given network structure is present versus absent.

Propinquity and Entrainment

The SAOM results indicate that propinquity and each entrainment factor, except little brother, were consequential for tie formation when new residents entered the unit (see Table S2 in the online supplement). As shown in Figure 3, Panel a, cellmates were almost 10 times more likely to be selected; big brothers more than four times more likely to be selected; and prior acquaintances were seven times more likely to be selected at unit entry

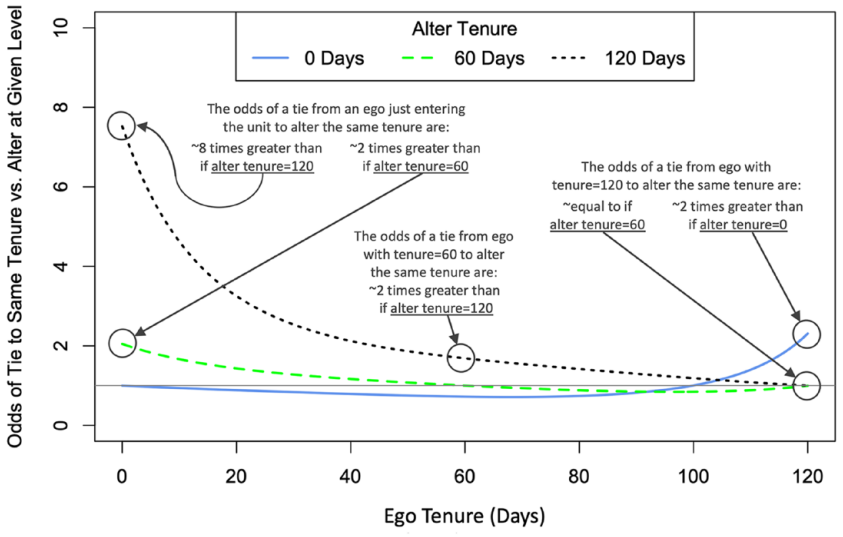

Figure 5. Change in Strength of Tenure Homophily with Tenure
Note: Predicted odds of ego choosing an alter with the same tenure versus an alter with 0, 60, or 120 days tenure (based on SAOM estimates for tenure reported in Table 3).

compared to peers not in these roles. Over time, the strength of the big brother effect decreased with tenure, dropping to zero by the end of one's tenure, and the strength of prior acquaintance, and to some extent cellmate, decreased but persisted throughout one's tenure. These patterns may be a function of more tenured residents having relationships with incoming residents who were a cellmate or known previously, perhaps serving as an informal mentor. These results suggest residents occupying these roles were among the first people incoming residents knew or met on the unit, making them a natural person to turn to, even if they were ultimately not particularly durable relationships.

Turning to opportunities (Panel b), we find that opportunities for cellmate ties were stable, which is expected given that residents reside in two-person cells and the unit hovers around maximum occupancy. Little and big brothers show opposing trajectories, which reflects how this relation is structured by the TC. Residents only become eligible to have little brothers once they reach Phase 2. Thus, as residents progress through treatment, opportunities for little brother relations increase. However, opportunities for ties to big brothers—who are necessarily further along in the program than their little brother—decreased over time as big brothers left the unit.

Opportunities for ties to prior acquaintances show a small but significant change, peaking toward the middle of resident tenure. This was not expected and could be due to residents' incomplete knowledge of unit membership early in their tenure, and then as residents prepared to transition out of the TC, they may have been less cognizant of new members.

Turning to RI (Panel c), we see that when opportunities did not change (i.e., cellmates), the trajectory of RI mirrored the change in strength, in both cases decreasing over time. Similarly, for big brothers, both the strength of the effect and opportunities decreased over time, resulting in decreasing RI as well. By contrast, the little brother effect shows increasing opportunities over time, but no change in strength or RI. Finally, for prior acquaintances, which displayed a curvilinear change in opportunities, RI decreased even as opportunities increased. Interestingly, the RI of prior acquaintances was greater than for

cellmates, even though the latter had a stronger effect early in a resident's tenure. This reflects the greater opportunities to form ties via prior acquaintances, of whom there could be many, versus one's only cellmate.

