Popularity, Similarity, and the Network Extraversion Bias[•]

Daniel C. Feiler
Dartmouth College
Tuck School of Business
df@dartmouth.edu
603.646.0567

Adam M. Kleinbaum
Dartmouth College
Tuck School of Business
adam.m.kleinbaum@tuck.dartmouth.edu
603.646.6447

Provisionally Accepted

at

Psychological Science

[•] The authors are grateful to Pino Audia, Andy Bernard, Alex Jordan, David Krackhardt, Sunita Sah, Jack Soll, Thalia Wheatley, seminar participants at Carnegie Mellon University, and participants in at the SunBelt 2014 conference for valuable comments and suggestions on this paper. This manuscript was previously titled "Network Extraversion Bias: People May Not Be As Outgoing As You Think (Unless You're an Introvert)".

Popularity, Similarity, and the Network Extraversion Bias

Using the emergent friendship network of an incoming cohort of MBA students, we examined the role of extraversion in shaping social networks. Extraversion has two important implications for the emergence of network ties: a popularity effect, in which extraverts accumulate more friends than introverts, and a homophily effect, in which two individuals are more likely to become friends if they have similar levels of extraversion. These effects result in a systematic *network extraversion bias*, in which people's social networks will tend to be overpopulated with extraverts and underpopulated with introverts. Further, network extraversion bias is greatest for the most extraverted individuals and least for more introverted individuals. Our finding that social networks are systematically misrepresentative of the broader social environment raises questions about whether there is a societal bias toward believing others are more extraverted than they actually are and whether introverts are better socially calibrated than extraverts.

Keywords: personality, extraversion, social networks, social judgment

A fundamental notion of social psychology is that one's beliefs about social behavior are largely determined by the individuals in one's immediate environment (Sherif, 1936). Because social perceptions are shaped by the people one is connected to (McArthur & Baron, 1983), a deeper understanding of how individuals' social networks are composed is valuable. It is particularly important to understand factors that may cause individuals' social networks to be misrepresentative of the broader social environment. As a step in this direction, we explore how individuals' personalities can cause systematic biases in the composition of their social networks.

We examine how the level of extraversion of two individuals makes them more or less likely to become friends and how these dyadic underpinnings influence the composition of people's social networks in aggregate. The likelihood that any two individuals in a social environment become friends is known to increase as (1) they have more opportunities to interact and (2) they like each other, upon interacting (Byrne, 1961; McPherson, Smith-Lovin, & Cook, 2001). We argue that extraversion, a fundamental personality variable, plays a role in shaping opportunities for interaction and interpersonal liking and, therefore, is an important psychological determinant of social network composition. However, the effects of extraversion on social connection ultimately lead to a bias in social networks. Our results provide an underlying logic for why people may not be as outgoing as you think (unless you are very introverted).

Extraversion-introversion[1] – the extent to which one is outgoing and sociable, as opposed to reserved and quiet (McCrae & Costa, 1990) – has long been established among psychologists as one of the "Big Five" dimensions along which personality varies (Costa & McCrae, 1992; Eyesenck, 1981). The key features of extraversion are sociability, outgoingness, and

[1] Henceforth, we will refer to this simply as extraversion. Occasionally, we will refer to extraverts and introverts for convenience. In all cases, we are referring to a continuum, where low extraversion is introversion. We never employ median splits on extraversion, as recommended by Grant (2013).

assertiveness, which yield a tendency to engage in more social interaction (McCrae & Costa, 1990) and to seek and attract more social attention (Ashton, Lee, & Paunonen, 2002). Individuals who are more extraverted tend to be more talkative than those who are more introverted and spend more time interacting with others (John & Srivastava, 1999; Paunonen & Ashton, 2001). More extraverted individuals are more likely to initiate social interactions and enter more social situations, both of which are conducive to the formation of new relationships (Shipilov, Labianca, Kalnysh, & Kalnysh, 2014). Introverts, by contrast, are inclined to spend more time alone and, when they do socialize, tend to prefer more intimate settings. Support for the link between extraversion and popularity has been found in work on school children, online profiles, and self-perceptions (Jensen-Campbell et al., 2002; Ong et al., 2011; Paunonen, 2003). Therefore, we expected *extraversion popularity*: extraversion should be associated with larger networks. More precisely, all else equal, being more extraverted makes one more likely to become friends with any given other.

Extraversion may also affect networks through social homophily—the tendency to associate with similar others (McPherson et al., 2001). For more than 50 years, psychologists have explored whether similarity yields liking and attraction (e.g., Byrne, 1961; Montoya, Horton, & Kirchner, 2008) and whether people whose friends are more similar are happier (Seder & Oishi, 2009), with particular focus on attitudinal similarity (Byrne, Baskett, & Hodges, 1971; Condon & Crano, 1988). Sociologists have argued that homophily also occurs because similar people choose to enter into similar situations (Feld, 1981), which increases their opportunity to connect circumstantially, even in the absence of any underlying preference for interaction with similar others. Suggestive evidence for the link between extraversion-similarity and relationship formation has been found in work on spouse selection, marriage distress, and "best friend" designation (Gattis, Berns, Simpson, & Christensen, 2004; Humbad, Donnellan, Iacono, McGue, & Burt, 2010; Selfhout, Branje, Raaijmakers, & Meeus, 2007; cf. Furler, Gomez, & Grob, 2013). Therefore, through greater liking due to similarity-attraction and/or greater interaction due to choosing similar social situations, we expected *extraversion homophily*: individuals with similar levels of extraversion should be more likely to become friends.

The extraversion popularity and homophily hypotheses are theoretically straightforward; however, in combination, they yield an interesting implication for the overall composition of individuals' social networks. We will refer to the true mean extraversion of the entire social environment as the population extraversion. The mean extraversion of an individual's social contacts—which we refer to as that individual's network extraversion—may deviate from the population extraversion. If friendships are randomly developed among the population, then one would expect no systematic deviation between network extraversion and population extraversion. However, since we expect greater extraversion to make one more likely to build friendships, more extraverted individuals will be over-represented, and more introverted individuals will be under-represented, in the networks of others. Network extraversion will, therefore, be systematically higher than the population extraversion. In making this argument, we build on and extend the "friendship paradox," about which Feld (1991) provocatively argued that "your friends have more friends than you do" due to the mathematical truism that as one has more connections, one is present in more networks of others. Therefore, people's social networks disproportionately contain individuals that have many connections. We extend this idea beyond a purely mathematical claim by joining the friendship paradox with extraversion-popularity and hypothesize the existence of a *network extraversion bias*: on average, people have networks that are more extraverted than the overall social environment.

Finally, we argue that this bias should depend on one's own level of extraversion. Throughout this paper, we will use the notation of person i as the focal individual and person j as an individual who may or may not be her friend. As illustrated in Figure 1a, for an introverted i, the popularity and homophily effects work in opposition: an extraverted j is more sociable and popular (+) but is also less similar to the introverted i (–). On the other hand, for an extraverted i, the popularity and homophily effects work in concert (see Figure 1b): an extraverted j is both more sociable and popular (+) and more similar to the extraverted i (+). Therefore, we expect that extraverts will have networks that are disproportionally populated with other extraverts. Introverts, on the other hand, may have social networks that are less biased and more representative of the true population in terms of extraversion. In sum, although we predict an overall network extraversion bias, we expect the degree of bias to be the greatest for the most extraverted individuals and least for more introverted individuals.

Data and Measures

To test these hypotheses, we studied a complete cohort of Masters of Business Administration (MBA) students at a private university in the northeastern United States. An incoming cohort of MBA students is a useful setting because the students are initially unfamiliar with each other, simultaneously enter a social environment, and friendships emerge in the first several months. This simultaneity, control, and access make it an ideal field setting to examine emergent social networks. Our sample included all 284 students (34% female; 56% white, non-Hispanic; 65% U.S. citizens; average age 28.4 years) who began their graduate program in the fall of 2012.

The emerging social network within their cohort was measured at two points in time. Time 1 was five weeks after students had arrived on campus for orientation. Time 2 was eleven weeks after their arrival (and six weeks after Time 1). Given our interest in social relations in general, rather than close friendships specifically, students were directed at each point in time to the study website, where they answered the following question: "Consider the people with whom you like to spend your free time. Since you arrived at [university name], who are the classmates you have been with most often for informal social activities, such as going out to lunch, dinner, drinks, films, visiting one another's homes, and so on?" (adapted from Burt, 1992, p. 123). To avoid problems of incomplete recall (Brewer, 2000), our survey included a roster-based name generator, which displayed the names of all other students in one column per class section of the MBA program and with names listed alphabetically within each section.[2] Each respondent indicated which other students they socialized with by checking the box next to those people's names. A minimum of two contacts were required, but no upper limit was imposed.

Following the Time 2 network survey, each individual's personality characteristics were measured using the Big Five Inventory (John & Srivastava, 1999), a well-established, 44-item instrument that measures extraversion, openness to experience, conscientiousness, agreeableness and neuroticism. The extraversion measure required subjects to rate the extent to which they agreed or disagreed (on a five-point scale) with each of eight statements about themselves. For example, the items included "is outgoing, sociable", "is talkative", and "is reserved" (reverse-scored). No analyses were initially run on any of the other personality characteristics in this project.[3]

[2] We found no evidence of order effects, in which people listed earlier on the roster were cited more often.
[3] We are grateful to an anonymous reviewer, who wondered whether our theory is specific to extraversion or whether it would apply to any positive personality trait. In response, we tested for popularity and homophily effects

Finally, demographic data were provided by the school's registrar about each student's gender, race, citizenship, age, class section, study group assignment, and residence status (i.e., whether they live on or off campus). For each source of data, all personally identifying information was removed, leaving the various sources of data linked by anonymous student ID numbers.

