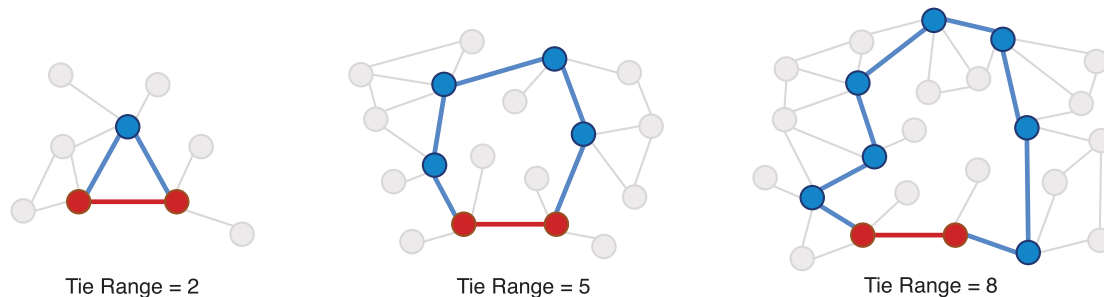# The antecedents and consequences of network mobility

Michael W. Macy[a,1] 🆔

Fig. 1.   Tie range is defined as the second-shortest path length (blue) between two connected nodes (red).

In "Long ties, disruptive life events, and economic prosperity," Jahani et al. use Facebook public comments to study the structural and economic correlates of network diversity at the individual and community level (1). The results support decades of research that "identified long ties, which connect people who lack mutual contacts, as a correlate of individuals' success within firms and places' economic prosperity." The authors also travel upstream to reveal the formative impact of disruptive events during adolescence: changing high schools, interstate migration, and attending college out of state. These experiences "expose individuals to diverse communities, require them to form new ties with others who are different than their old network, and potentially cause development of the social skills to do so."

The paper's contributions are fourfold. First, unlike previous studies comparing individuals within a relatively small community or organization (2) or comparing communities at population scale (3), the authors use Facebook public comments to analyze individual-level differences at the population scale. Second, rather than assuming "the strength of weak ties" (4), the authors weight the fraction of long ties by taking into account the intensity of communication between network neighbors. Third, the authors use school closures as an instrument in a quasi-experimental test of the formative impact of adolescent network mobility. Finally, the paper is a refreshing antidote to the overemphasis in social science on publishing surprising results. Instead, the authors demonstrate the importance of contributing to cumulative knowledge by confirming hypotheses derived from foundational theory while at the same time elaborating on what was previously known by digging deeper into the underlying causal mechanisms. In short, the paper is must reading not only for area specialists but for social scientists across the disciplines.

The term "long ties" has been conceptually defined in the networks literature as "social ties that bridge different communities" (5), a usage that goes back to Simmel, whom the authors cite as suggesting that "individuals with long ties are mediators who can resolve potential conflicts between disconnected communities." The network distance spanned by

bridge ties is often measured as a range, where the range of an edge ij is the length of the geodesic from i to j if the ij tie were removed (see Fig. 1, reprinted from ref. 6). Range has no theoretical upper bound, but the lower limit is two, as in a closed triad ikj with a two-step indirect path from i to j via k.

Compared to range, the authors' measure of long ties is much easier to calculate since it does not require tracing the geodesic. Instead, they operationalize long ties as an edge between nodes that have no common neighbors. Ties between nodes with one or more common neighbors have the shortest possible range, but not all ties without a common neighbor are long range. For example, an edge between adjacent nodes ij in a closed tetrad (with edges $ij\ jk\ kl$ and li) would be classified as "long", even though the range is only three—one more than would obtain if i and j shared a neighbor. Among ties with no common neighbors, the distribution of range is heavy tailed, with most having range three (see Fig. 2, reprinted from ref. 6). This suggests the possibility that the economic consequences of long ties may be conservatively understated by the authors since most ties with no common neighbors are very short range.

There is a second reason the economic benefits of long ties may be even stronger than what the authors report: a binary distinction between ties with and without overlap pools together the economic consequences of a tie with one shared neighbor and a tie with many shared neighbors. The latter can be measured as "overlap," where the overlap of an edge ij measures the proportion of all nodes adjacent to

Author affiliations: ªDepartment of Information Science, Cornell University, Ithaca, NY 14853

See companion article, "Long ties, disruptive life events, and economic prosperity," 10.1073/pnas.2211062120.

¹Email: mwm14@cornell.edu.

