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Homophily Through Nonreciprocity: Results of an Experiment

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This study outlines a new explanation for homophily in social networks that is neither intended nor imposed by constraints on partner choices. Rather, homophily is an endogenous product of the emergent exchange process, in which actors seek high-value partners who reciprocate their gestures. Whereas all actors initially direct exchange toward higher value partners, the gestures of lower value actors are more likely to go unreciprocated. This imbalance drives lower value actors to seek new partners, who end up being others who are also lower value. The consequence is homophily on value despite no such preference. I draw upon social exchange theory to articulate how this process unfolds in a newly forming network. A laboratory experiment tests hypotheses about how exchange patterns change over time. Findings reveal that shifts in participants' behavior over time were consistent with a concern for reciprocity, resulting in increasing levels of homophily in the network.

The tendency for individuals to associate with others who are similar to themselves (i.e., homophily) is long established (Lazarsfeld and Merton 1954). This "law-like" feature of social networks exists for numerous types of attributes, including sociodemographic characteristics, behaviors, attitudes and psychological traits (McPherson, Smith-Lovin and Cook 2001). Because social networks have implications for a wide range of outcomes, it is important to understand the processes by which individuals come to occupy their respective network positions. Positions characterized by homophilous relationships have consequences at the macro and micro level. For instance, homophily inhibits the diffusion of information and other cultural material (McPherson et al. 2001), which can result in cultural polarization (Macy et al. 2003). At the micro level, homophily on an attitude or behavior serves as reinforcement, which may contribute to undesirable outcomes for some dimensions (e.g., aggression; Dishion et al. 1991). By contrast, heterophilous relationships are more likely to facilitate information diffusion (Granovetter 1973) and promote outcomes such as creativity (Burt 2004). The current interest is in developing a new account for how actors' selection processes culminate in homophily.

There are two established classes of explanations behind selection homophily: preference and structural inducement (Kossinets and Watts 2009; McPherson et al. 2001; Rivera, Soderstrom and Uzzi 2010). Preference-based explanations cite mechanisms that make homophilous relationships more rewarding. Homophily has been argued to reduce interpersonal strain (Newcomb 1961), facilitate communication (Rogers and Bhowmik 1970), reinforce beliefs and identity (Byrne 1971) and increase coordination

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(Cole and Teboul 2004). Structuralist arguments emphasize factors that affect intergroup contact, including the relative sizes of different subgroups within the population, substructures that focus interactions (e.g., neighborhoods, schools, workplaces, and voluntary associations) and the correlation of salient dimensions of attraction within the population (Blau 1977; Feld 1982; McPherson et al. 2001). When the population structure restricts intergroup contact, chance alone can lead to homophily.

Structural and preference-based explanations help explain homophily on several dimensions, including race and ethnicity (Moody 2001; Mouw and Entwisle 2006; Wimmer and Lewis 2010), sex (McPherson and Smith-Lovin 1986), age (Feld 1982) and attitudes (Huston and Levinger 1978). However, there are other dimensions that exhibit homophily where these explanations may not suffice. For some dimensions, actors at the upper end of the spectrum may neither desire homophily nor be structurally constrained, yet still find themselves in homophilous relationships. For example, one argument behind depression homophily among adolescents is that because depressed youth are more passive and withdrawn, their peers do not select them as friends. Thus, "they become the 'leftovers' in the peer selection game, with only themselves to befriend" (Hogue and Steinberg 1995:904). Similar arguments have been made using notions of rejection, exclusion and avoidance to explain homophily on aggression (Sijtsema et al. 2010), obesity (Crosnoe, Frank and Mueller 2008) and attractiveness (Walster et al. 1966). These accounts suggest a third class of theory that explains how homophily can be endogenously induced in the absence of both structural forces and preferences for homophily (Schaefer, Kornienko and Fox 2011).

I draw upon social exchange theory to outline one such homophily mechanism. I propose that when actors share a common definition of value and seek higher value partners, lower value actors will be excluded and ultimately turn to one another, resulting in homophily. Key to this mechanism is reciprocity, that is, the act of responding to another's rewarding gestures with one's own rewarding gestures (Gouldner 1960). The desire for reciprocity pushes lower value actors who are excluded to seek new partners, resulting in a shift from higher to lower value targets. The consequence of these choices is homophily on value. Despite its intuitive appeal, this mechanism has not previously been tested in a social network context. I investigate how homophily emerges due to nonreciprocity using a laboratory experiment that examines the micro-level processes responsible for homophily. Among other advantages, the experiment manipulated participant value (i.e., low, medium and high) while keeping them unaware of their own value, which is essential to eliminate preference as an alternative explanation for homophily. I demonstrate how changes in partner selection over time bring about increasing levels of homophily. I conclude by discussing the conditions necessary for the nonreciprocity mechanism to produce homophily, where those conditions may be observed in the natural world, and the practical implications of homophily mechanisms for behavioral interventions.

Homophily Through Nonreciprocity

Homophily through nonreciprocity is an unintended consequence of actors seeking to build relationships that provide them with valued rewards. Briefly, homophily can

arise when a consensus on value exists, actors have a preference for high-value partners, and not everyone's preferences are met. In seeking higher valued partners, lower value actors will be less successful than higher value actors who have more to offer. As the gestures of lower value actors go unreciprocated by higher value actors, lower value actors are more likely to turn to one another as partners. Over time, this endogenous sorting process can lead to homophily on value. This form of homophily differs from structural homophily in that interactions are not constrained to be homogenous—the potential for heterophilous ties exists. Neither is this preference homophily, because no one prefers homophily *per se*. With preference-based homophily, selection is a joint product of one's own value and others' value on the attribute (i.e., similarity); whereas with homophily through nonreciprocity, selection is based solely on others' attributes (i.e., high value), regardless of one's own value. With homophily through nonreciprocity, higher value actors prefer higher value partners because they offer the greatest value, not because they are similar. Lower value actors also prefer high-value partners, but ultimately accept relationships with similarly valued partners. The consequence is homophily among both lower and higher value actors, though without a preference for homophily.

This process, where aspirations for high-value associates are tempered by the need for reciprocity, is described in a number of literatures. In theorizing the origins of status hierarchies, Gould (2002) proposed that actors face a tradeoff between partners who are high status and partners who reciprocate their gestures. As the desire for reciprocity increases, low-status actors reduce their attachments to high-status partners who fail to reciprocate, and instead focus on lower status partners who reciprocate their gestures. Martin (2009) echoes this tension between having ties that are reciprocated versus ties to popular associates. Both theories maintain that the relative strength of these forces has consequences for equality and group structure. Importantly, these theoretical accounts emphasize that homophily is more likely as the desire for reciprocity increases.

Empirical research has focused on whether possessing certain attributes leads to homophily via rejection. For instance, mental illness, such as depression, carries a stigma and is associated with behaviors that can strain relationships and foster avoidance by others (Joiner 1996; Lucas and Phelan 2010). This has been argued to produce homophily because depressed individuals' only choices for associates are one another (Hogue and Steinberg 1995). Developmental research has found that aggressive children often prefer nonaggressive friends, but such peers are less likely to reciprocate (Hektner, August and Realmuto 2000; Snyder, Horsch and Childs 1997). Similar to the argument for depression, aggressive children are rejected by peers and left to affiliate with one another (Dishion et al. 1991; Hartup and Moore 1990). Last, Crosnoe, Frank and Mueller (2008) found that larger adolescents were less often selected as friends, which they argue could lead to homophily on body size.

The process of homophily through nonreciprocity has received the most attention in research on the role of attractiveness in mate selection (and is more generally represented as a two-sided matching game; Roth and Sotomayor 1990). At issue is why couples often have similar levels of attractiveness: Do people prefer similarly attractive

partners or does the dating market impose similarity? The *matching hypothesis* proposed that individuals prefer partners who are as attractive as they are (Walster et al. 1966). Early studies found little support for the matching hypothesis, finding instead that most subjects preferred partners who were more attractive than themselves. However, when studies allowed the partner's reciprocity to be uncertain, meaning potential partners could reject the subject, the fear of rejection led subjects to select partners with a similar level of attractiveness (Huston 1973; Murstein 1972). A key component of this process is how individual selection behavior changes based on the outcomes of earlier selections. Murstein (1972:9) noted that "experienced" individuals are better able to avoid the costs of rejection while maximizing the attractiveness of the partner. This may be because individuals who are unsuccessful at mating lower their standards (Pennebaker et al. 1979). Alternatively, individuals may internalize the interpersonal feedback they receive when seeking mates, which alters their goals and ultimately the partners they seek (van Straaten et al. 2009). Changes such as these are necessary for less-attractive individuals to acquire partners who are similar, though not preferred.