Models

Dyad-Level Models. We employed dyad-level models to answer the question: how does the extraversion of two individuals affect whether one names the other as a friend? Person i is the respondent who designates which other individuals in the social environment she considers to be her friends, and j is a person who can possibly be named as a friend by i. Therefore, each individual appears in the data as an i, but also as a j for all others in the social environment. In our dyadic models, an observation is a given ij ordered pair and the dependent variable is an indicator of whether i cited j as a friend (0 or 1).

We estimated our dyadic effects with linear probability models using fixed effects for each individual (Angrist & Pischke, 2009; Mayer & Puller, 2008). Fixed effects were important because they allowed us to control for all characteristics of one individual (i or j) while testing whether the extraversion of the other individual (j or i, respectively) affects the likelihood of friendship. In the similarity models, we use fixed effects for *both* individuals to control for all individual characteristics of both individuals, allowing us to isolate effects related to the combination of individuals, such as extraversion-similarity. In the following section, we will clearly state which fixed effects were used in each model before presenting the results.

---

of agreeableness and found no evidence that either exists. These results appear in the Supplemental Online Materials.

Although fixed effects enabled us to isolate effects of interest, there were still many interdependencies across observations due to the dyadic and repeated nature of the data. We were careful to account for these interdependencies using clustering, which adjusts the coefficient standard errors (via the covariance matrix) by relaxing the assumption of independence within each cluster[4]. To account for common person effects (e.g., whether A names B as a friend is not independent of whether A names C)[5] we clustered standard errors around each i and each j (Kenny, Kashy, & Cook, 2006). To account for reciprocal autocorrelation (e.g., whether A names B as a friend is not independent of whether B names A) and repeated measures across time, we clustered standard errors around each unordered dyad ij. The multi-way clustering of standard errors was accomplished using Kleinbaum et al.'s (2013) published algorithm (see also Cameron, Gelbach, & Miller, 2011).

In estimating the dyad-level models, we controlled for i and j having the same class section, study group, gender, race, nationality, both living on campus, and the difference in their ages (added to one and logged). All of these covariates were mean-centered. Although including covariates which are known to affect the likelihood of social connection enables more accurate parameter estimates for our variables of interest, we show that identical patterns of significance hold if they are omitted from the analysis. We also included a binary indicator for the time the network was recorded, assigned a value of -1 for Time 1 and $+1$ for Time 2; this variable coding scheme allows us to directly interpret the estimators as the main effects of explanatory variables (i.e., pooling both time periods and treating them equally) while also testing whether the key effects increased in magnitude over time, using interactions.

[4] We obtained substantively identical results when alternatively accounting for this structural autocorrelation using multiple regression quadratic assignment procedure (MR-QAP) models (Dekker, Krackhardt, & Snijders, 2007), which appear in the Supplemental Online Materials.

[5] Similarly, whether A names B as a friend is not independent of whether C names B.

Individual-level models. We then proceeded to individual-level models to test how these dyadic underpinnings affect the composition of an individual's network as a whole. The unit of analysis was the individual, and the dependent variables were measures of that individual's network.

Our first individual-level models tested whether extraversion yielded popularity. For these models we operationalized popularity in two ways. The first was the number of people that named the focal person as a friend. The second operationalization of popularity was the number of people that the focal person named as a friend. The popularity measures are count variables which are truncated at the lower end. Because OLS regression is inappropriate with truncated data, these models employed a Poisson quasi-maximum likelihood estimation[6] (Wooldridge, 1997).

The final individual-level model tested the network extraversion bias hypothesis. This model tested whether the average extraversion of the people in one's network (i.e., network extraversion) was different from the average extraversion of the entire cohort (i.e., population extraversion). Extraversion was standardized, so the population extraversion was zero and the model was run using ordinary least squares regression.

To account for additional factors that might affect network composition, in our individual-level models we controlled for gender, U.S. citizenship, on-campus residency, and belonging to a racial minority group. All control variables were mean-centered. As above, we also controlled for the time when the network was recorded using a binary time indicator set to -1 (for Time 1) or $+1$ (for Time 2), a coding scheme that allowed us to interpret the estimated coefficients as main effects (i.e., pooling both time periods and treating them equally), while also testing whether the effect of extraversion changed in magnitude over time.

[6] Our results are robust to other count model specifications, such as negative binomial.

Results

The median respondent cited 16 friends at Time 1 and 26 at Time 2; both distributions had very long right tails (Time 1: min = 2; max = 148; *SD* = 17.8; Time 2: min = 2; max = 184; *SD* = 29.0)[7]. The increase in network size across time indicates that social networks were actively being formed during the time period of study. Additional descriptive statistics appear in the Supplemental Online Materials.

The reliability of the extraversion measure was very good (Cronbach's alpha = 0.86). The extraversion measure had a mean value of 3.45 and a standard deviation of 0.81 (on a 1 to 5 scale), prior to being standardized. The response rate from the cohort for both network surveys was 100%; however, four of the 284 students failed to complete the extraversion scale and were dropped from all analyses, yielding a final response rate of 98.6%.

For the following sections, the key significance test for each model is bolded in Tables 1 and 2. We are also able to replicate all results with a 3-item sub-scale of extraversion using only the items that pertain to being energetic rather than outgoing: "is full of energy", "generates enthusiasm", and "has an assertive personality" (see Supplemental Online Materials).

Dyadic underpinnings. To begin establishing the dyadic underpinnings of how extraversion is associated with network composition, we examined whether the responder's extraversion was predictive of the likelihood that she would cite a given other person as a friend. We controlled for all observable and unobservable attributes of j using individual fixed effects for j and then tested whether i's extraversion increased the likelihood of i citing j as a friend (Model 1). In using these fixed effects, we controlled for all heterogeneity across js as possible targets for

[7] To be sure that our results were not driven by extreme outliers, we re-estimated all models of popularity and network extraversion while omitting the individuals who had cited, or been cited by, the most extreme number of friends – the top 1% or top 5% of the sample in each case. In all instances, removing outliers slightly diminished effect sizes, but never affected their statistical significance (see Supplemental Online Materials).

friendship. We then re-estimated the model while controlling for dyadic covariates known to be associated with tie formation, giving us a more accurate estimate of the effect size (Model 2). We found that being more extraverted significantly increased the likelihood that an individual cites any given other person as a friend (see Table 1; $p < .01$ in both models). Overall, the effect size is significant: net of covariates and fixed effects, a one standard deviation increase in extraversion from the mean increases the probability of citing any given other person as a friend by 1.4 percentage points, from 9.6% to 11.0%. *Ceteris paribus*, the likelihood that an extravert in the 90^{th} percentile of extraversion cites any given other as a friend is 11.7%, whereas the same likelihood for an introvert in the 10^{th} percentile of extraversion is 7.8%. Furthermore, disaggregating the Time 1 effects from Time 2 reveals that this effect grew substantially over time from 0.6 percentage points (0.014 − 0.008) at Time 1 to 2.2 percentage points at Time 2 (0.014 + 0.008; $p < .01$).

Next, we tested whether being more extraverted makes one more likely to be cited by others as a friend. In Model 3, we controlled for all observable and unobservable attributes of the responder i using fixed effects for i and tested whether j's extraversion increased the likelihood that i cited j as a friend. In Model 4, we added the dyad-level covariates that are known to affect social ties, giving us a more accurate estimate of the effect size. We found that being more extraverted significantly increased the likelihood that an individual is cited as a friend by any given other person ($p < .01$ in both models). Net of covariates and fixed effects, a one standard deviation increase in extraversion from the mean increases the probability of being cited as a friend by any given other by 1.3 percentage points, from 9.6% to 10.9%. An extravert in the 90^{th} percentile of extraversion had an 11.6% chance of being cited as friend by a given other person, whereas an introvert in the 10^{th} percentile of extraversion has a 7.9% chance.. Again, this effect grew larger across time, from 0.8 percentage points (0.013 – 0.005) at Time 1 to 1.8 points (0.013 + 0.005) at Time 2.

We then examined extraversion-homophily. In order to isolate the effect of similarity, we included fixed effects for both i and j in Models 5 and 6 (Reagans & McEvily, 2003). These fixed effects accounted for all observable and unobservable individual attributes of both i and j that affect their propensity to form friendship ties, including their individual levels of extraversion. Again, established dyad-level covariates were added in Model 6 to improve the accuracy of the key parameter estimate. These models then tested whether the remaining variance could be explained by attributes of the ij dyad — specifically, similarity in their extraversion. The key independent variable of interest in Models 5 and 6 was extraversion-similarity. This was operationalized as the absolute value of the difference between i's and j's extraversion scores, multiplied by -1 to convert a difference into a similarity score. We found that greater similarity in extraversion between two individuals significantly increased the likelihood one cited the other as a friend ($p < .01$). This effect did not change significantly across time periods. Specifically, compared to two people who differed by one standard deviation in extraversion, two people with identical extraversion scores were 0.5 percentage points more likely to cite one another (9.8% *vs.* 10.3%). Examining the more extreme comparison, we find that highly similar dyads (similarity score in the 90th percentile) had a 10.2% chance of citing one another whereas highly dissimilar dyads (with similarity score in the 10th percentile) had an 8.8% chance. The fixed effects for i and j ensured that this similarity effect was not a by-product of any extraversion popularity effects. On the whole, although we find significant effects of extraversion homophily, it seems to play a smaller role in shaping social interactions than extraversion popularity.

Consequences for individuals' networks. Next, we examined how these dyadic underpinnings affected an individual's network composition as a whole, in terms of popularity and network extraversion bias (see Table 2).