Endogenous Network Mechanisms

Figure 4, Panel a shows that, as with the prior mechanisms, reciprocity and transitivity were strong upon unit entry and decreased in strength as resident tenure grew. Ties that created a reciprocated dyad were at least six times more likely than ties without such a structural basis. Transitive ties were 1.5 times more likely than non-transitive ties, and ties that would create both reciprocity and transitivity were more than seven times more likely than a tie creating neither. The magnitude of these effects dropped by the time residents were about to leave the unit, with ties no more than twice as likely through these structures as outside them.

Changes in opportunities for endogenous network processes clearly depart from the previously discussed micro-mechanisms (Panel b). As expected, residents initially had few options for reciprocated ties or closed triads. But, as their networks coalesced, opportunities for reciprocity and transitivity increased greatly, remaining elevated for the duration of their stay. Panel c displays a similar pattern, with the RIs of reciprocity and transitivity close to zero early in resident tenure. This is a product of so few opportunities to enact these processes. Both mechanisms increased in RI throughout much of resident stays on the unit, before dipping during the final days. The same pattern holds for ties that were both reciprocated and transitive.

Note that the strong SAOM estimates early in resident tenure, when there were few opportunities, indicate that residents readily formed ties via these processes when possible. As their networks developed, new entrants were less likely to embrace opportunities for reciprocal or transitive ties. Relationships were still supported by these mechanisms, and increasingly so throughout their tenure, but their conditional likelihood diminished.

DISCUSSION

Social activity is often centered around neighborhoods, schools, workplaces, and voluntary associations (Feld 1981; Kalmijn and Flap 2001). As membership in such contexts changes, personal network ties follow suit (Feld and Carter 1998; Mollenhorst, Volker, and Flap 2014). The current study investigated how people go about forming relationships when they join a new setting. Our study steps outside the conventional network formation framework (e.g., Newcomb 1961) by examining a context with frequent instances of individual network integration spread across time, and where changes at the system level were not confounded with individual tenure in the network. As such, individuals in our study each joined a different network, some with wholly different members, even as the broader organizational environment remained constant.

Our results point to two key takeaways. First, newcomers use the same rules as other members, but the importance of those rules and the capacity to enact them differ in systematic ways over time. Second, network formation from the individual perspective is distinct from network formation at the system level. The biggest difference is that opportunities to enact selection mechanisms change as newcomers become embedded in the network and learn about their peers. The consequences of this distinction differ depending on the mechanism in question.

Newcomer Integration

Our driving question was how newcomer network selection behavior changes with growing tenure in an organization. To answer this question and provide an overall picture of the newcomer integration process, we return to the relative importance results describing how consequential the various selection mechanisms were for residents across their

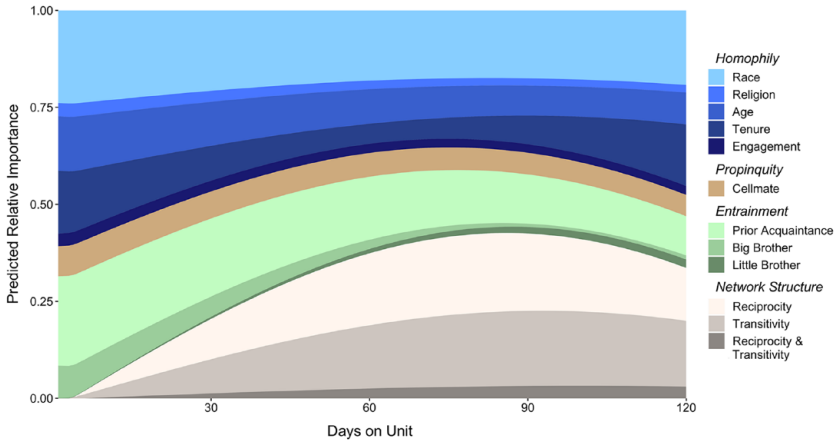

Figure 6. Predicted Relative Importance across Tenure for Homophily, Propinquity, Entrainment, and Network Effects (based on SAOM estimates in Table 3)

tenure. To aid this discussion, Figure 6 presents the predicted relative importance for each class of mechanism.