Published July 6, 2023.
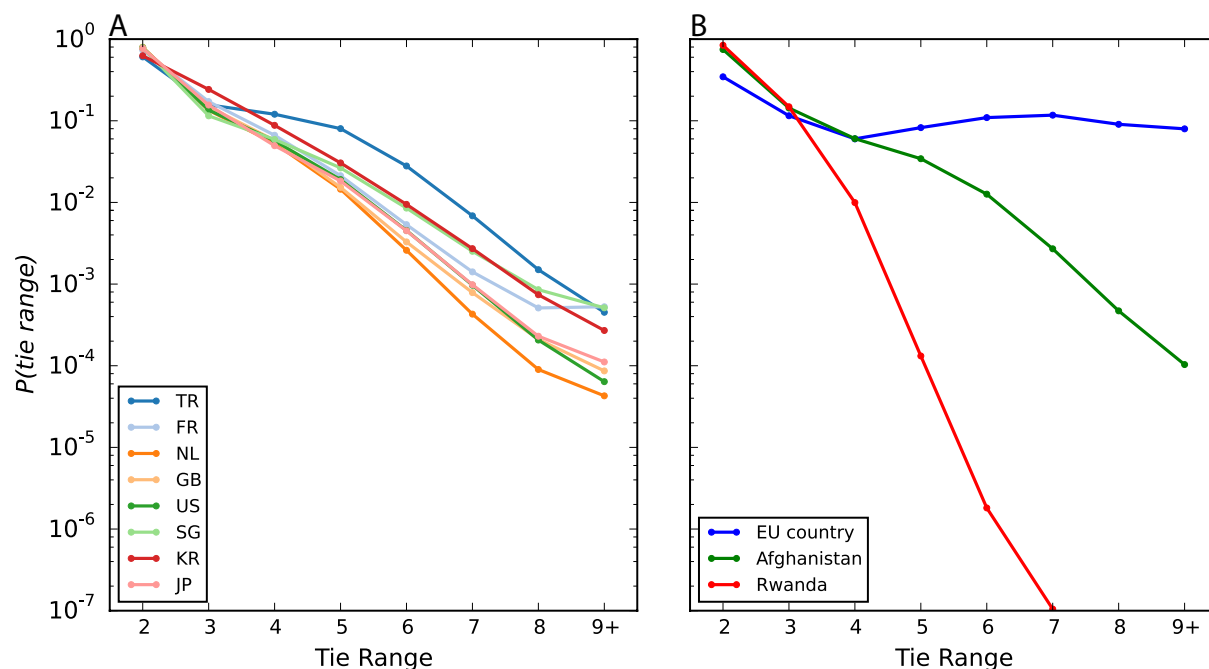
Fig. 2. Range distribution of national Twitter networks in eight countries (panel *A*) and national telecommunication networks in three countries (panel *B*).

either *i* or *j* that are adjacent to both (7). The greater the overlap, the more the tie is densely embedded. A recent field experiment using individual-level data from LinkedIn (7) found an inverted U- shaped relationship between the number of mutual connections and job mobility. In short, future research may reveal even more pronounced economic benefits of long ties by measuring their "length" and "width," using range and overlap.

The authors' most important contribution is their analysis of the formative impact of disruptive events like changing high schools, interstate migration, or attending college out of state. "We find that individuals who experienced such disruptions have more structurally diverse networks years later, in ways that are not mechanically due to geographic mobility or exposure to a new community during high school or college." Their analysis fills in an important part of the puzzle posed by our 2018 study of "network wormholes" (6). Using population-scale telecommunications and social media data, Patrick Park, Josh Blumenstock, and I found that long-range ties were surprisingly strong, but we could only speculate as to their origin. Our best guess was a theory of selective "tie stretching" loosely suggested by Granovetter's "forbidden triad" (4), in which ties that are strong but comparatively weak are more likely to break in the course of network mobility, while stronger ties are stretched but not broken. The current paper provides empirical support for the formative impact of network mobility and also provides a unique insight: It is not just the structural disruption that explains long ties, it is also the psychosocial disruption from experiencing network mobility, through which individuals develop the disposition and social skills to extend their relational horizons. The authors' analysis reveals an important direction for future research on the formative impact of events that disrupt social networks over the life course. For example, future research might use the content of Facebook comments to measure "Big Five" personality traits (8, 9). The

hypothesis is that Facebook users with long ties will display greater openness to experience, agreeableness, and extraversion—attributes that previous research has found conducive to network diversity (10) and job performance (11).

The authors also use a clever quasi-experimental design to drill down into the underlying causal mechanisms. Adolescents who choose to change schools might already have acquired the personality traits and social skills that facilitate concurrent network mobility and network diversity in later life. However, that cannot be the case when the move is induced by the involuntary closing of one's current school. The results of their instrumented model support the formative impact of disruptive events.

I find both causal processes equally plausible: disruptive events can shape as well as select for the disposition and skills that facilitate network diversity. Whether diversity in the comment network is explained by the experience of adolescent network mobility or by preexisting dispositions and skills that promote network mobility, or some combination of the two, what matters is that adolescents with the motivation and ability to explore the social landscape are more likely to change high schools, attend college out of state, and (years later) to venture out of their relational comfort zone.