We found that more extraverted individuals were cited as friends by significantly more people (Models 7 and 8, without and with control variables, respectively; p values < .01) and cited significantly more people as their friends (Models 9 and 10, without and with control variables, respectively; p values < .01). [8] All else being equal, a one standard deviation increase in extraversion corresponds with being cited as a friend by 15% more people and citing 16% more people as friends. Further, the model estimated that extreme introverts (in the 10^{th} percentile of extraversion) would be cited as friends by 22 people, whereas extreme extraverts (in the 90^{th} percentile of extraversion) would be cited by 34 people as friends. Although the aggregate number of friends increased significantly over time (as evidenced by the positive coefficient on the Time Indicator, with $p < .01$), there is no evidence that it did so as a function of extraversion.

We then tested the network extraversion bias hypothesis: that the average extraversion of the individuals in one's network is systematically greater than the average extraversion in the population of potential friends. Because (1) all covariates were mean-centered, (2) the two time periods were coded as -1 and $+1$, and (3) the extraversion measure was standardized so population extraversion was zero, the ideal test statistic was the coefficient of the model intercept (Models 11 and 12, without and with control variables, respectively). That is, the test statistic for the estimated constant in the regression model examined whether, at the mean of all included

[8] The same results hold if the measure of popularity incorporates not only the number of one's friends, but their popularity as well (i.e., eigenvector centrality). We note also that the correlation between extraversion and network size is moderate (0.20 if network size is measured as the number of friends one cites; 0.34 if measured as the number of times cited by others), suggesting that extraversion and popularity are, indeed, independent constructs.

explanatory variables and treating both time periods equally, network extraversion was greater than the true average extraversion in the social environment. We found that, on average, network extraversion was significantly higher than the population extraversion ($p < .01$).[9] On average, people's network extraversion is .12 standard deviations higher than the population extraversion, consistent with the network extraversion bias hypothesis. Because the coefficient of the time indicator is statistically insignificant, it suggests that the network extraversion bias was not increasing over time.

Finally, Models 13 and 14 tested the proposition that the magnitude of one's network extraversion bias depends on one's own level of extraversion. Consistent with that hypothesis, we found that being more extraverted corresponded with a significantly greater network extraversion bias ($p < .01$). The magnitude of this effect did not change significantly across time periods ($p > .05$). All else being equal, a one standard deviation increase in one's own extraversion from the mean increases one's network extraversion bias by 42% (from 0.120 at the population mean to 0.170). For a graphical depiction of the network extraversion bias, see Figure 2. The 95% confidence interval on the regression line estimates a statistically significant network extraversion bias for individuals in the 9th percentile of extraversion (1.31 standard deviations below the mean) and above, which is the point at which the 95% confidence interval intersects zero. The regression line itself intersects zero at -2.40 standard deviations on extraversion which implies that, *ceteris paribus*, the model predicts that an individual at the first percentile of extraversion will have no network extraversion bias. The most extreme introverts have the most calibrated network extraversion, in expectation.

[9] Because the coefficient on the intercept is an unusual test statistic, we also tested this hypothesis using a simple t-test, which is more straightforward, but lacks statistical controls. Here too, we found that the difference between network extraversion and the population extraversion was statistically significant (one-tailed mean-comparison test with paired data; $p < .002$).

The estimated coefficients on the covariates also shed light on the relative importance of location, demographics, and personality for the emergence of friendships in this setting. The effect of U.S. citizenship on popularity (measured here as the number of times cited by others as a friend) is roughly equivalent to that of a 1.04 standard deviation increase in extraversion; living on campus is associated with an increase in popularity equivalent to a 1.07 standard deviation increase in extraversion; and belonging to the racial majority yields an increase in popularity equivalent to a 1.3 standard deviation increase in extraversion. The only demographic variable that is significantly associated with network extraversion is U.S. citizenship: compared to foreign nationals, U.S. citizens have network extraversion that is higher by an amount equivalent to a 1.1 standard deviation increase in their own extraversion.

An important consideration is whether our conclusions here are influenced by our MBA student sample, which may be more extraverted than the general population. Our claim is that *within any given social environment*, if extraversion-popularity and extraversion-homophily occur, they will give rise to a network extraversion bias in which the extraversion of the people one is connected to will be greater than the average extraversion of the population of that social environment. This is empirically manifest in the fact that our test statistic compares each individual's network extraversion with the sample mean of individual extraversion. Therefore, the theory is sufficiently general to apply in settings with varying levels of sociability.

Discussion

This paper fills an empirical gap at the intersection of psychology and network science by documenting how the fundamental personality trait of extraversion is predictive of network composition. One is more likely to become friends with individuals who are (1) more extraverted and (2) similar in extraversion to oneself. The latter point is consistent with the notion of personality homophily. These dyadic underpinnings lead to two interesting network consequences: extraverts become overly represented, and introverts underrepresented, in the social networks of others — or put differently, the average extraversion of the people in one's network is greater than the average extraversion in the whole social environment; and this network extraversion bias is greatest for the most extraverted individuals and least for more introverted individuals. Despite limitations (e.g., correlational data, unobservability of network ties outside our sample, a binary measure of friendship, extraversion measured after the dependent variable), and boundary conditions on generalizability (e.g., tie formation rather than tie maintenance, a sample of highly educated adults, a high-interaction social environment), these findings shed new light on issues fundamental to psychology.

Psychologists have long held that an individuals' social beliefs are shaped by the people with whom they interact (e.g., McArthur & Baron, 1983; Sherif, 1936). Given the influence of availability in making judgments (Kahneman, 2011), individuals are likely to draw inferences about the general social environment based on the individuals to whom they are socially connected. For example, Flynn and Wiltermuth (2010) showed that the structure of one's network affected one's perceptions of consensus on matters of ethics. However, our results suggest that in some important respects, social networks are likely to be misrepresentative of the population. Future research should explore whether the network extraversion bias contributes to a societal misperception toward believing others are more extraverted on average than they actually are. Our results provide an underlying logic for why people may overestimate the number of extraverts in the general population. Such social miscalibration might affect people's self-perceptions or lead to poor policy and management decisions. A prevalent self-belief that one's social behavior is more reclusive than the perceived norm may reduce feelings of belongingness, self-esteem, and self-worth. Further, societal miscalibration regarding norms of outgoingness may also affect the manner in which young people are educated and encouraged to behave.

This work also builds on a growing literature arguing that greater extraversion is not always better (Bendersky & Shah, 2013; Grant, Gino, & Hofmann, 2011; Grant, 2013). Our findings suggest that introverts have the smallest network extraversion bias, which might aid them, for example, as leaders. If introverts do in fact benefit from a hidden social-calibration advantage, they may be more tolerant of both introversion and extraversion among their colleagues, team members, or employees (Grant et al., 2011). This may be an important direction for future research since past work has found that extraverts are more likely to attain leadership positions than introverts (Judge, Bono, Ilies, & Gerhardt, 2002), but are no more effective as leaders (Grant et al., 2011).

While we have examined how personality affects whether one's social network accurately reflects the general social environment, how individuals draw social inferences from their networks remains a critical empirical question. An important direction for future research will be to examine how misrepresentative social networks translate into skewed perceptions and inaccurate beliefs. We encourage further interdisciplinary collaborations to address and delve into these important questions.

References

Angrist, J. D., & Pischke, J.-S. (2009). *Mostly harmless econometrics: an empiricist's companion* (p. xiii, 373 p.). Princeton: Princeton University Press.

Ashton, M. C., Lee, K., & Paunonen, S. V. (2002). What is the central feature of extraversion?: Social attention versus reward sensitivity. *Journal of Personality and Social Psychology*, *83*(1), 245–251. doi:10.1037//0022-3514.83.1.245

Bendersky, C., & Shah, N. P. (2013). The Downfall of Extraverts and Rise of Neurotics: The Dynamic Process of Status Allocation in Task Groups. *Academy of Management Journal*, *56*(2), 387–406. doi:10.5465/amj.2011.0316

Brewer, D. D. (2000). Forgetting in the recall-based elicitation of personal and social networks. *Social Networks*, *22*(1), 29–43.

Burt, R. S. (1992). *Structural holes: The social structure of competition*. Cambridge, MA: Harvard University Press.

Byrne, D. (1961). Interpersonal attraction and attitude similarity. *The Journal of Abnormal and Social Psychology*, *62*(3), 713–715.

Byrne, D., Baskett, G., & Hodges, L. (1971). Behavioral indicators of interpersonal attraction. *Journal of Applied Social Psychology*, *1*(2), 137–149.

Cameron, A. C., Gelbach, J. B., & Miller, D. L. (2011). Robust Inference with Multi-way Clustering. *Journal of Business and Economic Statistics*, *29*(2), 238–249.

Condon, J. W., & Crano, W. D. (1988). Inferred evaluation and the relation between attitude similarity and interpersonal attraction. *Journal of Personality and Social Psychology*, *54*(5), 789–797. doi:10.1037//0022-3514.54.5.789

Costa, P. T., & McCrae, R. R. (1992). Normal personality assessment in clinical practice: The NEO Personality Inventory. *Psychological Assessment*, *4*(1), 5–13. doi:10.1037//1040-3590.4.1.5

Dekker, D., Krackhardt, D., & Snijders, T. (2007). Sensitivity of MRQAP Tests to Collinearity and Autocorrelation Conditions. *Psychometrika*, *72*(4), 563–581.

Eyesenck, H. J. (1981). *A model of personality*. New York: Springer.

Feld, S. L. (1981). The Focused Organization of Social Ties. *American Journal of Sociology*, *86*(5), 1015–1035.

Feld, S. L. (1991). Why Your Friends Have More Friends Than You Do. *American Journal of Sociology*, *96*(6), 1464–1477.