Upon entry, relative importance was greatest for homophily, at 61 percent, followed by entrainment at 31 percent and propinquity at 8 percent, with no contribution from endogenous network mechanisms. Within these mechanisms, race homophily and prior acquaintances had the greatest RI. Such relations were presumably among the easiest and most familiar, helping smooth the transition into the TC. Homophily diminished somewhat from the first few days but remained highly influential throughout residents' tenure, accounting for close to half of the relative importance by residents' departure. Likewise, the effects of entrainment and propinquity decreased, ultimately falling to around half their initial magnitude (13 and 5 percent of relative importance, respectively).

The fact that homophily, propinquity, and entrainment largely decreased with tenure is consistent with the notion that these are crude sorting mechanisms and, as residents got to know one another better, more salient characteristics and selection mechanisms took precedence (Biancani and McFarland 2013). By contrast, as new residents built their community within the TC, mechanisms based on endogenous network processes became increasingly influential, accounting for 43 percent of relative importance at their zenith. These findings suggest that micro-mechanisms based on network structure partially supplanted formal roles as the main drivers of relationship formation as tenure grew. This can be understood in light of the growing capacity for network processes—which require the accrual of ties—versus formal roles that are limited in their reach (e.g., cellmates and big brother/little brother relations were restricted to one per resident, capping their total importance). All told, the bases of resident relationships shifted greatly, but in a systematic manner across residents' tenure.

Network Formation versus Newcomer Integration

Our results suggest that new network entrants' reliance on homophily and entrainment followed the same downward trajectory as in macro-level studies of network formation (Conti and Doreian 2010; Newcomb 1961; van Duijn et al. 2003). Even though TC membership changed regularly, the unit's demographic composition did not. Thus, mirroring the network formation context, opportunities for homophily were fairly constant throughout each resident's tenure. Still, knowledge of fellow residents' characteristics could increase

as "hidden" attributes become visible and salient to selection across time. Our results do not support this hypothesis, although our measures of religion and treatment engagement may not have been ideal hidden attributes. The strong initial effect of treatment engagement points to it being a very visible attribute, which perhaps is to be expected within the community-based treatment context of the TC, where individuals high in treatment engagement would gravitate toward the front of community activities and the less-engaged would filter to the back (Kreager et al. 2019; Warren et al. 2020). With respect to religion, our results indicate this was not a particularly salient selection factor. Drawing on Blau (1977), this may be a function of multiform heterogeneity, whereby small settings limit options such that not all selection preferences can be realized, but it could also indicate consolidation, such that the weak pattern of religion homophily we observe is explained by homophilous selection on a related attribute (e.g., race).

Our findings for propinquity and entrainment are consistent with Conti and Doreian (2010) in that proximity, preexisting relations, and formal roles exerted a strong early influence on tie formation. As in their study, we found that previous acquaintances became less important with growing tenure, and other roles shifted in importance based on activities within the setting. Cellmates were always available, but big brother and little brother relations were only possible during specific treatment phases. Whereas the strength and relative importance of big brother relations increased across time, little brother relations showed no meaningful change. This pattern for big brothers is in line with organizational goals, in that longer-tenured residents increasingly took on the responsibilities of assimilating little brothers to unit norms and responsibilities, becoming less necessary as assimilation became complete (De Leon 2000).