The process of homophily through nonreciprocity has been documented only through computer simulations of mate selection (Kalick and Hamilton 1986). Social networks differ from dyads in at least one key manner. Research on mate selection has imposed mutual exclusiveness by allowing actors to have only one partner at a time. Once actors select a partner (e.g., marry), they are no longer eligible to form new unions. In social networks, however, actors can simultaneously maintain multiple ties, which allows them to retain less rewarding partners while more rewarding relationships are pursued. Below, I draw upon social exchange theory to articulate the process behind homophily through nonreciprocity and identify open questions regarding its operation in social networks.

Theoretical Background

I adopt the following standard scope conditions of social exchange theory (Molm and Cook 1995). Actors are assumed to be dependent upon one another for valued rewards, which are broadly defined as any behavior by one actor that is valued by another (Emerson 1972). Rewards can include the provision of material goods, behaviors (e.g., social support), and symbolic rewards such as status (cf. Schaefer 2009). Social exchange occurs when actors engage in repeated interactions to obtain valued rewards from one another (Blau 1964). Conceptualizing relationships as ongoing exchange helps emphasize their dynamic character. Relationships do not just "appear" and "disappear," but vary in strength over time. For the present study, I assume a set of actors come together with multiple opportunities to exchange with one another. Actors are heterogeneous on value and aware of one another's value, but have no prior history of exchange.

Much exchange research has examined the effects of a fixed network structure on power or integrative outcomes such as trust or cohesion. Power imbalances exist when one actor receives more than a partner at the partner's expense (Cook and Emerson

1978). When the network is static, low-power actors can do little to overcome their disadvantage. Few studies have examined how social exchange structures emerge. One exception is Kollock (1994), who investigated how uncertainty shapes exchange patterns by moderating the development of trust and commitment. Like Kollock, I depart from the traditional exchange approach by treating networks as the phenomenon to be explained. I place no constraints on who can exchange with whom or the number of exchange partners. Thus, actors have complete control over the relations in which they exchange.

Molm (2010) highlighted the importance of distinguishing between direct exchange that is negotiated versus reciprocal. In *negotiated* exchange, actors explicitly bargain with one another over what each will receive from exchange, whereas in *reciprocal* exchange actors provide unilateral rewards to one another without knowledge of what, if anything, will be received in return. I assume reciprocal exchange because it more closely resembles social, versus economic, exchange (Bonacich and Bienenstock 2009; Lawler, Thye and Yoon 2008; Molm, Peterson and Takahashi 1999). In particular, reciprocal exchange introduces greater risk and uncertainty to the exchange process, which poses a barrier to building relationships (Molm et al. 1999). At the same time, the presence of risk provides the opportunity for partners to demonstrate their trustworthiness (Yamagishi and Yamagishi 1994) and develop commitments (Kollock 1994). When partners behave in a trustworthy manner then trust and affect toward the partner can develop (Molm, Schaefer and Collett 2009).

Hypotheses

When a set of actors comes together with the opportunity to exchange they must somehow identify likely partners. Because the goal of exchange is to obtain valued rewards, I expect actors to initially attempt to forge relationships with higher value associates. In the reciprocal exchange context, where exchange behavior is unilateral, this means that actors will more often give to others of higher rather than lower value. This proposition is consistent with research on triads finding that actors initially explore exchange with higher value partners (Molm, Schaefer and Collett 2007).

A key feature of reciprocal exchange is that it offers both the incentive and opportunity to exploit others by failing to reciprocate (Bonacich 2009; Molm 2010). This has two implications in the present context. First, while all actors may attempt exploitation, higher value actors will be more successful. Actors are more tolerant of nonreciprocity from others who provide greater rewards on those occasions when they do reciprocate. Thus, higher value actors will more often find that they are rewarded, even when they do not reciprocate. Over time, higher value actors will learn to reciprocate less often than lower value actors. Second, reciprocity will differ based upon who is being reciprocated. By serving as reinforcement, reciprocity is a means to encourage others' future exchange. Accordingly, actors will reciprocate those partners who offer the most value. Thus, giving by higher value actors will more often be reciprocated than giving by lower value actors. In combination, these implications result in imbalanced

reciprocity in relations involving unequal value actors, with higher value actors reciprocating less often than their lower value partners.

The nature of reciprocal exchange makes it difficult to monitor precisely how often one has given versus received in a relationship (Molm et al. 2009). Relationships can sustain some imbalance in exchange outcomes; however, too much imbalance can threaten their survival. First, the power imbalance coinciding with imbalanced reciprocity creates an incentive for disadvantaged actors to change the network to reduce the power imbalance (Emerson 1972). Imbalances raise issues of fairness that can arouse negative emotions such as anger (Hegtvedt 1990) and elicit attempts to restore justice (Markovsky 1985). Power imbalances also reduce commitment by inhibiting the positive emotions produced by exchange (Lawler and Yoon 1993) and perpetuating risk and uncertainty (Molm et al. 2009). Together, these factors reduce the incentive to invest in an imbalanced relationship.

Second, reciprocity itself has an effect on actors' reactions to exchange outcomes. In a direct test of value versus reciprocity, Molm and colleagues (2007) evaluated whether participants preferred a low-value exchange partner who reciprocated at a high rate or a high-value partner who reciprocated at a low rate. They found that participants' giving choices were indifferent between the two partners, but, the constant reciprocator was more trusted and well-liked and their relationship was characterized by greater solidarity. They concluded that reciprocity provides *symbolic value*, in the form of positive regard for the partner, in excess of the instrumental value of resources received.

Altogether, these features of reciprocal exchange lead to the following hypotheses:

> *Hypothesis 1: Initially, all actors will direct exchange towards higher value actors, with the effect dissipating over time.*
>
> *Hypothesis 2: Initially, higher value actors will be less likely to reciprocate than lower value actors, with the effect dissipating over time.*

The impetus for the dissipation of effects in Hypotheses 1 and 2 is that actors—especially those with lower value—will cease giving to higher value partners who don't reciprocate. In redirecting their exchange, actors will seek partners who reciprocate more often. Thus, lower value actors should experience greater reciprocity over time, leading to Hypothesis 3.

> *Hypothesis 3: Initially, higher value actors will be reciprocated more often than lower value actors, with the effect dissipating over time.*

The aforementioned process will create homophily among *higher value* actors because they are one another's preferred exchange partners and will thus reciprocate at acceptable rates. By contrast, lower value actors will abandon their imbalanced relationships with higher value partners who do not reciprocate and search for better

reciprocating partners. The options for new partners will inevitably be other lower value actors whose value made them less attractive initially. This process can lead to homophily among *lower value* actors if two conditions are met. First, lower value actors who are not adequately reciprocated must maintain a desire for exchange and actively seek new partners. It is an open question whether the lack of reciprocity by one's preferred partners reduces the desire for social contact. Experimental studies have found that rejection produces negative emotional responses (Blackhart et al. 2009) and can lead to antisocial and aggressive behavior (Twenge et al. 2001, 2007). Other studies have found that rejected individuals are more attuned to signs of acceptance (DeWall, Maner and Rouby 2009) and take steps to facilitate new relationships (Maner et al. 2007).

Second, low-value partners must be better reciprocators than the high-value partners who were abandoned. The logic behind Hypothesis 2 suggests that lower value actors will learn to reciprocate more often than higher value actors. In addition, psychological research suggests that prior rejection can lead to greater cooperation in new relationships (Maner et al. 2007). Rejected individuals are more likely to respond positively to others who offer the possibility for acceptance (Finkel and Baumeister 2010). Thus, as lower value actors seek new partners and find them to be better reciprocators, relationships will form among lower value actors. Over time this will create homophily among all actors, not just those with higher value.

> *Hypothesis 4: The high-value preference effect (Hypothesis 1) will be gradually replaced by a tendency to direct exchange towards same-value actors.*

Method

Homophily through nonreciprocity is characterized by both a widespread preference for higher value partners and an observed homophily on the dimension. However, documenting the co-occurrence of these patterns is not enough to support the theorized mechanism. Such patterns may arise through other selection mechanisms that do not involve reciprocation. For example, when lower value is associated with decreased sociability, network mechanisms can lead to homophily (Schaefer et al. 2011). Alternatively, the causal order may be reversed. For instance, social rejection may decrease one's value (e.g., cause depression; see Bukowski, Laursen and Hoza 2010). Thus, identifying homophily through nonreciprocity requires observing the partner selection process over time. This necessitates longitudinal data, including information on both successful and failed relationships (Kalick and Hamilton 1986). Such requirements may help explain why this mechanism has only rarely been investigated despite its articulation in a number of literatures.