Flynn, F. J., & Wiltermuth, S. S. (2010). Who's with me? False consensus bias, social networks, and ethical decision making in organizations. *Academy of Management Journal*, *53*(5), 1074–1089.

Furler, K., Gomez, V., & Grob, A. (2013). Personality similarity and life satisfaction in couples. *Journal of Research in Personality*, *47*(4), 369–375.

Gattis, K. S., Berns, S., Simpson, L. E., & Christensen, A. (2004). Birds of a feather or strange birds? Ties among personality dimensions, similarity, and marital quality. *Journal of Family Psychology*, *18*(4), 564–574.

Grant, A. M. (2013). Rethinking the extraverted sales ideal: the ambivert advantage. *Psychological Science*, *24*(6), 1024–30. doi:10.1177/0956797612463706

Grant, A. M., Gino, F., & Hofmann, D. (2011). Reversing the extraverted leadership advantage: The role of employee proactivity. *Academy of Management Journal*, *54*(3), 528–550.

Humbad, M. N., Donnellan, M. B., Iacono, W. G., McGue, M., & Burt, S. A. (2010). Is spousal similarity for personality a matter of convergence or selection? *Personality and Individual Differences*, *49*(7), 827–830.

Jensen-Campbell, L. A., Adams, R., Perry, D. G., Workman, K. A., Furdella, J. Q., & Egan, S. K. (2002). Agreeableness, extraversion, and peer relations in early adolescence: Winning friends and deflecting aggression. *Journal of Research in Personality*, *36*(3), 224–251.

John, O. P., & Srivastava, S. (1999). The Big Five trait taxonomy: History, measurement, and theoretical perspectives. In L. A. Pervin & O. P. John (Eds.), *Handbook of personality: Theory and research* (2nd ed., pp. 102–138). New York: Guilford Press.

Judge, T. a., Bono, J. E., Ilies, R., & Gerhardt, M. W. (2002). Personality and leadership: A qualitative and quantitative review. *Journal of Applied Psychology*, *87*(4), 765–780. doi:10.1037//0021-9010.87.4.765

Kahneman, D. (2011). *Thinking fast and slow*. New York, NY: Febrar, Straus, and Giroux.

Kenny, D. A., Kashy, D. A., & Cook, W. L. (2006). *Dyadic data analysis*. *Methodology in the social sciences* (pp. xix, 458). New York: Guilford Press.

Kleinbaum, A. M., Stuart, T. E., & Tushman, M. L. (2013). Discretion Within Constraint: Homophily and Structure in a Formal Organization. *Organization Science*, *24*(5), 1316–1336. doi:10.1287/orsc.1120.0804

Mayer, A., & Puller, S. L. (2008). The old boy (and girl) network: Social network formation on university campuses. *Journal of Public Economics*, *92*(1-2), 329–347.

McArthur, L. Z., & Baron, R. M. (1983). Toward an Ecological Theory of Social Perception. *Psychological Review*, *90*(3), 215.

McCrae, R. R., & Costa, P. T. (1990). *Personality in adulthood*. New York: Guilford Press.

McPherson, M., Smith-Lovin, L., & Cook, J. (2001). Birds of a feather: Homophily in social networks. *Annual Review of Sociology*, *27*, 418–444.

Montoya, R., Horton, R., & Kirchner, J. (2008). Is actual similarity necessary for attraction? A meta-analysis of actual and perceived similarity. *Journal of Social and Personal Relationships*, *25*(6), 889–922.

Ong, E. Y. L., Ang, R. P., Ho, J. C. M., Lim, J. C. Y., Goh, D. H., Lee, C. S., & Chua, A. Y. K. (2011). Narcissism, extraversion and adolescents' self-presentation on Facebook. *Personality and Individual Differences*, *50*(2), 180–185. doi:10.1016/j.paid.2010.09.022

Paunonen, S. V, & Ashton, M. C. (2001). Big Five factors and facets and the prediction of behavior. *Journal of Personality and Social Psychology*, *81*(3), 524–539. doi:http://dx.doi.org/10.1037/0022-3514.81.3.524

Paunonen, S. V. (2003). Big Five factors of personality and replicated predictions of behavior. *Journal of Personality and Social Psychology*, *84*(2), 411–424.

Reagans, R., & McEvily, B. (2003). Network Structure and Knowledge Transfer: The Effects of Cohesion and Range. *Administrative Science Quarterly*, *48*(2), 240–267.

Seder, J., & Oishi, S. (2009). Ethnic/racial homogeneity in college students' Facebook friendship networks and subjective well-being. *Journal of Research in Personality*, *43*(3), 438–443.

Selfhout, M., Branje, S., Raaijmakers, Q., & Meeus, W. (2007). Similarity in adolescent best friendships: The role of gender. *The Netherlands Journal of Psychology*, *63*, 50–57.

Sherif, M. (1936). *The psychology of social norms.* (pp. xii, 210). Oxford, England: Harper.

Shipilov, A., Labianca, G., Kalnysh, V., & Kalnysh, Y. (2014). Network-building behavioral tendencies, range, and promotion speed. *Social Networks*, *39*, 71–83. doi:10.1016/j.socnet.2014.03.006

Wooldridge, J. M. (1997). Quasi-Likelihood Methods for Count Data. *Handbook of Applied Econometrics*, *2*, 252–406.

Figure 1a. Illustrative diagram of the dual effects of *j*'s extraversion on the likelihood of a friendship between *i* and *j*, when *i* is introverted.

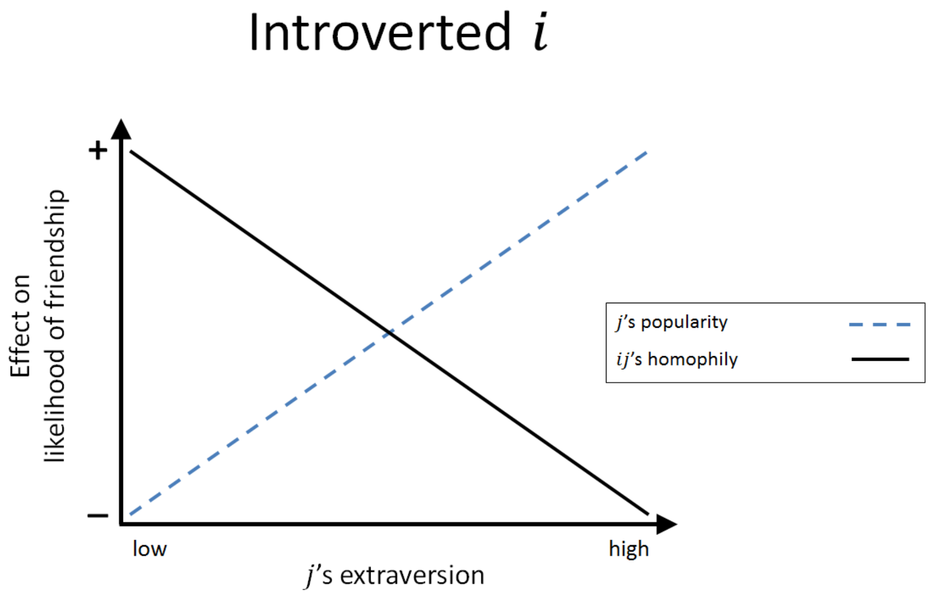


Figure 1b. Illustrative diagram of the dual effects of *j*'s extraversion on the likelihood of a friendship between *i* and *j*, when *i* is extraverted.

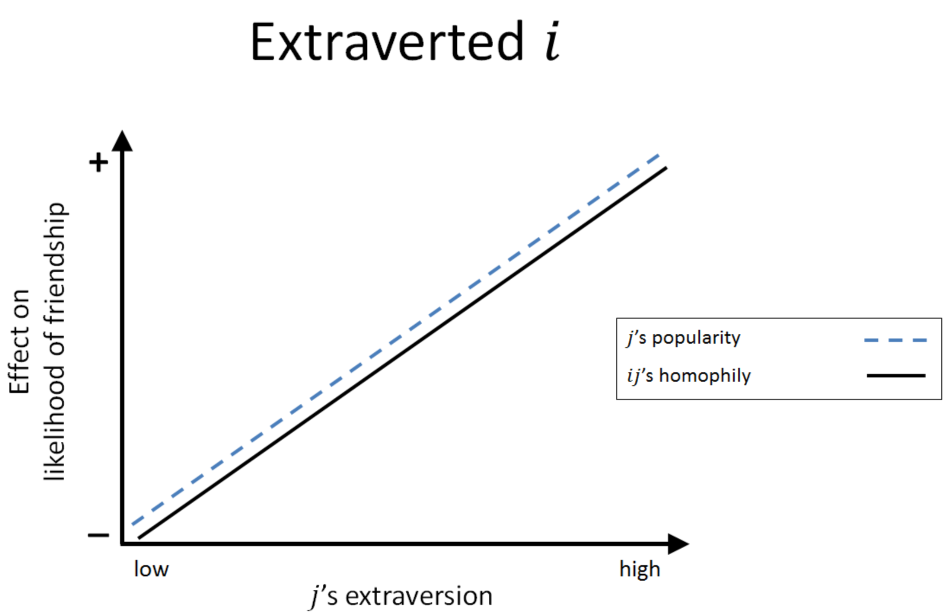


Figure 2. Fitted estimates of Network Extraversion as a function of one's own extraversion. The shaded gray area represents the 95% confidence interval around the fitted solid line, based on Model 7. The dashed line indicates the average extraversion of the population, which is zero by construction. The distance between the solid and dashed lines represents the estimated network extraversion bias at each level of extraversion.