Newcomers' use of endogenous network processes offers the greatest contrast with studies of network formation. Group-level network formation research highlights the stable or growing influence of reciprocity and transitivity across time (Doreian et al. 1996; Newcomb 1961; Schaefer et al. 2010). In such an emergent network context, as ties begin to develop, they unite into local structures such that both the counts and strength of reciprocity and transitivity increase. By contrast, when new members join established networks, initial opportunities to form reciprocated and transitive structures are absent, only emerging as friendship overtures are made and ties solidify. We observed that reciprocity and transitivity were strongest early in resident tenure, meaning these are quite powerful mechanisms for initially building one's network. As more opportunities arose over time, the conditional likelihood of a tie through these mechanisms *decreased*, which directly contrasts with the network formation case. As a whole, though, the relative importance of reciprocity and transitivity increased throughout a member's tenure, driven by growing opportunities that offset the decreased conditional likelihood. Thus, individuals had more reciprocated and transitive ties as their tenure increased, which is consistent with network formation studies, but this pattern was driven by increased opportunities, not increased strength of these selection mechanisms.

Broader Implications

Several of the mechanisms and corresponding trajectories we observed have implications beyond the TC context. To begin, this study speaks beyond organizational entrance to network processes surrounding organizational exit. We found that, for members approaching departure, both the strength and relative importance of tenure homophily increased, even as opportunities for such ties decreased. This suggests that as residents neared the end of their tenure, and they lost ties to others who had already departed the TC, those ties were either not replaced or replaced with similarly-tenured residents. This occurred during Phase 3 of treatment, which involves a shift away from TC leadership and toward

preparations for exit. As part of this shift, we suspect that residents increasingly turned to peers undergoing the same exit preparations as a form of social support and future role preparation, which for most residents would include prison release. Such relationships may be best suited to provide the specific types of support needed as one confronts uncertainties regarding transitioning out of the TC and prison altogether (Thoits 2011).

A similar phenomenon occurs in many types of organizations. In our case, it appeared as a tenure effect because, with the standard four-month TC membership period, tenure indexes both entry and exit dates. In organizations without fixed membership durations, this form of selection would be relative to expected exit dates (e.g., workers approaching retirement). Organizations often support such normative transitions (e.g., college fairs, campus career centers, retirement seminars). Our findings reinforce networks as a useful pathway to disseminate knowledge of such services; in turn, such services may offer a means to build networks to support the upcoming transition.

Our findings also shed light on one of the mysteries surrounding intergroup relations within organizations. Structural (Feld 1982; McPherson, Smith-Lovin, and Cook 2001) and psychological (Allport 1954) theories maintain that the composition of settings can affect the rate of cross-group relationships. However, many contexts seemingly meet conditions that would facilitate intergroup friendships yet do not reduce exhibited ingroup preferences (Mollica, Gray, and Trevino 2003; Schaefer, Simpkins, and Vest Ettekal 2018). In our case, the TC philosophy is intentionally designed to break down typical intergroup barriers to create a cohesive community (De Leon 2000). Accordingly, we found that selection based on race homophily decreased as individuals' time in the setting grew, as intergroup contact theory would predict (Allport 1954).

However, the impact of this effect may have been counteracted by the trajectories of other effects. Namely, early ties are likely to be reinforced, or "amplified" (Wimmer and Lewis 2010), through the rising influence of network processes like reciprocity and transitivity. If these initial ties form when preferences for homophilous ties are strongest, then early same-race ties may become cemented by network processes such that a pattern of homophily does not dissipate, even in a diverse context that otherwise reduces members' prejudice toward outgroups. In this manner, social network evolution can exhibit a path-dependence that restricts intergroup relationships, especially on visible attributes or other factors that drive early selection behavior (e.g., role relations). One viable means to offset this pattern and promote intergroup relationships would be to ensure early encounters and opportunities are diverse (e.g., Boda et al. 2020).