To meet these requirements, I devised a laboratory experiment that brought participants together and allowed them to form exchange relationships. The experimental approach has many advantages over observations of networks in the natural world for

testing the theorized mechanism. First, it reduced value to a single dimension that could be manipulated. Manipulating actor value is necessary to control for individual characteristics that confound one's value as an exchange partner with the tendency to occupy distinct network positions (e.g., personality traits; Kalish and Robins 2006). Thus, any observed differences in behavior by actor value can be attributed to the experimental manipulation (i.e., randomly assigned value). Second, the laboratory provided the capacity to keep individuals unaware of their own value. This is important to prevent participants from selecting partners because they are similar to themselves, which would constitute preference homophily. Third, the experiment enabled a complete recording of exchanges, including attempts to forge relationships that went unreciprocated. These data can be used to identify changes in behavior over time and investigate the micro-level processes responsible for relationship development.

The experiment included six networks of sizes 9, 12 and 14 (two cases each).[1] Within each network, participants were randomly assigned to be low, medium or high value, which determined how rewarding they were as exchange partners. An equal number of participants were assigned to each value except for in the 14-actor networks, which comprised 4 low-value, 6 medium-value and 4 high-value actors. To reduce the potential for preference homophily, participants were not informed of their own value. Participants were undergraduate students recruited based on their desire to earn money (i.e., recruitment media and instructions for the experiment stressed a cash payment). At the beginning of the experiment, students were seated in the same room at separate cubicles, each with its own computer. Students read detailed instructions and completed several practice exchanges prior to beginning the experimental exchange phase. For the exchange phase, participants were assigned a unique letter; this was the only way for them to keep track of the behavior of the other participants during the experiment. A total of 70 students participated in the experiment (28 females and 42 males).

Exchange Process

The exchange process was quite straightforward. Participants were told they would have several opportunities to give points to other participants. On each opportunity, participants decided who would receive their points: They could give to all, some or none of the other participants. In network terms, the network was maximally dense, meaning any participant could potentially exchange with any other participant. At the end of the experiment, participants were paid based on the number of points they had accumulated. I provide more detail on the design below.

Participants interacted with one another through computers using a program developed with z-Tree software (Fishbacher 1999). The experiment comprised 120 rounds (participants were not told the number of rounds). At the beginning of each round, participants were given an endowment of 12 points. Participants could keep their 12 points or give their points to one or more fellow participants. The number of points participants could give to one another was fixed at 6 points each, meaning the 12-point endowment allowed participants to give to two other participants within a round. Giving to more than two participants was possible, but that required participants to

draw upon their previously accumulated profit. Thus, participants could give points to as many other participants as they liked once they had accumulated sufficient profit. Points given to others increased depending upon the giver's value by a factor of 1.33, 1.67 or 2 (though givers and recipients were unaware of this multiplication factor). From a participant's perspective others could give them 8 points (low value), 10 points, (medium value) or 12 points (high value), making regular exchange more profitable than keeping one's own points.

Within each round, participants indicated to whom to give points on a Recipient Selection screen. The screen listed each other participant, along with their identifying letter and point value (e.g., 8, 10 or 12). Participants could select one or more recipients or they could keep their endowment by selecting zero recipients. After a round, participants received a summary of their own giving behavior and what they received from others. A brief message indicated how many participants they had given to, the cost they incurred giving to others and the amount they earned, both by receiving others' points and by retaining their own endowment. After this message, another round began. In rounds 2-120, the Recipient Selection screen provided the letter corresponding to those participants who had given them points on the previous round. Participants were not told the number of points others received from them or whether exchange occurred in others' relationships.

Relational Measures of Exchange Behavior

Individual value was coded 1 (low), 2 (medium) or 3 (high). For analytic purposes, exchange behavior was reduced to the level of *dyad type*.[2] The combination of three giver values (i.e., low, medium and high) and three recipient values produces nine dyad types. For each dyad type, *giving* was a proportion, measured as the number of instances of giving within a round divided by the maximum possible giving (i.e., the number of dyads of that type). For example, in a particular round, giving in low-medium dyads was calculated as the number of relations in which a low-value participant gave to a medium-value participant divided by the number of low-medium dyads. *Reciprocity* for each dyad type was calculated as the proportion of giving during the previous round that was reciprocated in the current round. For example, reciprocity in low-medium dyads in round t was calculated as follows. The denominator was the number of relations in which low-value participants gave to medium-value participants in round t-1. The numerator was the number of those exchanges included in the denominator in which medium-value participants gave back to low-value participants in round t. Reciprocity was impossible during round 1, but all subsequent rounds contained the possibility for reciprocity in each dyad type. Probabilities of giving and reciprocating were multiplied by 100 to create percentages, which allows greater precision in reporting results.

Analysis

The main analysis had three elements. First, giving behavior was assessed by regressing giving on giver value, recipient value, round and interactions between (a) round and

giver value and (b) round and receiver value. Second, reciprocity was assessed using the same model specification, but with reciprocity as the outcome. Third, the level of homophily at the conclusion of the experiment was assessed using odds ratios. Odds ratios represent homophilous giving relative to nonhomophilous giving within the final 10 rounds. For example, the odds of homophilous giving among low-value participants was calculated as the odds of giving within low-low dyads divided by the odds of giving within dyads containing either a low-value giver or a low-value recipient (not both). Homophily is indicated by an odds ratio that exceeds 1, while an odds ratio of 1 indicates that participants were just as likely to exchange with similar value others as with dissimilar value others. To test whether homophily existed among participants of each value, separate odds ratios were calculated for low-low, medium-medium and high-high dyads. I follow the main analysis with an examination of two steps in the process theorized to produce homophily.

Standard linear models are unsuitable for these analyses because the interdependence between dyads violates the assumption of independent observations, which leads to correlated errors and unreliable standard errors (Krackhardt 1988). For instance, *i*'*s* giving to *j* is dependent upon *j*'s giving to *i* as well as *i*'s giving in other dyads. Instead, I use permutation-based analyses along the lines of Krackhardt's (1987) Quadratic Assignment Procedure (QAP). This procedure entails (1. calculating a statistic based upon the observed data and (2. constructing a distribution of statistics by repeatedly permuting the data and recalculating the statistic (10,000 times for the results reported below). *P* values are obtained by comparing the observed statistic to the distribution of statistics from the permuted data. The relevant statistics in the current study are regression coefficients and odds ratios. Each permutation first involved simultaneously reordering the columns and rows of the matrices representing each network and round. This had the effect of randomly reassigning participant values. Second, to facilitate estimates of change over time, the temporal order of the matrices within each case was permuted. After each permutation of the data, the amount of giving and reciprocity by dyad type was recalculated for each round and the relevant statistic was estimated. Examples of similar QAP-based approaches are available in Gould (2002) and Kilduff (1992).

Results

On average, exchange occurred in 39% of dyads on any round. An analysis of variance indicates no overall differences in giving by network size ($F_{2,53} = .301$, $p = .741$), participant value ($F_{2,53} = .895$, $p = .415$) or sex ($F_{1,53} = 3.246$, $p = .077$). In general, participants explored exchange in all of their relations. Of the 772 possible unilateral exchange relations, 98% displayed giving on at least one round. Figure 1 presents rates of giving in each round for the nine different dyad types. At first glance, giving increased over time in each dyad type, though the mean level of giving and change over time differed by type. The following analyses investigate these patterns in more detail and test whether they conform to the hypotheses.

Giving and Reciprocation

Hypothesis 1 stated that actors would initially direct their giving to higher value actors, but this effect would dissipate over time. To evaluate this hypothesis, I regressed giving on giver value and recipient value. Change over time is assessed by including exchange round as a main effect and in interactions with giver value and recipient value. Results in the Giving model (Table 1) indicate that higher value participants were more likely than lower value participants to receive points from others. The percent of dyads in which participants received points increased by 4.7 for a one-unit increase in recipient value (e.g., from low to medium). However, this difference largely disappeared over time, as indicated by the negative interaction between round and recipient value. At round 120, the interaction effect is evaluated at -4.2 (120 * -0.035), which nearly offsets the main effect of recipient value (4.673). As exchange relationships evolved, participants were less likely to preferentially give to higher value others, which provides support for Hypothesis 1.