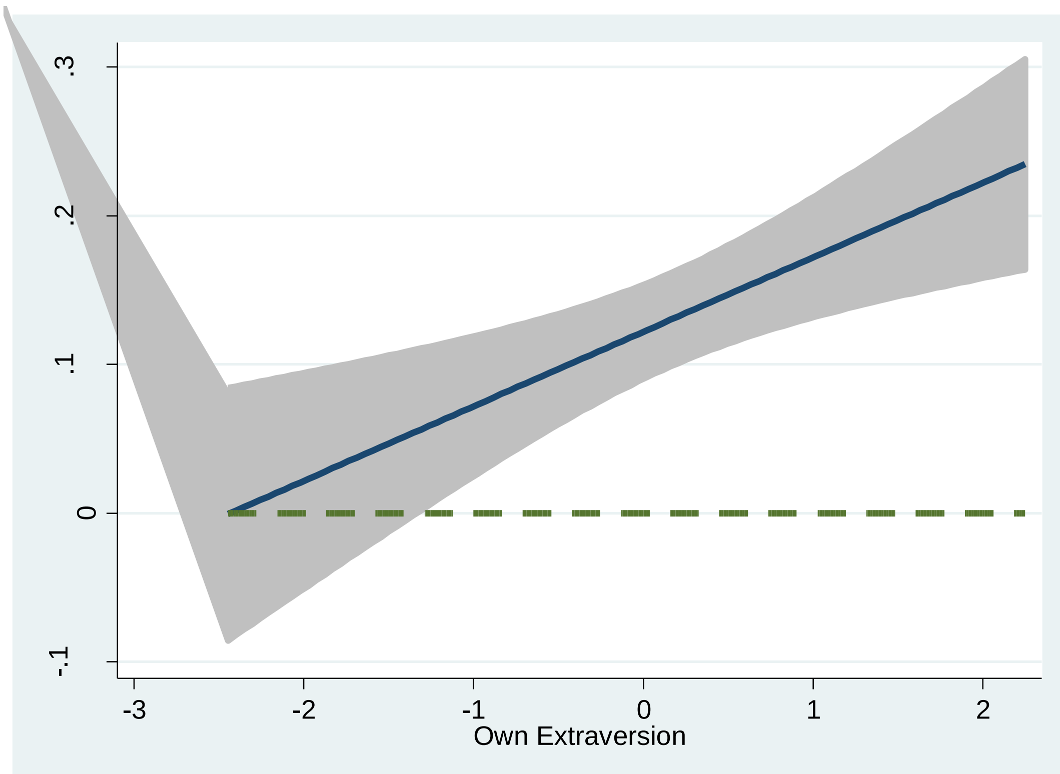


Table 1. Dyad-level models of network ties.

	(1)	(2)	(3)	(4)	(5)	(6)
***i* Fixed Effects**			**Incl.**	**Incl.**	**Incl.**	**Incl.**
***j* Fixed Effects**	**Incl.**	**Incl.**			**Incl.**	**Incl.**
***i*'s Extraversion**	**0.018 (0.004)****	**0.014 (0.004)****				
***j*'s Extraversion**			**0.017 (0.003)****	**0.013 (0.002)****		
Extraversion Similarity					**0.010 (0.003)****	**0.006 (0.003)***
Time indicator	0.023 (0.003)**	0.023 (0.003)**	0.023 (0.003)**	0.023 (0.003)**	0.023 (0.003)**	0.023 (0.003)**
i's Extraversion × Time indicator	0.008 (0.003)**	0.008 (0.003)**				
j's Extraversion × Time indicator			0.005 (0.001)**	0.005 (0.001)**		
Extraversion Similarity × Time indicator					0.001 (0.002)	0.001 (0.002)
Same Section		0.038 (0.004)**		0.038 (0.003)**		0.038 (0.004)**
Same Study Group		0.452 (0.020)**		0.452 (0.020)**		0.454 (0.020)**
Both On Campus		0.055 (0.010)**		0.052 (0.007)**		0.061 (0.008)**
Same Gender		0.042 (0.004)**		0.040 (0.003)**		0.042 (0.004)**
Same Race		0.070 (0.007)**		0.065 (0.007)**		0.072 (0.008)**
Same Nationality		0.035 (0.009)**		0.047 (0.007)**		0.088 (0.011)**
Age Difference (logged)		-0.019 (0.004)**		-0.016 (0.004)**		-0.014 (0.004)**
Constant	0.096 (0.004)**	0.017 (0.007)*	0.096 (0.002)**	0.012 (0.006)	0.057 (0.005)**	-0.078 (0.010)**
Observations	156,240	156,240	156,240	156,240	156,240	156,240
R-squared	0.03	0.10	0.07	0.14	0.09	0.16

Cluster-robust standard errors in parentheses
* significant at 5%; ** significant at 1%

Table 2. Individual-level models

DV	Popularity: Times Cited by Others		Popularity: Number of Friends Cited		Network Extraversion			
Specification	Poisson		Poisson		Ordinary Least Squares			
	(7)	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**	**(13)**	**(14)**
Extraversion	**0.175**	**0.142**	**0.173**	**0.145**			**0.065**	**0.050**
	(0.024)**	**(0.022)****	**(0.040)****	**(0.039)****			**(0.016)****	**(0.015)****
Time Indicator	0.241	0.241	0.235	0.235	0.014	0.014	0.014	0.014
	(0.008)**	(0.008)**	(0.024)**	(0.024)**	(0.009)	(0.009)	(0.009)	(0.009)
Extraversion ×	0.010	0.010	0.043	0.042			-0.001	-0.001
Time indicator	(0.008)	(0.008)	(0.024)	(0.024)			(0.009)	(0.009)
Female		-0.041		-0.121		0.019		0.021
		(0.044)		(0.083)		(0.034)		(0.033)
U.S. Citizen		0.178		-0.023		0.157		0.142
		(0.066)**		(0.116)		(0.049)**		(0.047)**
On Campus		0.208		0.270		0.002		-0.007
Resident		(0.045)**		(0.086)**		(0.033)		(0.033)
Racial Minority		-0.121		-0.249		-0.062		-0.057
		(0.061)*		(0.105)*		(0.041)		(0.039)
Constant	3.258	3.243	3.243	3.227	**0.122**	**0.120**	0.122	0.120
	(0.025)**	(0.023)**	(0.043)**	(0.041)**	**(0.017)****	**(0.016)****	(0.017)**	(0.016)**
Observations	560	560	560	560	560	560	560	560
Pseudo / R-squared	0.20	0.25	0.11	0.15	0.00	0.09	0.04	0.11

Cluster-robust standard errors in parentheses
* significant at 5%; ** significant at 1%

Supplemental Online Materials

for

Popularity, Similarity, and the Network Extraversion Bias

Daniel C. Feiler
Dartmouth College
Tuck School of Business
df@dartmouth.edu
603.646.0567

Adam M. Kleinbaum
Dartmouth College
Tuck School of Business
adam.m.kleinbaum@tuck.dartmouth.edu
603.646.6447

December 22, 2014

Table A-1. Descriptive statistics of Individual-level variables. Outdegree is the number of friends a given person named. Indegree is the number of others who named a given person as their friend.

	Mean	SD	Min	Max	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) Extraversion (standardized)	0	1	-2.50	1.92	1							
(2) Network Extraversion	0.122	0.330	-1.21	1.31	0.196*	1						
(3) Indegree	26.9	14.4	1	81	0.34*	0.353*	1					
(4) Outdegree	26.9	24.9	2	184	0.203*	0.2*	0.448*	1				
(5) Female	0.342	0.475	0	1	0.018	0.058	0.018	-0.045	1			
(6) On Campus	0.518	0.500	0	1	0.084*	-0.002	0.227*	0.135*	0.146*	1		
(7) U.S. Citizen	0.651	0.477	0	1	0.166*	0.29*	0.287*	0.091*	0.122*	0.018	1	
(8) Racial Minority	0.482	0.500	0	1	-0.126*	-0.242*	-0.236*	-0.124*	-0.027	0.086*	-0.654*	1
(9) Age	28.360	2.331	24	42	-0.031	-0.071	-0.177*	-0.093*	-0.172*	-0.149*	-0.149*	0.131*

Figure A-2. Histograms showing the distribution of outdegree (the number of friends a given person named) and indegree (the number of others who named a given person as their friend) in the pooled data, the Time 1 data, and the Time 2 data. Please note the different scales of the x-axes.