Limitations

Although an atypical setting to study network dynamics, a strength of the sampled prison TC is that it decouples a high volume of new member integration from overall network growth. Nonetheless, as with many studies of intra-organizational network change (e.g., students in schools), we only considered relationship changes within the bounds of this context. Given that the TC is an ephemeral experience and most residents will return to the community, their ties outside the TC and prison may have influenced the selection behavior we observed (Volker et al. 2016). Residents with strong external relationships may have chosen to minimize socialization and simply "do their time" (Kreager et al. 2016).

In addition, we only examined one context, and idiosyncratic features may have contributed to our findings and limit their generalizability. For instance, the four-month duration of TC programs in Pennsylvania is shorter than the typical 9- to 12-month prison TC program (Wexler and Prendergast 2010). Programmatically, the TC's community-centered approach may have resulted in unit-level norms that promoted intergroup contact and weakened network processes that create

social divisions (Kreager et al. 2018). Group therapy sessions might have affected relationship building—particularly as individuals are meant to make themselves vulnerable and have their actions corrected by peers. These kinds of contextual factors (e.g., norms and practices) can carry an equivalent, if not more important, role for newcomer integration than individual factors (Fleming et al. 2016). We expect the relative strength of particular attributes to differ across contexts, and some roles to be more salient in certain contexts than others, but we do not expect the shape of the trajectories we observe (i.e., upward or downward) to differ qualitatively. Thus, we expect our findings to extend to other task-oriented and high-investment organizations with rolling membership, such as community associations, workplaces, and social clubs.

An additional limitation is that our test of the visibility hypothesis is based on assumptions about how observable individual characteristics were to residents. Visibility is likely to vary greatly due to factors such as context, dyadic interaction, individual perceptiveness, and attributes themselves. Indeed, the immersive and group-oriented environment of a prison TC almost guarantees that residents will learn much about each other over time. Thus, a stronger test would directly incorporate residents' subjective knowledge of one another and, ideally, include attributes with a wider range of observability and salience (e.g., attitudes).

A remaining question is how changes in selection mechanisms might differ for building new relationships versus supporting ongoing connections. We do not have the statistical power to discern the trajectories of tie formation from tie maintenance, but such investigations would be insightful. For instance, we expect propinquity and foci to follow parallel trajectories for relationship formation and persistence, as these mechanisms operate primarily by increasing contact opportunities (Kleinbaum 2018). By contrast, the declining strength of triadic closure we observed may be more emblematic of its role in tie formation, with its effect on tie persistence showing a flatter trajectory (i.e., transitivity helps ties endure). Related, our context had fixed membership durations, which is similar to schools and training programs where members can anticipate their departure date. This simplified our analysis as it kept membership duration relatively constant. However, there may be important endogenous effects worth investigating (e.g., members coordinating their organizational departures).

Conclusion

There is no single pathway by which new members integrate into groups and organizations. Rather, individual behavior and organizational structure interact to shape the opportunities by which new members form relationships. In drawing attention to this, our study makes several noteworthy contributions. First, understanding network selection behavior requires separating network patterns from the processes responsible for creating those patterns. Statistical network models like ERGMs (Goodreau et al. 2009) and SAOMs (Snijders et al. 2010) help discern the strength of multiple micro-mechanisms. However, care must be taken in interpreting estimates from statistical models as they condition on opportunities to form or maintain ties through a given mechanism (Indlekofer and Brandes 2013). Hence, such models say nothing about the underlying opportunities, other than there are enough present to estimate an effect. As we have shown, opportunities can change over time, with trajectories differing across mechanisms. Indeed, effects based on the same mechanism (i.e., entrainment) can have very different trajectories of strength, opportunities, and relative importance depending on the underlying relation. Thus, we emphasize clarity when discussing network selection and clearly differentiating network patterns, selection mechanisms, and opportunities to enact mechanisms.