Other effects in the Giving model provide further insight to the exchange process. The positive effect of round reflects the overall increase in giving over time. The main effect of giver value indicates that higher value participants were less likely than lower value participants to give to others. The interaction between giver value and round tests whether this difference changed over time based upon participant value. The negative interaction suggests that higher value participants became even less likely to give to others over time relative to lower value participants. This effect was not hypothesized, but satisfies one prerequisite for homophily. The logic behind homophily through nonreciprocity required that lower value participants who were not reciprocated at acceptable rates had to maintain their desire for exchange and seek new partners. Results from Model 1 indicate that, in fact, lower value participants were increasingly likely to give over the course of the experiment relative to higher value participants.

Giving was expected to change over time due to differential patterns of reciprocity across dyad types as articulated by Hypotheses 2 and 3. Hypothesis 2 stated that higher value actors would reciprocate less than lower value actors, though this effect would dissipate over time. This hypothesis is tested through the reciprocator value effects in the Reciprocation model (Table 1), which has the same specification of effects as the Giving model. The negative main effect of reciprocator value indicates that higher value participants were less likely than lower value participants to reciprocate others' giving. The positive interaction with round suggests that this effect became weaker over time but did not completely disappear. At round 120, the interaction is evaluated at 6.5 (120 * .054), which does not completely counteract the main effect of reciprocator value (-13.031). By the end of the experiment, higher value participants were still reciprocating less than lower value participants, but the discrepancy was smaller than earlier in the experiment. Thus, in support of Hypothesis 2, higher value participants became better reciprocators over time relative to lower value participants.

Hypothesis 3 stated that lower value actors would be reciprocated less often than higher value actors, though this effect would dissipate over time. This hypothesis is tested with the giver value effects in the Reciprocation model. The main effect of giver

value is positive and significant, indicating that higher value participants were more likely to be reciprocated by others than lower value participants. However, the negative interaction indicates that this difference disappeared over time. The model predicts no difference in rates of being reciprocated by round 120 (120 * -0.047 = -5.64, which offsets the main effect of giver value [5.227]). This suggests that exchange patterns evolved to alleviate the greater nonreciprocity experienced by lower value participants. In effect, lower value participants found better partners.[3]

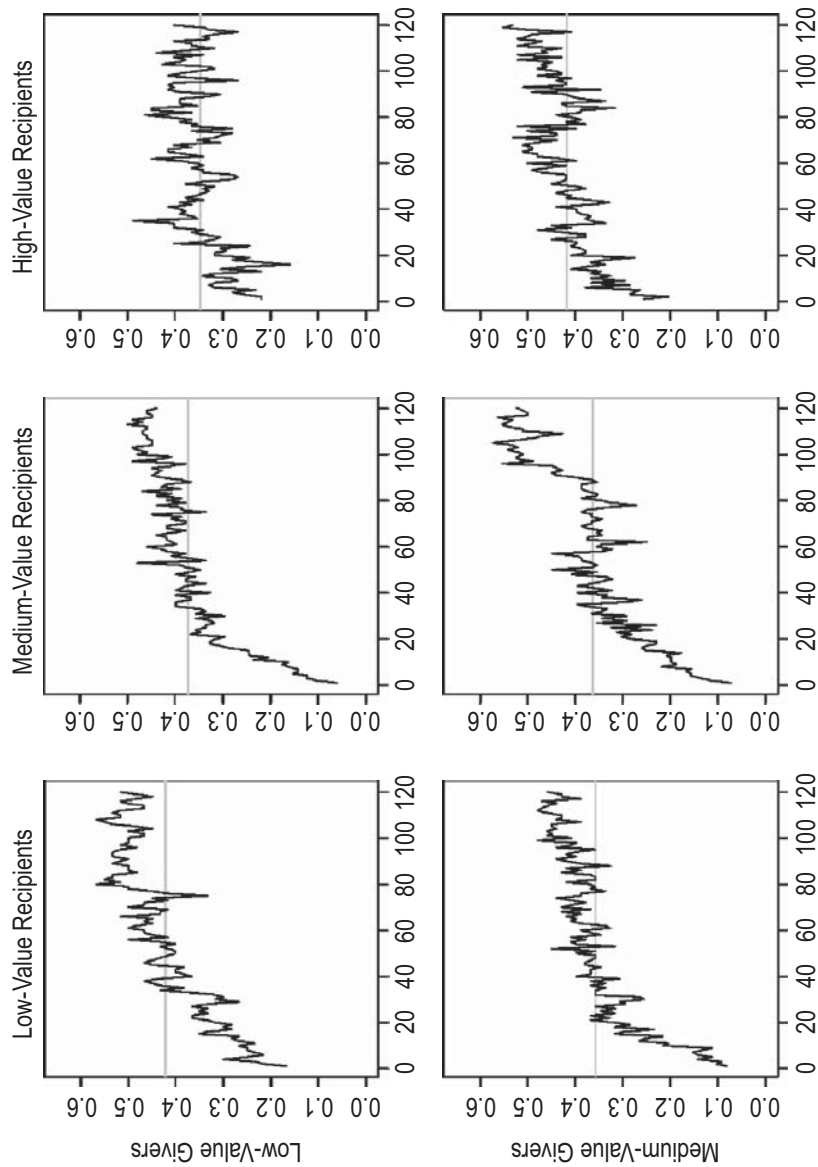
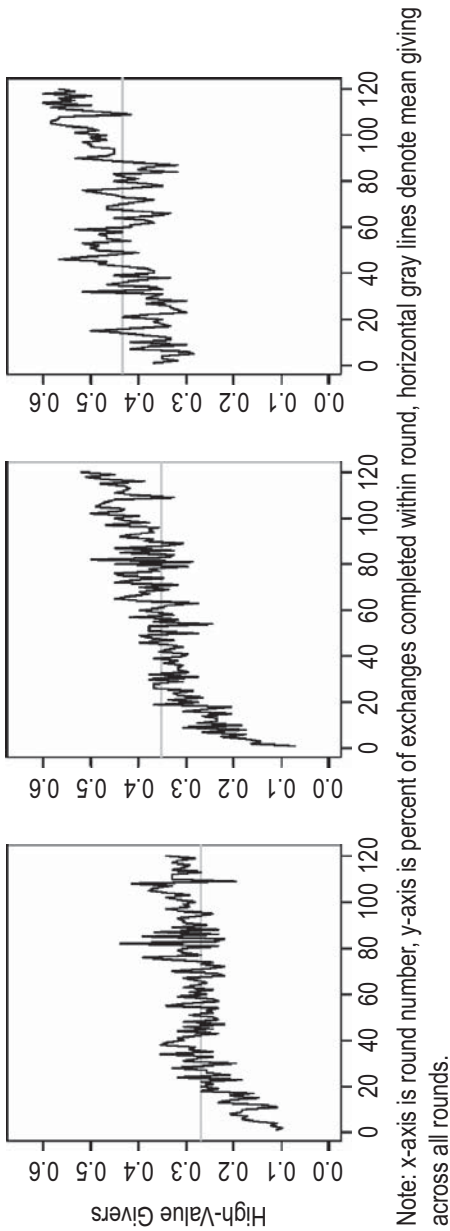


Figure 1. Exchange in Each Round by Giver Value and Recipient Value

Homophily

Hypothesis 4 proposed that all actors would exhibit homophilous exchange over time. To test whether homophily became increasingly prevalent, I regressed giving on a dummy variable representing whether each dyad was homophilous or not (1 = homophilous, 0 = nonhomophilous). I created an interaction between the homophily variable and round to test for change in homophilous giving over time. These models were estimated separately for participants of each value and their partners. For example, the models testing homophily among low-value participants only included dyads with a low-value giver or low-value recipient. This allows for different trajectories of homophilous exchange over time for participants of each value.



As shown in Table 2, the main effects for homophily indicate that homophilous exchange was more likely among low-value and high-value participants. The interactions between homophily and round reveal that homophilous giving increased over time among low-value and medium-value participants. By contrast, high-value participants exhibited a smaller increase in their preference for same value partners that was not statistically significant. This relative stability is not surprising because from the start of the experiment high-value participants were expected to preferentially give to high-value others. For low-value participants, the significant main and interaction effects offer evidence of homophily strengthening over time. For medium-value participants, the combination of homophily main and interaction effects suggests that homophily appeared later in the experiment.