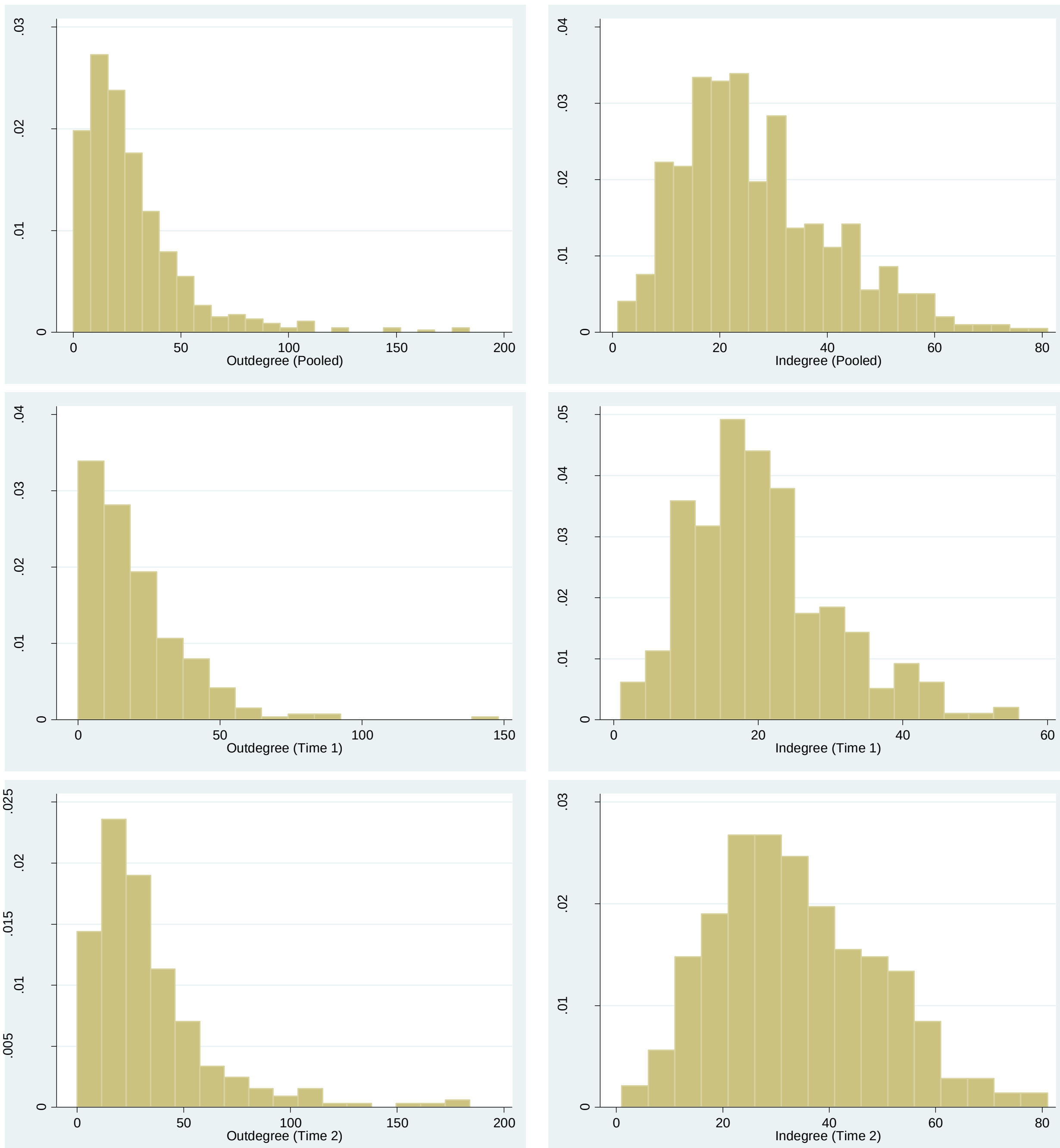
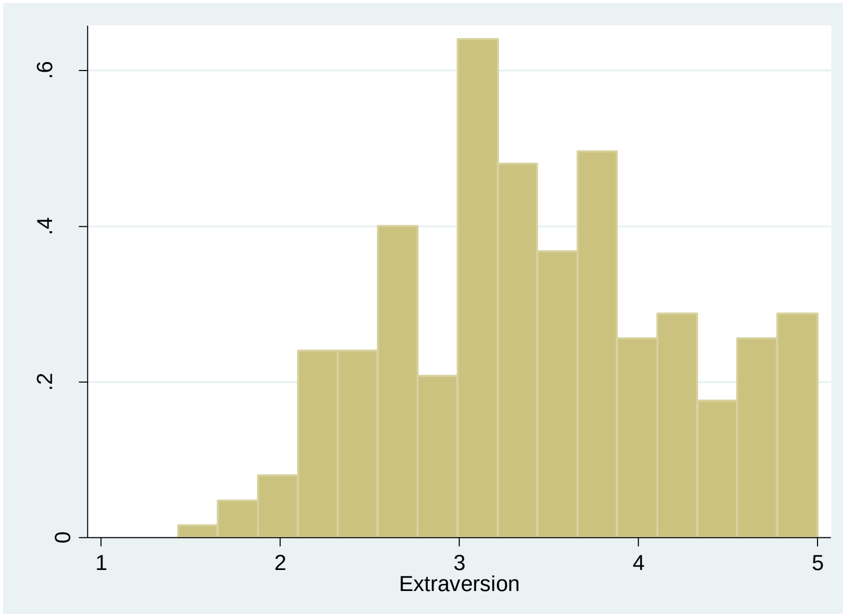


Figure A-3. Histograms showing the distributions of (time-invariant) extraversion (prior to being standardized; the standardized variable has the same distribution, but a mean of 0 and a standard deviation of 1) and of network extraversion in the time-pooled sample.



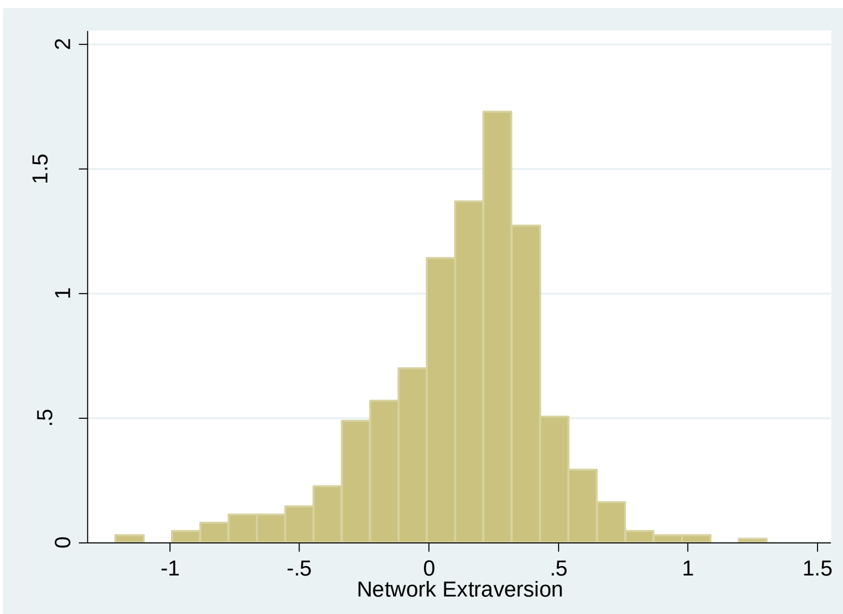


Table A-4. Dyad-level models of network ties. These models replicate Models 1-4 in the manuscript, using abbreviated extraversion scales in place of the full, 8-item measure. Several items in the full extraversion scale are explicitly related to having friends. To ensure that our results are not tautological, we created two abbreviated extraversion scales, based on those items least related to how many friends one listed. The 3-item subscale includes the items "is full of energy," "generates a lot of enthusiasm," and "has an assertive personality" (Cronbach's alpha = .66). The 5-item subscale adds to these "is talkative" and "tends to be quiet (R)" (Cronbach's alpha = .75). All patterns of significance hold with the 3- and 5-item measures of extraversion.

	(1-Ex3)	(2-Ex3)	(3-Ex3)	(4-Ex3)	(1-Ex5)	(2-Ex5)	(3-Ex5)	(4-Ex5)
Extraversion Measure	**3-item Subscale**				**5-item Subscale**			
***i* Fixed Effects**			Incl.	Incl.			Incl.	Incl.
***j* Fixed Effects**	Incl.	Incl.			Incl.	Incl.		
***i*'s Extraversion**	0.012	0.011			0.015	0.011		
	(0.004)**	(0.004)**			(0.004)**	(0.004)**		
***j*'s Extraversion**			0.011	0.010			0.015	0.011
			(0.003)**	(0.002)**			(0.003)**	(0.002)**
Time Indicator	0.023	0.023	0.023	0.023	0.022	0.022	0.023	0.023
	(0.003)**	(0.003)**	(0.003)**	(0.003)**	(0.003)**	(0.003)**	(0.003)**	(0.003)**
***i*'s Extraversion ×**	0.009	0.009			0.009	0.009		
Time Indicator	(0.002)**	(0.002)**			(0.003)**	(0.003)**		
***j*'s Extraversion ×**			0.004	0.004			0.005	0.005
Time Indicator			(0.001)**	(0.001)**			(0.001)**	(0.001)**
Same Section		0.038		0.038		0.038		0.038
		(0.004)**		(0.003)**		(0.004)**		(0.003)**
Same Study Group		0.452		0.452		0.452		0.452
		(0.020)**		(0.020)**		(0.020)**		(0.020)**
Both On Campus		0.055		0.053		0.055		0.052
		(0.010)**		(0.007)**		(0.010)**		(0.007)**
Same Gender		0.042		0.040		0.042		0.040
		(0.004)**		(0.003)**		(0.004)**		(0.003)**
Same Race		0.069		0.065		0.070		0.065
		(0.007)**		(0.007)**		(0.007)**		(0.007)**
Same Nationality		0.039		0.051		0.037		0.049
		(0.009)**		(0.007)**		(0.009)**		(0.007)**
Age Difference		-0.019		-0.016		-0.019		-0.016
(logged)		(0.004)**		(0.004)**		(0.004)**		(0.004)**
Constant	0.095	0.015	0.095	0.010	0.095	0.016	0.095	0.011
	(0.004)**	(0.007)*	(0.002)**	(0.007)	(0.004)**	(0.007)*	(0.002)**	(0.007)
Observations	156,240	156,240	156,240	156,240	156,240	156,240	156,240	156,240
R-squared	0.03	0.10	0.07	0.14	0.03	0.10	0.07	0.14

Robust standard errors in parentheses, clustered by sender, recipient, and undirected sender-recipient pair.
* significant at 5%; ** significant at 1%

Table A-5. Poisson models of popularity as a function of extraversion. These models replicate models 7-10 in the manuscript using the 3-item and 5-item extraversion measures in place of the full 8-item scale. As described in Table A-1 above, the items selected were those least related to how many friends one listed in the network survey. All patterns of significance hold with the 3- and 5-item measures of extraversion.