Our focus was on changes in mechanism strength and opportunities due to growing organizational tenure, but this is only one of a handful of forces that can disrupt "logics of

attachment" in social networks. Mechanism usage may also shift due to *environmental change*. For instance, if a context becomes more dangerous (e.g., a neighborhood crime rate) or growth in population size or heterogeneity increases the number of strangers or outgroup members, respectively, then relational mechanisms that enhance trust and security, like homophily and triad closure, may strengthen (McFarland et al. 2014). At the individual level, change may be driven by development (*maturation*), such as the growing interest in romantic relationships that accompanies puberty. Individuals also learn from others the proper way to interact within a setting (*social learning*). For instance, Walker (2016) describes how the prison environment instills norms that prohibit ethnoracial mixing, which newcomers must conform to or risk negative sanctions. Also, individuals receive feedback from their interactions that leads to changing relational strategies (*environmental feedback*). Schaefer (2012) describes how such a process can lead less-desirable actors to shift their preference away from high-value partners who do not reciprocate to similarly low-value partners who do reciprocate (see also Gould 2002). Likewise, Powell and colleagues (2005) explain how the relational logics driving organization-level network selection behavior can evolve with changes in the market.

Several forces can drive change in opportunities to enact mechanisms, meaning the sources of change we identified can have a wide range of consequences. To clarify such possibilities, Table 4 offers a framework for characterizing the factors that alter opportunities and links those to effects on specific mechanisms. For example, our study focused exclusively on the effects of endogenous changes for network structure. However, opportunities for homophily can change endogenously if members influence one another (changing the distribution of attributes); and, opportunities for entrainment can change endogenously if individuals create and join groups together (i.e., selective affiliation [McFarland et al. 2014] or affiliation-based closure [Lomi and Stadtfeld 2014]) or create roles that sustain their relationship (e.g., marriage). Similarly, changing organizational practices, membership turnover, or changes in individual perception and cognition can each affect opportunities for the micro-mechanisms we studied. We focused on only some of these linkages (some were not salient to the TC context or the four-month observation window, and data limitations precluded examining others). Our hope is that by calling attention to the distinction between mechanism opportunities and strength, and highlighting sources of change in each, we spur future research and theoretical development.

Finally, our results have practical consequences for the design of treatment and intervention programs (Kreager et al. 2018). Sociodemographic homophily and transitivity promote clustering, which can work against the TC ideal of a single cohesive community. It may be possible to overcome these processes by strategically leveraging other mechanisms we find, namely cellmate assignments and mentorship roles. Efforts to foster such relationships early in residents' tenures could help counteract effects promoting homogenous subgroups. Indeed, in the late twentieth century, the Texas Department of Corrections was forced by legislation to reduce racial segregation in its prisons and began random cell assignment for newcomers. Subsequent research showed that this policy increased racial integration without feared increases in interracial victimization or race riots (Trulson and Marquart 2009). Moreover, strategies that help residents learn about one another at a deeper level may help shift network selection and build community solidarity. For instance, sharing personal stories of addiction, loss, and resilience is critical for group-based treatment models, such as Alcoholics Anonymous and outpatient recovery groups. These practices can also prompt connections that may not occur otherwise. Beyond these settings, our results underscore the importance of leadership and mentor roles that can facilitate the disclosure necessary to build relationships and model group norms to new members,

Table 4. Sources of Change in Opportunities to Enact Network Selection Mechanisms with Examples

Source of Change in Opportunities	Selection Mechanism Affected (and the inputs subject to change)			
	Homophily (distribution of attributes)	**Propinquity/ Foci** (dyadic co-presence)	**Entrainment/ Role Relations** (pattern of non-network relations)	**Network Endogeneity** (pattern of network relations)
Organizational Practice	Change in individual job/task assignments, training	Change in office, roommate, workgroup, courses (selective differentiation; McFarland et al. 2014)	Change in chain of command, formal mentors	Change in formal ties that crosscut organizational units (Watts 2003)
Endogenous Processes	Influence among network members changes individual attributes	Friends joining the same group or taking the same class; creating a group (elective differentiation; McFarland et al. 2014)	Formalize role relation based on network tie (e.g., marriage)	Reciprocity, triad closure, popularity
Perception and Cognition	Hidden attributes become known to network members	Members meet or learn about others who are nearby or in the same group	Learning what role relations exist and their nature	Recognizing others' behavior toward oneself, who's popular, or one's friends' friends
Membership Turnover	New, departing, and stable members likely have different attributes (necessary for tenure)	Members entering or departing affect opportunities for those who share their location or activities	Role occupants change; dyad-specific roles may be created or dissolved	Ties to new members can create new indirect connections; departures sever ties and network substructures

Note: Shaded cells designate mechanisms tested in the current study.

thereby stimulating network formation and ensuring group-level stability.