At round 120, the interaction equals 11.16 (120 * 0.093), which exceeds the main effect of homophily (-6.8). By the end of the experiment, the percent of homophilous exchanges completed among medium-value participants was 4.36 (11.16–6.8) higher than the percent of nonhomophilous exchanges completed. Thus, in support of

Table 1: Coefficients from Regression of Giving and Reciprocation

	Giving		Reciprocation	
	b	*p*	*b*	*p*
Intercept	17.609	< .001	86.000	< .001
Round	0.275	< .001	0.116	.064
Giver Value	-0.544	.350	5.227	< .001
Giver Value × Round	-0.013	.007	-0.047	< .001
Recipient/Reciprocator Value	4.673	< .001	-13.031	< .001
Recipient/Reciprocator Value × Round	-0.035	< .001	0.054	< .001
R^2	0.502		0.516	

Note: Unstandardized coefficients obtained from OLS models. Statistical significance determined by comparing observed coefficients to the distribution of coefficients from 10,000 models estimated on randomly permuted networks. The Giving model has N = 1,080 (9 dyad types × 120 rounds). Because reciprocity was only possible after the first round, the Reciprocation model has N = 1,071.

Hypothesis 4, exchange became more likely in homophilous dyads over time among lower value participants.

The preceding results show that the changes in exchange behavior over time led to an increase in the tendency for homophilous exchange. However, this does not demonstrate the presence of homophily, which requires that rates of homophilous giving exceed nonhomophilous giving by the end of the experiment. It is possible for an increase in homophily to occur if an early pattern of heterophilous exchange (i.e., preferentially giving to others *unlike* oneself, such as medium giving to high) later shifted to no preference at all. The difference is between looking at the slope of the homophily effect over time and the mean level of homophily at the end of the experiment. To address this possibility, I test whether homophily existed at the conclusion of the experiment by examining the odds of homophilous giving within the final 10 rounds. Results reveal that the odds of homophilous exchange exceeded one for participants of each value (all $p < .001$). The odds of homophilous versus nonhomophilous exchange were 1.48 times greater for low-value participants, 1.29 times greater for medium-value participants, and 1.80 times greater for high-value participants. By the end of the experiments, participants of each value had become more likely to exchange with partners who shared their value than with dissimilar partners.

Table 2: Coefficients from Regression of Giving – Value Specific Models

	Low Value		Medium Value		High Value	
	b	*p*	*b*	*p*	*b*	*p*
Intercept	24.200	.002	26.189	.009	27.094	.018
Round	0.160	.016	0.186	.005	0.130	.045
Homophilous Dyad	3.818	.007	-6.804	< .001	7.242	< .001
Homophilous Dyad × Round	0.075	< .001	0.093	< .001	0.020	.057
R^2	0.508		0.612		0.365	

Note: Models include all dyads with at least one actor of the specified value (e.g., the Low value model was estimated using all dyads with at least one Low value actor). Each model has N = 600 (5 dyad types × 120 rounds). Unstandardized coefficients obtained from OLS models. Statistical significance determined by comparing observed coefficients to the distribution of coefficients from 10,000 models estimated on randomly permuted networks.

Follow-Up Analysis

The next section further investigates two intervening steps in the process

Table 3: Overall Percent of Exchanges Reciprocated by Dyad Type

		Reciprocator Value		
		Low	Medium	High
Giver Value	Low	88.7	81.6	59.2
	Medium	88.4	81.5	67.5
	High	82.6	84.6	75.3

Note: For each dyad type, cells represent the percent of time that *i* giving to *j* at time *t* was reciprocated by *j* giving to *i* at time *t*+1.

leading to homophily. First, the logic behind the homophily through nonreciprocity mechanism specified that lower value actors would take the initiative to end imbalanced relations with higher value partners. The alternative is that lower value actors may have been completely rejected by higher value partners who refused to exchange with them. Both processes can lead to homophily; the difference is whether lower value actors dissolve such relations of their own accord. This distinction is subtle, but has implications for lower value actors' alternative relationships. In particular, whether exchange in alternative relationships is voluntary or compelled by others (e.g., due to rejection) has implications for the development of positive emotions and relational commitment (Lawler, Thye and Yoon 2006). To differentiate these possibilities, I calculated who was the *last* to give in dyads that did not survive until the end of the experiment (defined as no giving in the final 10 rounds [37% of dyads]). The last person to give in a dyad presumably had a greater interest in maintaining the relationship and was not primarily responsible for ending it.

Results indicate that lower value participants were more likely to end relationships. In low-high dyads, low-value participants were the last to give only 26% of the time, ($t[81] = 4.955$, $p < .001$), meaning that in 74% of the low-high dyads, the high-value partner tried to sustain the relationship longer. The rate is comparable in medium-high dyads, where 31% of medium-value participants were the last to give, ($t[97] = 4.067$, $p < .001$), but slightly more balanced in low-medium dyads, where 41% of low-value participants were the last to give, ($t[97] = 1.811$, $p = .073$). Overall, these results suggest that lower value actors had a greater tendency to abandon relationships with their higher value partners. It may seem odd that higher value actors tried to sustain relationships longer given their poor reciprocation. However, it was the imbalance in reciprocity favoring higher value actors that made such relationships valuable and worth attempting to preserve.

Second, I expected lower value participants to turn to lower value partners because they were better reciprocators than higher value partners. Earlier results showed that lower value participants were more likely to reciprocate, but did not consider reciprocation within the different types of dyads. To shed additional light on reciprocation patterns, Table 3 presents overall reciprocity rates for each dyad type. These results indicate that reciprocation rates differed by dyad type in the manner necessary to

produce homophily. High-value participants reciprocated low-value participants 59% of the time, while low-value participants reciprocated one another 89% of the time ($p < .001$). High-value participants also reciprocated medium-value participants at a lower rate than medium-value participants reciprocated one another ($p = .03$), while there was no significant difference in reciprocation rates within low-medium dyads compared to low-low dyads (82% vs. 89%, $p = .142$). Focusing only on homophilous dyads, reciprocity rates were inversely related to giver and recipient value. Low-value participants reciprocated one another 7.2% more often than medium-value participants reciprocated one another, which was 6.2% more often than high-value participants reciprocated each other. A permutation test indicates that differences this large would occur with probability of .016. Thus, lower value participants not only became better reciprocators than higher value participants, but also reciprocated one another at higher rates than participants in higher value dyads.

Discussion

This research investigated one of the most common patterns of human association—homophily. Prior research on homophily has emphasized structural factors or psychological preferences as the basis for selection into homophilous relationships, both of which are exogenous explanations. By contrast, I offer a "mechanism" based account that explains how individual action and interaction lead to homophily (Hedström and Bearman 2009). This mechanism describes how homophily can occur in the absence of either preferences or structural inducements. Drawing on social exchange theory I outline how homophily develops through nonreciprocity. Experimental results provide support for this process. Behavioral preferences for higher value partners emerged initially, but corresponding asymmetries in giving and reciprocity pushed lower value actors to abandon their higher value partners in favor of lower valued partners. This form of unintended homophily was not the product of population composition, nor was it born out of a preference for homophily. Indeed, actors were unaware of their value and most actors would have preferred someone different than themselves (i.e., higher value). Rather, homophily was endogenously induced through the unfolding exchange process. Such a process has been proposed to explain homophily on several dimensions, but has not previously been tested in a social network.

The current theory belongs to a third class of explanations for homophily that delineate endogenous selection mechanisms. This class also includes mechanisms such as amplification (Wimmer and Lewis 2010) and withdrawal (Schaefer et al. 2011). Amplification occurs when network processes, such as transitivity, disproportionately promote homophilous ties. For example, suppose *i* and *j* have no ingroup preferences but are both friends with *k* who does prefer homophily. If the *i*-*j* tie forms because *k* introduced *i* and *j* (i.e., transitivity), their tie is likely to be homophilous, even though neither *i* nor *j* sought homophily (Mouw and Entwisle 2006). Withdrawal creates homophily when, for instance, the reduction in social activity associated with depression excludes adolescents from the network processes that less depressed adolescents

rely upon for friendships (e.g., transitivity). As a consequence depressed adolescents find one another through other means, resulting in homophily. These are distinct selection mechanisms but they produce the same outcome. One means to distinguish them is to consider the conditions necessary for their operation. Each of these theories presupposes heterogeneity in value among actors. However, amplification requires that at least some actors have homophilous ties to begin with and withdrawal requires that lower valued actors seek fewer ties. By contrast, the nonreciprocity mechanism posits that homophily can arise even when all actors begin in the same structural position and have the same partner selection preferences. Still, these mechanisms are not mutually exclusive and may operate in conjunction in some circumstances.