	(7-Ex3)	**(8-Ex3)**	**(9-Ex3)**	**(10-Ex3)**	**(7-Ex5)**	**(8-Ex5)**	**(9-Ex5)**	**(10-Ex5)**
Extraversion Measure	**3-item Subscale**				**5-item Subscale**			
Extraversion	0.118	0.097	0.114	0.096	0.160	0.123	0.138	0.111
	(0.027)**	(0.023)**	(0.041)**	(0.038)*	(0.026)**	(0.023)**	(0.044)**	(0.040)**
Time Indicator	0.242	0.242	0.235	0.235	0.241	0.241	0.234	0.235
	(0.008)**	(0.008)**	(0.023)**	(0.023)**	(0.008)**	(0.008)**	(0.024)**	(0.024)**
Extraversion ×	0.011	0.010	0.073	0.071	0.012	0.012	0.061	0.060
Time Indicator	(0.008)	(0.008)	(0.023)**	(0.022)**	(0.008)	(0.008)	(0.025)*	(0.024)*
Female		-0.042		-0.133		-0.036		-0.127
		(0.046)		(0.084)		(0.045)		(0.084)
U.S. Citizen		0.245		0.008		0.213		-0.023
		(0.072)**		(0.116)		(0.071)**		(0.115)
On Campus Residence		0.230		0.261		0.220		0.254
		(0.046)**		(0.089)**		(0.046)**		(0.089)**
Racial Minority		-0.111		-0.229		-0.106		-0.226
		(0.065)		(0.104)*		(0.063)		(0.104)*
Constant	3.259	3.241	3.258	3.242	3.254	3.238	3.255	3.242
	(0.026)**	(0.024)**	(0.044)**	(0.043)**	(0.025)**	(0.024)**	(0.045)**	(0.044)**
Observations	566	566	566	566	566	566	566	566

Robust standard errors in parentheses
* significant at 5%; ** significant at 1%

Table A-6. Poisson models of popularity as a function of extraversion. The first model in each trio replicates the model in the paper with the same number. In Models 7 and 8, popularity is measured as indegree, the number of other people citing the focal individual as their friend; in Models 9 and 10, popularity is measured as outdegree, the number of friends the focal individuals cites. Control variables are excluded from Models 7 and 9 and included in Models 8 and 10. Given the skewed distributions in the number of friends, we assessed the robustness of our results to outliers. The second and third models in each trio exclude outliers by successively broader definitions. Models ending in "-p99" exclude people whose Time 1 outdegree places them above the 99th percentile of the sample; "-p95" models exclude observations above the 95th percentile of the sample. Additional analyses, available from the authors, replicate these results when excluded outliers were defined instead in terms of outdegree at Time 2; indegree at Time 1; or indegree at Time 2.

	Indegree			**Indegree**			**Outdegree**			**Outdegree**		
	(7)	**(7-p99)**	**(7-p95)**	**(8)**	**(8-p99)**	**(8-p95)**	**(9)**	**(9-p99)**	**(9-p95)**	**(10)**	**(10-p99)**	**(10-p95)**
Extraversion	**0.175**	**0.167**	**0.157**	**0.142**	**0.136**	**0.125**	**0.173**	**0.167**	**0.117**	**0.145**	**0.147**	**0.098**
	(0.024)**	**(0.024)****	**(0.024)****	**(0.022)****	**(0.022)****	**(0.022)****	**(0.040)****	**(0.040)****	**(0.037)****	**(0.039)****	**(0.039)****	**(0.036)****
Time indicator	0.241	0.241	0.241	0.241	0.241	0.241	0.235	0.219	0.201	0.235	0.219	0.201
	(0.008)**	(0.008)**	(0.008)**	(0.008)**	(0.008)**	(0.008)**	(0.024)**	(0.023)**	(0.023)**	(0.024)**	(0.023)**	(0.023)**
Extraversion ×	0.010	0.011	0.012	0.010	0.011	0.012	0.043	0.023	0.021	0.042	0.023	0.021
Time indicator	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.024)	(0.019)	(0.020)	(0.024)	(0.019)	(0.020)
Female				-0.041	-0.027	-0.013				-0.121	-0.067	-0.013
				(0.044)	(0.044)	(0.045)				(0.083)	(0.081)	(0.075)
U.S. Citizen				0.178	0.177	0.188				-0.023	-0.035	-0.025
				(0.066)**	(0.067)**	(0.068)**				(0.116)	(0.115)	(0.111)
Campus Resident				0.208	0.193	0.206				0.270	0.212	0.196
				(0.045)**	(0.045)**	(0.045)**				(0.086)**	(0.081)**	(0.074)**
Racial Minority				-0.121	-0.109	-0.099				-0.249	-0.203	-0.200
				(0.061)*	(0.061)	(0.062)				(0.105)*	(0.102)*	(0.096)*
Constant	3.258	3.250	3.246	3.243	3.238	3.233	3.243	3.218	3.154	3.227	3.210	3.147
	(0.025)**	(0.025)**	(0.025)**	(0.023)**	(0.023)**	(0.024)**	(0.043)**	(0.041)**	(0.039)**	(0.041)**	(0.040)**	(0.039)**
Observations	560	554	534	560	554	534	560	554	534	560	554	534

Robust standard errors in parentheses
* significant at 5%; ** significant at 1%

Table A-7. Ordinary least squares models of network extraversion bias as a function of one's own extraversion. The first model in each trio replicates the model in the paper with the same number. Control variables are excluded from Models 11 and 13 and are included in Models 12 and 14. The second model in each trio re-estimates the network extraversion variable by omitting outlying extraverts from each person's network. Models ending in "-p99" and "-p95" exclude from each person's network those contacts whose Time 1 outdegree score places them above the 99th and the 95th percentile of the sample, respectively. Note that in this analysis, the set of observations included in the model does not vary; rather, we vary the composition of each person's network and the resulting value of the network extraversion variable to examine the robustness of the core result to the exclusion of outliers. Additional analyses, available from the authors, replicate these results when excluded outliers were defined instead in terms of outdegree at Time 2; indegree at Time 1; or indegree at Time 2.

	(11)	**(11-p99)**	**(11-p95)**	**(12)**	**(12-p99)**	**(12-p95)**	**(13)**	**(13-p99)**	**(13-p95)**	**(14)**	**(14-p99)**	**(14-p95)**
Extraversion							**0.065**	**0.063**	**0.062**	**0.050**	**0.050**	**0.049**
							(0.016)**	**(0.016)****	**(0.016)****	**(0.015)****	**(0.015)****	**(0.015)****
Time indicator	0.014	0.013	0.016	0.014	0.013	0.017	0.014	0.013	0.017	0.014	0.013	0.017
	(0.009)	(0.010)	(0.009)	(0.009)	(0.010)	(0.009)	(0.009)	(0.010)	(0.009)	(0.009)	(0.010)	(0.009)
Extraversion ×							-0.001	-0.002	-0.001	-0.001	-0.002	-0.002
Time indicator							(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Female				0.019	0.018	0.021				0.021	0.020	0.022
				(0.034)	(0.034)	(0.033)				(0.033)	(0.033)	(0.032)
U.S. Citizen				0.157	0.153	0.148				0.142	0.138	0.134
				(0.049)**	(0.049)**	(0.049)**				(0.047)**	(0.047)**	(0.047)**
Campus Resident				0.002	0.003	0.003				-0.007	-0.006	-0.006
				(0.033)	(0.033)	(0.032)				(0.033)	(0.033)	(0.032)
Racial Minority				-0.062	-0.047	-0.051				-0.057	-0.043	-0.047
				(0.041)	(0.041)	(0.041)				(0.039)	(0.039)	(0.039)
Constant	**0.122**	**0.108**	**0.074**	**0.120**	**0.107**	**0.072**	0.122	0.108	0.074	0.120	0.107	0.072
	(0.017)**	**(0.017)****	**(0.017)****	**(0.016)****	**(0.016)****	**(0.016)****	(0.017)**	(0.017)**	(0.016)**	(0.016)**	(0.016)**	(0.016)**
Observations	560	560	559	560	560	559	560	560	559	560	560	559
	0.00	0.00	0.00	0.09	0.08	0.09	0.04	0.04	0.04	0.11	0.10	0.11

Robust standard errors in parentheses
* significant at 5%; ** significant at 1%

Table A-8. Ordinary least squares models of network extraversion bias as a function of one's own extraversion. The first model in each trio replicates the model in the paper with the same number. Control variables are excluded from Model 13 and included in Model 14. The second and third models in each trio exclude outliers, by successively broader definitions. Models ending in "-p99" exclude the 8 people who share the maximal extraversion score; "-p95" models exclude 5% of observations with the highest extraversion scores in the sample. In this analysis, we make no changes to the network extraversion variable; rather, we vary the set of observations included in the model based on the individual's own extraversion to examine the robustness of our results to the exclusion of outliers. Because Models 11 and 12 excluded extraversion as a covariate, it was unnecessary to assess their robustness to its outliers.