The more pertinent question is whether the Facebook commenting network corresponds to the offline networks that confer and reflect economic opportunity. The authors acknowledge the problematic assumption: "...we use communication activity on Facebook as a measure of social networks more generally (i.e., interaction offline and via other media)." The problem is that Facebook users can freely choose the posts on which to comment, while institutional arrangements, spatial proximity, and social norms constrain the choices of persons with whom to interact offline. Further research is needed to test whether comment targeting generalizes to the Facebook friends network, and beyond that, to offline social networks. The authors questioned the relevance of Facebook's friend

network, which they dismissed as largely composed of users "who are only acquaintances." On the other hand, ties to acquaintances could provide a rich opportunity to study the causes and consequences of long ties.

Jahani et al. use Facebook public comments to study the structural and economic correlates of network diversity at the individual and community level.

Testing for offline robustness is far more challenging, but the authors have already laid important groundwork in their county-level analysis of network diversity and local prosperity. Future research might use the county-level data to compare the commenting topology with offline communication networks based on telephone call logs (3, 6), including the distribution of long ties and their association with network degree.

Suppose we were to find that online comment targeting does not correspond to offline network diversity. This would not weaken their conclusions; on the contrary, the authors' analysis of antecedent disruptive events avoids the need to assume that Facebook mirrors offline networks. Instead, their causal narrative suggests that long ties on Facebook reflect antecedent individual attributes that can be expected to also impact offline tie formation. Adolescent social explorers are more likely as adults to form long ties, not only on Facebook

but in offline networks as well. Simply put, the willingness and ability to target Facebook comments far beyond one's immediate circle proxies for unmeasured psychosocial attributes that confer economic advantage, whether directly (e.g., through greater risk-taking, entrepreneurship, or extraversion) or indirectly through the offline formation of long ties that provide greater access to economic opportunities.

Finally, the authors entertain the possibility that the causal arrow also runs from socio-economic status to networking strategy: "the observed associations likely reflect causal processes in both directions; that is, social networks affect economic outcomes and also economic prosperity affects network formation and maintenance." For example, Oishi and Kesebir found that people who are residentially stable but economically disadvantaged are more satisfied with "a narrow but deep social network," with fewer friends but higher density of interactions (12). The authors' income proxies (charitable donations, log-ins with pricey phones, and touristic web addresses) are time-stamped, as are user comments, and these longitudinal data could be used to test the hypothesis that pre-existing economic prosperity encourages broader targeting of Facebook comments. This explanatory strategy avoids the need to generalize to offline networks by positing causal processes internal to the actual network from which the data were obtained.

1. E. Jahani, S. P. Fraiberger, M. Bailey, D. Eckles, Long ties, disruptive life events and economic prosperity 10.1073/pnas.2211062120.
2. R. Burt, *Structural Holes: The Social Structure of Competition* (Harvard University Press, Cambridge, MA, 1992).
3. N. Eagle, M. Macy, R. Claxton, Network diversity and economic development. *Science* **328**, 1029–1031 (2010), http://science.sciencemag.
4. M. Granovetter, The strength of weak ties. *Am. J. Sociol.* **78**, 1360–1380 (1973).
5. D. Lyu, Y. Yuan, L. Wang, X. Wang, A. Pentland, Investigating and modeling the dynamics of long ties. *Commun. Phys.* **5**, 87 (2022).
6. P. S. Park, J. E. Blumenstock, M. W. Macy, The strength of long-range ties in population-scale social networks. *Science* **362**, 1410–1413 (2018).
7. K. Rajkumar, G. Saint-Jacques, I. Bojinov, E. Brynjolfsson, S. Aral, A causal test of the strength of weak ties. *Science* **377**, 1304–1310 (2022).
8. R. Pratama, W. Maharani, "Predicting big five personality traits based on twitter user using random forest method" in *International Conference on Data Science and Its Applications* (IEEE.org, Bandung, Indonesia, 2021), pp. 110–117, 10.1109/ICoDSA53588.2021.9617501.
9. L. Qiu, H. Lin, J. Ramsay, F. Yang, You are what you tweet: Personality expression and perception on Twitter. *J. Res. Pers.* **46**, 710–718 (2012), 10.1016/j.jrp.2012.08.008.
10. Y. Kalish, G. Robins, Psychological predispositions and network structure: The relationship between individual predispositions, structural holes and network closure. *Soc. Networks* **28**, 56–84 (2006), 10.1016/j.socnet.2005.04.004.
11. M. Barrick, M. Mount, The big five personality dimensions and job performance: A meta-analysis. *Pers. Psychol.* **44**, 1–26 (1991).
12. S. Oishi, S. Kesebir, Optimal social-networking strategy is a function of socioeconomic conditions. *Psychol. Sci.* **23**, 1542–1548 (2012), 10.1177/0956797612446708.