The experiment was useful to test the hypothesized causal process and eliminate alternative explanations for homophily. Participants were randomly assigned a value; thus, differences in behavior that emerged among participants of different value were a consequence of the endogenous exchange process. The experiment also kept participants blind of their own value, which eliminates homophily through preference as an alternative explanation for the findings.[4] The experimental design departed from most social network research by operationalizing ties as ongoing exchange. This provided the opportunity to examine the consequences of behavior within relationships for the evolving network structure. This process is difficult to observe with dichotomous ties, which mask the fluctuations in relationship strength that characterize relationship formation (Blau 1964; Fine 1980). Treating ties as ongoing exchange allowed the micro-dynamics behind homophily through nonreciprocity to play out over time.

An open question is whether homophily through nonreciprocity operates outside the laboratory. This mechanism may explain homophily on dimensions that meet certain criteria. First, homophily through nonreciprocity can only occur for dimensions where there is a consensus on value (otherwise, ingroup preferences can directly lead to homophily). Second, the mechanism requires that relationships between actors of different value be possible, which precludes it from operating in contexts that prohibit cross-value associations (such as caste systems). Finally, dimensions must be visible or otherwise readily observable in their value or behavioral implications. This is necessary for the initial preferential selection of higher value actors to occur. Dimensions that are unobservable may still exhibit homophily, however the process will likely differ. When sustained interaction is required to learn another's value, the sorting process will involve more "trial and error" to find suitable partners. Thus, homophily should take longer to unfold and may involve higher value actors rejecting or "deselecting" lower value partners (see Van Zalk et al. 2010) instead of lower value actors leaving imbalanced relationships. In addition, the interactions that transpire prior to learning another's value may foster commitments that sustain cross-value relationships.

One likely candidate for the homophily through nonreciprocity mechanism is popularity itself as proposed by Gould (2002) and Martin (2009). These results support their assertions that reciprocity concerns push networks toward more homophilous and less hierarchical structures. Results also offer support to the logic underlying prior studies investigating homophily on depression (Hogue and Steinberg 1995),

aggression (Dishion et al. 1991) and attractiveness (Walster et al. 1966). Additional candidates include qualities that are universally recognized as desirable in friends. For instance, trustworthiness is essential to most relationships, while emotional stability, respectfulness and extroversion are oftentimes desired (Cottrell, Neuberg and Li 2007).

A natural question is whether this process operates for dimensions that act as status characteristics, where different values (or states) carry expectations about competence (Berger, Cohen and Zelditch 1972). Laboratory research has shown that actors with high-status characteristics are more likely to be sought as exchange partners, to the point that others sacrifice power to consummate such exchanges (Thye 2000). Thus, in the abstract, this mechanism can operate with status characteristics. Nevertheless, a complicating factor in the natural world is that selection is often driven by multiple forces. For instance, race homophily is partially explained by the presence of foci that affect cross-group contact (Moody 2001), residential segregation (Mouw and Entwisle 2006) and ethnic homophily (Wimmer and Lewis 2010). These forces can disrupt the homophily through nonreciprocity mechanism when they are more salient to the selection process and associated with the focal dimension. For example, when race is associated with spatial location and relationships between proximate actors are more likely, then a certain level of race homophily will be imposed on actors (Mouw and Entwisle 2006). Homophily might also arise spuriously when, for instance, preferences for culturally similar partners lead to homophily on dimensions related to culture, even if those dimensions act as status characteristics in isolation. Homophily through nonreciprocity in the natural world is most likely for dimensions where, net of structural and other selection forces, the set of potential relationships remains heterogeneous.

Key to understanding the source of homophily is the preferences and behaviors of individuals with low value. One of the requirements for homophily through nonreciprocity is that lower value actors must maintain their desire for social contact and become better reciprocators than higher value actors. Some dimensions where this mechanism has been hypothesized may fail to meet these conditions. For example, if rejection leads depressed individuals to completely shun social contact instead of seeking new partners, then homophilous friendships would not necessarily develop. With other dimensions, such as aggression, low value (i.e., aggressiveness) may be incompatible with greater reciprocation. For instance, aggressive individuals may be rejected by others but their aggression may also pose challenges to relationships with one another.

Understanding the origins of homophily is especially important for dimensions that are problematic in some way. In such cases, the practical implications for behavioral interventions may depend upon the mechanism responsible for homophily. For instance, homophilous relationships can reinforce problem behavior such as aggression (Dishion et al. 1991) and depression (Stevens and Prinstein 2005). Intervening in such relationships by providing nonhomophilous alternatives may help break this feedback loop. If homophily is structurally induced, then increasing heterogeneity among the pool of potential associates should be enough to reduce homophily. But, if individuals prefer homophilous relationships, then interventions must find ways to alter preferences to pull individuals away from similar associates. Alternatively, if homophily is a

product of nonreciprocity, then interventions must focus on why particular individuals are less preferred associates. There may be aversive behavior or stigma associated with the dimension that affects how others respond to them. The aim then becomes developing quality relationships that are heterophilous on the dimension.

An important future question is whether changes in the target of one's exchange behavior (e.g., shifting from higher to lower value partners) lead to changes in preferences (e.g., a preference for lower value partners). Such shifts were unlikely in the current study because participants were unaware of their own value and could not know who was similar. However, when rejection occurs in the natural world, lower value actors may attract one another based on their common identity as unpopular or "rejects" (Kinney 1993). This could be due to differences in reinforcement across relationships (van Straaten et al. 2009) or a means to eliminate cognitive dissonance (i.e., a preference for higher value partners but ties with lower value partners). Over time, a distinct subculture may develop which could reinforce segregation based on value (Mark 1998). Alternatively, more favorable definitions of value may emerge (possibly on other dimensions) and serve as the basis for attraction (Kinney 1993). Testing such processes can offer new insight to how preferences for partners develop, including preferences for homophily, which will help further theories of network dynamics.

This research helps fill the need for a better understanding of the processes behind network formation and change (Burger and Buskens 2009). Prior research has argued that preference homophily can vary in strength over time, with observable characteristics being salient earlier than unobservable characteristics (van Duijn et al. 2003). Others have found that network processes fluctuate in importance as networks evolve (Doreian et al. 1996; Schaefer et al. 2010). The results herein reveal how patterns of exchange behavior and homophily (and possibly preferences for homophily) can systematically change as the network evolves. Findings such as these imply that the rules governing network dynamics may themselves shift over time. Studies of network dynamics must therefore be cognizant of the "stage" of the network when making inferences about the mechanisms driving change. Given the ubiquity of homophily, it may not be surprising that it can emerge through several mechanisms. Fortunately, between laboratory settings that offer access to interactional micro-dynamics, and longitudinal network models that can test competing sources of homophily (Snijders, van de Bunt and Steglich 2010), the tools are available to investigate the processes responsible for network structure.

Notes

1. Networks needed to be large enough that participants would be unlikely to exchange regularly in all of their relations (which would preclude any findings). Pretesting revealed that nine was an acceptable minimum size. Fourteen was the maximum size based on the physical constraints of the lab. Different-sized networks were used as a means to meet the challenge of coordinating the involvement of a large number of participants. No differences were expected across different sized networks due to their relatively limited range. It is possible that differences by size could emerge in much larger networks that provided a greater number of potential partners, especially those with higher value.