	(13)	**(13-p99)**	**(13-p95)**	**(14)**	**(14-p99)**	**(14-p95)**
Extraversion	**0.065**	**0.068**	**0.068**	**0.050**	**0.053**	**0.053**
	(0.016)**	**(0.016)****	**(0.017)****	**(0.015)****	**(0.015)****	**(0.016)****
Time indicator	0.014	0.013	0.013	0.014	0.013	0.013
	(0.009)	(0.009)	(0.010)	(0.009)	(0.009)	(0.010)
Extraversion ×	-0.001	-0.004	-0.003	-0.001	-0.004	-0.003
Time indicator	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Female				0.021	0.018	0.019
				(0.033)	(0.034)	(0.035)
U.S. Citizen				0.142	0.142	0.143
				(0.047)**	(0.047)**	(0.048)**
Campus Resident				-0.007	-0.004	-0.004
				(0.033)	(0.033)	(0.034)
Racial Minority				-0.057	-0.060	-0.061
				(0.039)	(0.039)	(0.040)
Constant	0.122	0.123	0.122	0.120	0.122	0.121
	(0.017)**	(0.017)**	(0.017)**	(0.016)**	(0.016)**	(0.017)**
Observations	560	554	534	560	554	534
R-squared	0.04	0.04	0.04	0.11	0.12	0.12

Robust standard errors in parentheses
* significant at 5%; ** significant at 1%

Table A-9. Dyad-level models of network ties. These models replicate Models 1-6 in the manuscript, using reciprocated network ties as the dependent variable. A tie is defined to take a value of 1 if both individuals cited the other as a friend and a value of 0 otherwise. The results are substantively the same, indicating their robustness against alternative specifications of the dependent variable. Note also that Models 1-R and 2-R are identical to Models 3-R and 4-R, respectively, because when the network tie is undirected, each individual appears as both an *i* and a *j*.

	(1-R)	**(2-R)**	**(3-R)**	**(4-R)**	**(5-R)**	**(6-R)**
***i* Fixed Effects**			**Incl.**	**Incl.**	**Incl.**	**Incl.**
***j* Fixed Effects**	**Incl.**	**Incl.**			**Incl.**	**Incl.**
***i*'s Extraversion**	**0.010**	**0.008**				
	(0.002)**	**(0.002)****				
***j*'s Extraversion**			**0.010**	**0.008**		
			(0.002)**	**(0.002)****		
Extraversion Similarity					**0.007**	**0.005**
					(0.002)**	**(0.002)***
Time indicator	0.013	0.013	0.013	0.013	0.014	0.014
	(0.001)**	(0.001)**	(0.001)**	(0.001)**	(0.002)**	(0.002)**
i's Extraversion ×	0.004	0.004				
Time indicator	(0.001)**	(0.001)**				
j's Extraversion ×			0.004	0.004		
Time indicator			(0.001)**	(0.001)**		
Extraversion Similarity ×					0.001	0.001
Time indicator					(0.001)	(0.001)
Same Section		0.020		0.020		0.020
		(0.003)**		(0.003)**		(0.003)**
Same Study Group		0.298		0.298		0.300
		(0.020)**		(0.020)**		(0.020)**
Both On Campus		0.029		0.029		0.039
		(0.005)**		(0.005)**		(0.006)**
Same Gender		0.026		0.026		0.027
		(0.002)**		(0.002)**		(0.003)**
Same Race		0.040		0.040		0.043
		(0.005)**		(0.005)**		(0.005)**
Same Nationality		0.025		0.025		0.053
		(0.005)**		(0.005)**		(0.008)**
Age Difference (logged)		-0.011		-0.011		-0.009
		(0.003)**		(0.003)**		(0.003)**
Constant	0.048	0.000	0.048	0.000	0.045	-0.037
	(0.002)**	(0.004)	(0.002)**	(0.004)	(0.004)**	(0.007)**
Observations	156,240	156,240	156,240	156,240	78,120	78,120
R-squared	0.024	0.079	0.024	0.079	0.040	0.096

Robust standard errors in parentheses, clustered by sender, recipient, and undirected sender-recipient pair.
* significant at 5%; ** significant at 1%

Table A-10. Dyad-level models of network ties at Time 2, re-estimated using the Quadratic Assignment Procedure to account for structural dependencies in the dyadic data, rather than using multi-way clustering. QAP cannot be estimated on pooled data, but substantially the same results obtain in Time 1 data. QAP also calculates p-values directly and does not report standard errors, which are therefore omitted from the table. The substantive findings of Models 1-6 in the manuscript are fully replicated using this alternative specification.

	(1-QAP)	(2-QAP)	(3-QAP)	(4-QAP)	(5-QAP)	(6-QAP)
***i* Pseudo Fixed Effects**			***Incl.***	***Incl.***	***Incl.***	***Incl.***
***j* Pseudo Fixed Effects**	***Incl.***	***Incl.***			***Incl.***	***Incl.***
***i*'s Extraversion**	***0.026*****	***0.023*****				
***j*'s Extraversion**			***0.022*****	***0.019*****		
Extraversion Similarity					**0.009****	**0.007****
Same Section		0.052**		0.052**		0.052**
Same Study Group		0.504**		0.504**		0.502**
Both On Campus		0.046**		0.044**		0.031**
Same Gender		0.049**		0.046**		0.045**
Same Race		0.073**		0.070**		0.067**
Same Nationality		0.024**		0.032**		0.018**
Age Difference (logged)		-0.018**		-0.015**		-0.009**
Constant	0.0001	-0.058**	-0.0001	-0.080**	-0.109**	-0.171**
Observations	78,120	78,120	78,120	78,120	78,120	78,120
R-squared	0.033	0.110	0.103	0.180	0.126	0.195

* significant at 5%; ** significant at 1%

Table A-11. Individual-level models of popularity and network extraversion in the reciprocated ties network. These models test the robustness of the popularity effect and network extraversion bias with an alternative form of the dependent variable. A tie takes a value of 1 if each individual cited the other as a friend and a value of 0 otherwise.

DV	**Popularity: Reciprocated Ties**		**Network Extraversion**			
Specification	**Poisson**		**Ordinary Least Squares**			
	(7-R)	**(8-R)**	**(11-R)**	**(12-R)**	**(13-R)**	**(14-R)**
Extraversion	**0.198**	**0.168**			**0.090**	**0.075**
	(0.034)**	**(0.033)****			**(0.019)****	**(0.018)****
Time Indicator	0.266	0.266	0.026	0.026	0.026	0.026
	(0.016)**	(0.016)**	(0.011)*	(0.011)*	(0.011)*	(0.011)*
Extraversion ×	0.027	0.026			0.003	0.003
Time indicator	(0.019)	(0.019)			(0.011)	(0.011)
Female		-0.055		0.012		0.016
		(0.063)		(0.043)		(0.042)
U.S. Citizen		0.081		0.171		0.171
		(0.090)		(0.062)**		(0.058)**
On Campus		0.181		0.025		0.016
Resident		(0.066)**		(0.041)		(0.041)
Racial Minority		-0.217		-0.058		-0.035
		(0.081)**		(0.052)		(0.048)
Constant	2.553	2.538	**0.119**	**0.116**	0.116	0.113
	(0.033)**	(0.032)**	**(0.021)****	**(0.020)****	(0.021)**	(0.020)**
Observations	560	560	558	558	554	554
Pseudo / R-squared	0.15	0.18	0.00	0.07	0.06	0.11

Robust standard errors in parentheses
* significant at 5%; ** significant at 1%

Table A-12. Dyad-level models of network ties to test whether agreeableness, rather than extraversion, yielded popularity and homophily effects. We found weak and inconsistent evidence of a popularity effect. We found no statistically significant effect of agreeableness on the number of others one cites as a friend (i.e., outdegree). Agreeable people are more likely to be cited as friends by others, but the effect sizes are small and their statistical significance depends on particular configurations of control variables. Finally, we found no evidence of agreeableness homophily: dyads with similar levels of agreeableness were not more likely to be friends. Without these building blocks, there is no network agreeableness bias. This provides some evidence that our theory does not simply apply to all socially positive traits.

	(1-Agree)	**(2-Agree)**	**(3-Agree)**	**(4-Agree)**	**(5-Agree)**	**(6-Agree)**
***i* Fixed Effects**			**Incl.**	**Incl.**	**Incl.**	**Incl.**
***j* Fixed Effects**	**Incl.**	**Incl.**			**Incl.**	**Incl.**
***i*'s Agreeableness**	**0.003 (0.004)**	**0.006 (0.004)**				
***j*'s Agreeableness**			**0.003 (0.002)**	**0.005 (0.002)***		
Agreeableness Similarity					**0.001 (0.002)**	**0.000 (0.002)**
Time indicator	0.023 (0.003)**	0.023 (0.003)**	0.023 (0.003)**	0.023 (0.003)**	0.025 (0.003)**	0.025 (0.003)**
i's Agreeableness × Time indicator	0.004 (0.003)	0.004 (0.003)				
j's Agreeableness × Time indicator			0.001 (0.001)	0.001 (0.001)		
Agreeableness Similarity × Time indicator					0.002 (0.002)	0.002 (0.002)
Same Section		0.038 (0.004)**		0.038 (0.003)**		0.038 (0.004)**
Same Study Group		0.452 (0.020)**		0.452 (0.020)**		0.455 (0.020)**
Both On Campus		0.058 (0.010)**		0.055 (0.007)**		0.061 (0.008)**
Same Gender		0.042 (0.004)**		0.040 (0.003)**		0.042 (0.004)**
Same Race		0.070 (0.007)**		0.065 (0.007)**		0.072 (0.008)**
Same Nationality		0.041 (0.010)**		0.052 (0.008)**		0.088 (0.011)**
Age Difference (logged)		-0.018 (0.004)**		-0.014 (0.004)**		-0.014 (0.004)**
Constant	0.096 (0.004)**	0.012 (0.008)	0.096 (0.002)**	0.007 (0.007)	0.050 (0.004)**	-0.083 (0.010)**
Observations	156,240	156,240	156,240	156,240	156,240	156,240

Robust standard errors in parentheses, clustered by sender, recipient, and undirected sender-recipient pair.
* significant at 5%; ** significant at 1%