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Notes

1. Some scholars distinguish foci from propinquity as relational mechanisms. Both mechanisms bring people together and offer opportunities for interaction. The difference is that the concept of foci also implies a shared interest that allows homophily to operate alongside propinquity (Feld 1981).
2. The declining marginal utility of triadic closure also leaves a footprint in cross-sectionally observed networks (Snijders et al. 2006).
3. An exception would be if a former member returns to an organization, in which case our claims are limited to "current tenure" as opposed to "cumulative tenure."
4. This creates windows approximately one standard deviation in width.
5. To simplify presentation of our methods and findings, we discuss propinquity and entrainment jointly, recognizing differences where appropriate.
6. The matrices representing big brother and little brother relations are transposes of one another.
7. OLS has the benefit of simplicity and interpretability and is sufficient to show patterns of individual-level change. Supplementary analyses using multilevel models accounting for repeated observations within individuals and treating opportunities as a count variable produce similar findings (see Tables S3 and S4 in the online supplement).
8. Although the TC is structured by phase, we chose to use days on the unit to measure tenure given our argument that time in a social context is the prime driver of change in mechanism usage. Conceptually, this aligns with the idea that residents who are new to the unit (or the phase) have different strategies and opportunities than do individuals of longer tenure in the same phase. Choosing a little brother is an exception, because residents are not allowed to be big brothers until they reach Phase 2. However, for the sake of comparability to other mechanisms, we use days on the unit to measure change for all mechanisms.
9. It remains possible that non-respondents were different from survey respondents. Indeed, respondents were named an average of 4.5 times by their peers (i.e., indegree), compared to 3.0 times for non-respondents. To shed light on this, we estimated a series of OLS models regressing indegree on survey participation status, while adjusting for tenure and opportunities for homophily (see Table S1 in the online supplement). Results show that (1) more recent residents were less integrated and less likely to participate in the survey (which matches anecdotal reports from interviewers about new residents' skepticism toward the survey), and (2) accounting for tenure and opportunities to enact mechanisms explained away differences in indegree based on participation status. That is, effects included in our SAOM are sufficient to model differences in network indegree between respondents and non-respondents. These results support our use of the SAOM to impute ties for non-respondents present on the unit.
10. Specifically, the odds ratio is interpreted as the odds of a tie being present versus absent when a condition is met (e.g., homophily is present) relative to the odds of a tie being present versus absent when the condition is not met (e.g., homophily is absent). Assuming all other effects remain constant is essential for this interpretation. For some effects, like being of the same race, it is simple to compare hypothetical dyads that differ in this regard and no other. For other effects, like having the same tenure, this is impossible because manipulating similarity in tenure also involves manipulating either ego's or alter's tenure, both of which are effects included in the model. Given this, our interpretation of tenure homophily is more involved (see Figure 3). In addition, exponentiating effects to obtain changes in odds is only advised when a one-unit difference in the effect is meaningful. For a fuller discussion, see Snijders and colleagues' (2010) general introduction to the SAOM.
11. RSiena centers covariates by default. To offer a statistical test of conditional effects specifically at unit entry, we estimated additional models with tenure specified as uncentered. In this specification, the main effect for a selection mechanism represents the

estimated effect upon unit entry, whereas the interaction with tenure captures changes in the effect over time. We report results using the centered effect in the main text as centering improves model convergence (Ripley et al. 2019).

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