2. The experiment contained 772 directed relationships, where *i*'s behavior toward *j* was measured separately from *j*'s behavior toward *i*. To facilitate the analysis, exchange behavior was recorded in matrix form, with rows representing givers and columns representing recipients (or reciprocators). A separate matrix was constructed for each case (network) and round. Cell *i, j* of a matrix indicates whether the participant in row *i* gave to the participant in column *j* within the round (for reciprocity, whether *j* reciprocated *i*).
3. Based upon a reviewer suggestion, I re-estimated the Giving and Reciprocation models using dummy variables for low value and high value (with medium value as the reference category). This specification allows the effects of participant value on giving, reciprocity and their change over time to be nonlinear. The pattern of results was generally stronger for differences between medium and high value than between medium and low-value participants. Regarding Hypothesis 1, differences in initial giving were driven solely by participants giving to high-value, rather than medium-value or low-value, partners. Change in giving over time was due to low-value and medium-value participants becoming more attractive as partners relative to high-value participants. The model for reciprocity, testing Hypotheses 2 and 3, revealed that low-value and high-value participants differed in the expected directions from medium-value participants, in both reciprocating others and being reciprocated. Change in these effects was attributable to differences between high-value and lower value participants: over time, high-value participants were less likely to be reciprocated but more likely to reciprocate others relative to low-value and medium-value participants. Despite these nonlinearities, the results lead to the same decisions for Hypotheses 1-3. These results are available upon request.
4. Participants may have tried to guess their value based upon others' responses to them. However, this would be difficult to do accurately given that participants did not have information about exchange outcomes in other relationships. Thus, participants had no reference for others' behavior and could not know whether others' reciprocity was relatively high or low and could not determine whether others' behavior toward them was driven by their own value or others' cooperativeness. Moreover, the novelty of the laboratory experiment likely inhibited the use of existing cognitive schemas to deduce value.

References

Berger, Joseph, Bernard P. Cohen, and Morris Zelditch, Jr. 1972. "Status Characteristics and Social Interaction." *American Sociological Review* 37:241-55.

Blackhart, Ginette C., Brian C. Nelson, Megan L. Knowles, and Roy F. Baumeister. 2009. "Rejection Elicits Emotional Reactions but Neither Causes Immediate Distress nor Lowers Self-Esteem: A Meta-Analytic Review of 192 Studies on Social Exclusion." *Personality and Social Psychology Review* 13:269-309.

Blau, Peter M. 1964. *Exchange and Power in Social Life*. New York, NY: Wiley.

_____. 1977. *Inequality and Heterogeneity*. New York, NY: Free Press.

Bonacich, Phillip. 2009. "Using Social Networks for Evil." Keynote address at Sunbelt XXIX International Network for Social Network Analysis Conference, San Diego, California.

Bonacich, Phillip and Elisa J. Bienenstock. 2009. "Structural Implications of Reciprocal Exchange: A Power-Dependence Approach." *Social Psychology Quarterly* 72:226-40.

Bukowski, William M., Brett Laursen, and Betsy Hoza. 2010. "The Snowball Effect: Friendship Moderates Escalations in Depressed Affect among Avoidant and Excluded Children." *Development and Psychopathology* 22:749-57.

Burger, Martijn J. and Vincent Buskens. 2009. "Social Context and Network Formation: An Experimental Study" *Social Networks* 31:63-75.
Burt, Ronald S. 2004. "Structural Holes and Good Ideas." *American Journal of Sociology* 110:349-99.
Byrne, Donn. 1971. *The Attraction Paradigm*. New York, NY: Academic Press.
Cole, Tim and JC. Bruno Teboul. 2004. "Non-Zero-Sum Collaboration, Reciprocity, and the Preference for Similarity: Developing and Adaptive Model of Close Relational Functioning." *Personal Relationships* 11:135-60.
Cook, Karen S. and Richard M. Emerson. 1978. "Power, Equity and Commitment in Exchange Networks." *American Sociological Review* 43:721–39.
Cottrell, Catherine A., Steven L. Neuberg, and Norman P. Li. 2007. "What do People Desire in Others? A Sociofunctional Perspective on the Importance of Different Valued Characteristics." *Journal of Personality and Social Psychology* 92:208-31.
Crosnoe, Robert, Kenneth Frank, and Anna S. Mueller. 2008. "Gender, Body Size and Social Relations in American High Schools." *Social Forces* 86:1189-1216.
DeWall, C.N., Jon K. Maner, and D.A. Rouby. 2009. "Social Exclusion and Early-Stage Interpersonal Perception: Selective Attention to Signs of Acceptance." *Journal of Personality and Social Psychology* 96:729-41.
Dishion, T.J., G.R. Patterson, M. Stoolmiller, and M.L. Skinner. 1991. "Family, School, and Behavioral Antecedents to Early Adolescent Involvement with Antisocial Peers." *Developmental Psychology* 27:172-80.
Doreian, Patrick, Roman Kapuscinski, David Krackhardt, and Janusz Szczypula. 1996. "A Brief History of Balance through Time." *Journal of Mathematical Sociology* 21:113-31.
Emerson, Richard M. 1972. "Exchange Theory, Part II: Exchange Relations and Networks." In *Sociological Theories in Progress*, Vol. 2, edited by J. Berger, M. Zelditch, Jr., and B. Anderson. Pp 58-87. Boston, MA: Houghton-Mifflin.
Feld, Scott L. 1982. "Social Structural Determinants of Similarity among Associates." *American Sociological Review* 47:797-801.
Fine, Gary A. 1980. "The Natural History of Preadolescent Male Friendship Groups." In *Friendship and Social Relations in Children*, edited by Hugh C. Foot, Antony J. Chapman, and Jean R. Smith. Pp. 293-32. New York, NY: Wiley.
Finkel, Eli J. and Roy F. Baumeister. 2010. "Attraction and Rejection." In *Advanced Social Psychology: The State of the Science*, edited by R. F. Baumeister and E. J. Finkel. Pp. 419-60. New York, NY: Oxford University Press.
Fischbacher, Urs. 1999. "z-Tree - Zurich Toolbox for Readymade Economic Experiments - Experimenter's Manual." Zurich, CH: Institute for Empirical Research in Economics.
Gould, Roger V. 2002. "The Origins of Status Hierarchies: A Formal Theory and Empirical Test." *American Journal of Sociology* 107:1143-78.
Gouldner, Alwin W. 1960. "The Norm of Reciprocity: A Preliminary Statement." *American Sociological Review* 25:161-78.
Granovetter, Mark S. 1973. "The Strength of Weak Ties." *American Journal of Sociology* 78:1360-81.
Hartup, Willard and Shirley G. Moore. 1990. "Early Peer Relations: Developmental Significance and Prognostic Implications." *Early Childhood Research Quarterly* 5:1-17.
Hedström, Peter and Peter Bearman. 2009. "What is Analytical Sociology All About? An Introductory Essay." In *The Oxford Handbook of Analytical Sociology*, edited by Peter Hedström and Peter Bearman. Pp. 3-24. Oxford, UK: Oxford University Press.

Hegtvedt, Karen A. 1990. "When Rewards are Scarce: Equal or Equitable Distributions." *Social Forces* 66:183-207.

Hektner, Joel M., Gerald J. August, and George M. Realmuto. 2000. "Patterns and Temporal Changes in Peer Affiliation among Aggressive and Nonaggressive Children Participating in a Summer School Program." *Journal of Clinical Child & Adolescent Psychology* 29:603-14.

Hogue, Aaron and Lawrence Steinberg. 1995. "Homophily of Internalized Distress in Adolescent Peer Groups." *Developmental Psychology* 31:897-906.

Huston, Ted L. 1973. "Ambiguity of Acceptance, Social Desirability, and Dating Choice." *Journal of Experimental Social Psychology* 9:32-42.

Huston, Ted L. and George Levinger. 1978. "Interpersonal Attraction and Relationships." *Annual Review of Psychology* 29:115-56.

Joiner, Thomas E. 1996. "Depression and Rejection: On Strangers and Friends, Symptom Specificity, Length of Relationship, and Gender." *Communication Research* 23:451-71.

Kalick, S. Michael and Thomas E. Hamilton, III. 1986. "The Matching Hypothesis Reexamined." *Journal of Personality and Social Psychology* 51:673-82.

Kalish, Yuval and Garry Robins. 2006. "Psychological Predispositions and Network Structure: The Relationship between Individual Predispositions, Structural Holes and Network Closure." *Social Networks* 28:56-84.

Kilduff, Martin. 1992. "The Friendship Network as a Decision-Making Resource: Dispositional Moderators of Social Influences on Organizational Choice." *Journal of Personality and Social Psychology* 62:168-80.

Kinney, David A. 1993. "From Nerds to Normals: The Recovery of Identity among Adolescents from Middle School to High School." *Sociology of Education* 66:21-40.

Kollock, Peter. 1994. "The Emergence of Exchange Structures: An Experimental Study of Uncertainty, Commitment, and Trust." *American Journal of Sociology* 100:313-45.

Kossinets, Geuorgi and Duncan J. Watts. 2009. "Origins of Homophily in an Evolving Social Network." *American Journal of Sociology* 115:405-50.

Krackhardt, David. 1987. "QAP Partialling as a Test of Spuriousness." *Social Networks* 9:171-86.

_____. 1988. "Predicting with Networks: A Multiple Regression Approach to Analyzing Dyadic Data." *Social Networks* 10:359-81.

Lawler, Edward J., Shane R. Thye, and Jeongkoo Yoon. 2006. "Commitment in Structurally Enabled and Induced Exchange Relations." *Social Psychology Quarterly* 69:183-200.

_____. 2008. "Social Exchange and Micro Social Order." *American Sociological Review* 73:519-42.

Lawler, E.J. and J. Yoon. 1993. "Power and the Emergence of Commitment Behavior in Negotiated Exchange." *American Sociological Review* 58:465-81.

Lazersfeld, Paul F. and Robert K. Merton. 1954. "Friendship as Social Process: A Substantive and Methodological Analysis." in *Freedom and Control in Modern Society*, edited by M. Berger. Pp. 18-66. New York, NY: Van Nostrand.

Lucas, Jeffrey W. and Jo C. Phelan. 2010. "Stigma and Status." Presented at the Annual Group Processes Conference. Atlanta, GA.

Macy, Michael W., James A. Kitts, Andreas Flache, and Steve Benard. 2003. "Polarization in Dynamic Networks: A Hopfield Model of Emergent Structure." In *Dynamic Social Network Modeling and Analysis*, edited by Ronald Breiger, Kathleen Carley, and Phillipa Pattison. Pp. 162-73. Washington DC: National Academy of Sciences.

Maner, Jon K., C.N. DeWall, Roy F. Baumeister, and Mark Schaller. 2007. Does Social Exclusion Motivate Interpersonal Reconnection? Resolving the 'Porcupine Problem.' *Journal of Personality and Social Psychology* 92:42-55.

Mark, Noah. 1998. "Beyond Individual Differences: Social Differentiation from First Principles." *American Sociological Review* 63:309-30.

Markovsky, Barry. 1985. "Toward a Multilevel Distributive Justice Theory." *American Sociological Review* 50:822-39.

Martin, John Levi. 2009. *Social Structures*. Princeton, NJ: Princeton University Press.

McPherson, J.M. and Lynn Smith-Lovin. 1986. "Sex Segregation in Voluntary Associations." *American Sociological Review* 51:61-79.

McPherson, J.M., Lynn Smith-Lovin, and James Cook. 2001. "Birds of a Feather: Homophily in Social Networks." *Annual Review of Sociology* 27:415-44.

Molm, Linda D. 2010. "The Structure of Reciprocity." *Social Psychology Quarterly* 73:119-31.

Molm, Linda D. and Karen S. Cook. 1995. "Social Exchange and Exchange Networks." In House *Sociological Perspectives on Social Psychology*, edited by Karen S. Cook, Gary Alan Fine, and James S. Pp. 209-35. Boston, MA: Allyn and Bacon.

Molm, Linda D., Gretchen Peterson, and Nobuyuki Takahashi. 1999. "Power in Negotiated and Reciprocal Exchange." *American Sociological Review* 64:876-90.

Molm, Linda D., David R. Schaefer, and Jessica L. Collett. 2007. "The Value of Reciprocity." *Social Psychology Quarterly* 70:199-217.

_____. 2009. "Fragile and Resilient Trust: Risk and Uncertainty in Negotiated and Reciprocal Exchange." *Sociological Theory* 27:1-32.

Moody, James. 2001. "Race, School Integration, and Friendship Segregation in America." *American Journal of Sociology* 107:679-716.

Mouw, Ted and Barbara Entwisle. 2006. "Residential Segregation and Interracial Friendship in Schools." *American Journal of Sociology* 112: 394-441.

Murstein, Bernard I. 1972. "Physical Attractiveness and Marital Choice." *Journal of Personality and Social Psychology* 22:8-12.

Newcomb, Theodore M. 1961. *The Acquaintance Process*. New York, NY: Holt, Rinehart and Winston.

Pennebaker, J.W.M.A. Dyer, R.S. Caulkins, D.L. Litomtz, P.L. Ackreman, D.B. Anderson, and K.M. McGraw. 1979. "Don't the Girls Get Prettier at Closing Time: A Country and Western Application to Psychology." *Personality and Social Psychology Bulletin* 5:122-25.

Rivera, Mark T., Sara B. Soderstrom, and Brian Uzzi. 2010. "Dynamics of Dyads in Social Networks: Assortative, Relational, and Proximity Mechanisms." *Annual Review of Sociology* 36:91-115.

Rogers, Everett M. and Phillip K. Bhomik. 1970. "Homophily-Heterophily: Relational Concepts for Communication Research." *Public Opinion Quarterly* 34:523-38.

Roth, Alvin E. and Marilda A. Oliveira Sotomayor. 1990. *Two-Sided Matching: A Study in Game-Theoretic Modeling and Analysis*. Cambridge, UK: Cambridge University Press.

Schaefer, David R. 2009. "Resource Variation and the Development of Cohesion in Exchange Networks." *American Sociological Review* 74:551-72.

Schaefer, David R., Olga Kornienko, and Andrew M. Fox. 2011. "Misery Does Not Love Company: Network Selection Mechanisms and Depression Homophily." *American Sociological Review* 76:764-85.

Schaefer, David R., John M. Light, Richard A. Fabes, Laura D. Hanish, and Carol L. Martin. 2010. "Fundamental Principles of Network Formation among Preschool Children." *Social Networks* 32:61-71.

Sijtsema, Jelle J., Tiina Ojanen, René Veenstra, Siegwart Lindenberg, Patricia H. Hawley, and Todd D. Little. 2010. "Forms and Functions of Aggression in Adolescent Friendship Selection and Influence: A Longitudinal Social Network Analysis." *Social Development* 19:515-34.

Snijders, Tom A.B., Gerhard G. van de Bunt, and Christian E.G. Steglich. 2010. "Introduction to Stochastic Actor-Based Models for Network Dynamics." *Social Networks* 32:44-60.

Snyder, James, Ellen Horsch, and Jocelyn Childs. 1997. "Peer Relationships of Young Children: Affiliative Choices and the Shaping of Aggressive Behavior." *Journal of Clinical Child Psychology* 26:145-56.

Stevens, Elizabeth A. and Mitchell J. Prinstein. 2005. "Peer Contagion of Depressionogenic Attributional Styles among Adolescents: A Longitudinal Study." *Journal of Abnormal Child Psychology* 33:25-37.

Thye, Shane R. 2000. "A Status Value Theory of Power in Exchange Networks." *American Sociological Review* 65:407-32.

Twenge, J.M., R.F. Baumeister, C.N. DeWall, N.J. Ciarocco, and J.M. Bartels. 2007. "Social Exclusion Decreases Prosocial Behavior." *Journal of Personality and Social Psychology* 92:56-66.

Twenge, J.M., R.F. Baumeister, D.M. Tice, and T.S. Stucke. 2001. "If You Can't Join Them, Beat Them: Effects of Social Exclusion on Aggressive Behavior." *Journal of Personality and Social Psychology* 81:1058-69.

van Duijn, Marijtje A.J., Evelien P.H.Zeggelink, Mark Huisman, Frans N. Stokman, and Frans W. Wasseur. 2003. "Evolution of Sociology Freshmen into a Friendship Network." *Journal of Mathematical Sociology* 27:153-91.

van Straaten, Ischa Rutger, C.M.E. Engels, Catrin Finenauer, and Rob W. Holland. 2009. "Meeting your Match: How Attractiveness Similarity Affects Approach Behavior in Mixed-Sex Dyads." *Personality and Social Psychology Bulletin* 35:685-97.

van Zalk, Maarten H.W, Margaret Kerr, Susan J.T. Branje, Hakan Stattin, and Wim H.J. Meeus. 2010. "It Takes Three: Selection, Influence, and De-selection Processes of Depression in Adolescent Friendship Networks." *Developmental Psychology* 46:927-38.

Walster, E., V. Aronson, D. Abrahams, and L. Rottman. 1966. "Importance of Physical Attractiveness in Dating Behavior." *Journal of Personality and Social Psychology* 5:508-16.

Wimmer, Andreas and Kevin Lewis. 2010. "Beyond and Below Racial Homophily: ERG Models of a Friendship Network Documented on Facebook." *American Journal of Sociology* 116:583-642.

Yamagishi, Toshio and Midori Yamagishi. 1994. "Trust and Commitment in the United States and Japan." *Motivation and Emotion* 18:129-66.