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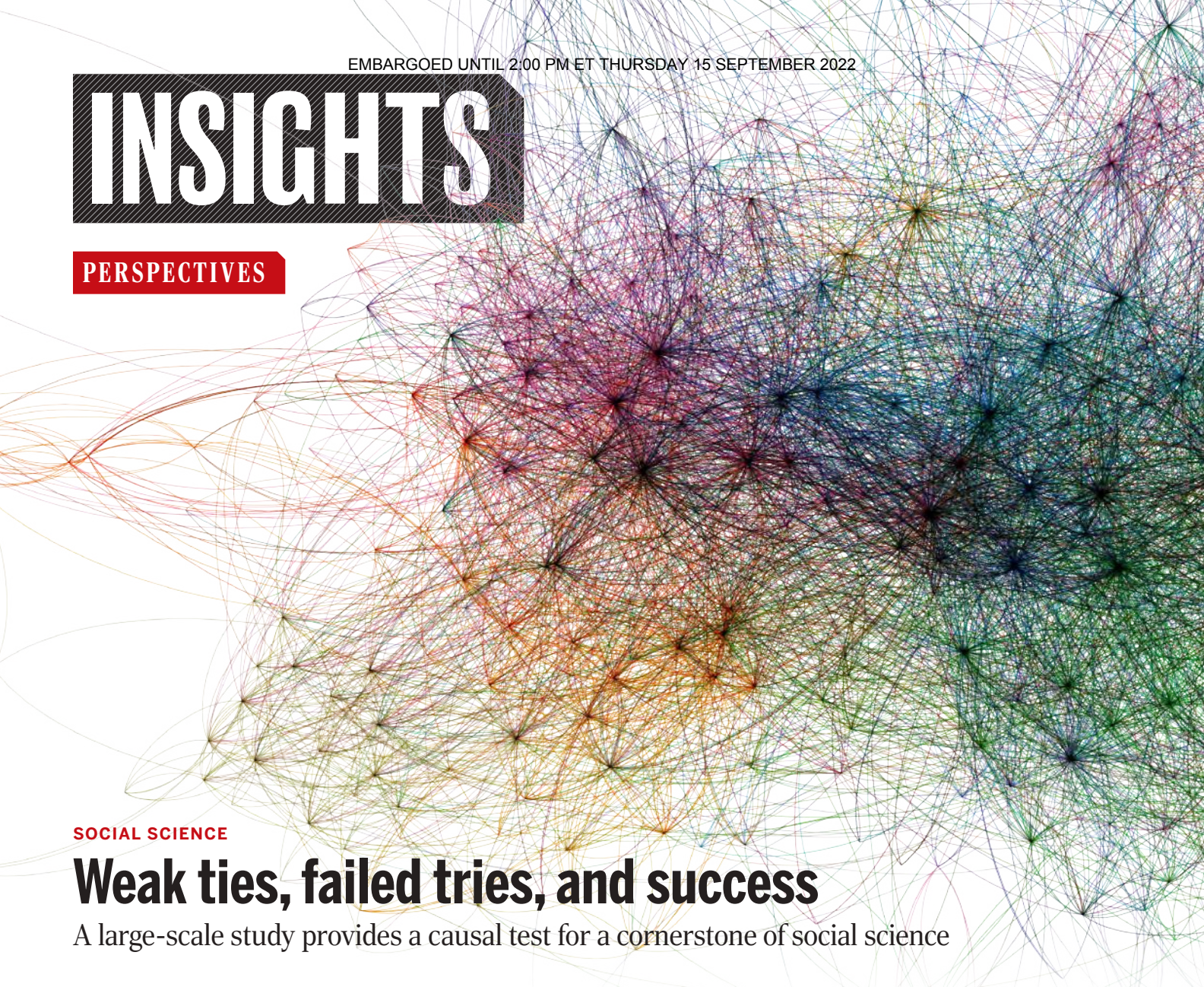
INSIGHTS

PERSPECTIVES



SOCIAL SCIENCE

Weak ties, failed tries, and success

A large-scale study provides a causal test for a cornerstone of social science

By **Dashun Wang**[1,2,3,4] *and* **Brian Uzzi**[2,3]

A seminal finding in social science is that people are most likely to land high-paying jobs through their social connections rather than through advertisements or direct job applications (*1*). Unexpectedly, the most useful contacts are not the job seeker's strong ties—close friends or family. Rather, they are friends of a friend, or weak ties (*1*)—contacts least expected to be capable, or willing, to help. Although numerous studies of in-person and online social networks in various contexts have used the strength of weak ties (SWT) to explain their findings, the theoretical foundations had yet to be put to a causal test. Now, having traced more than 20 million users on the LinkedIn social network platform, Rajkumar *et al.* report on page 1304 (*2*) a causal test for the SWT thesis. The data bear out the power of weak ties but raise questions about the implications of human connections for success and failure.

Mark Granovetter's landmark SWT publication (*1*) revealed much more about social networks than just their role in getting a job. It showed that different types of network contacts play different roles in shaping our lives. Strong ties tend to know the same information and to think in similar ways. By contrast, weak ties access new information because they bridge otherwise disconnected social circles (*3*). Particularly, over the past two decades, network science has developed rapidly, transforming our understanding of systems as diverse as the Internet, social networks, and human cells (*4*). At the same time, there has been an explosion in large-scale social network data and the use of experimentation that have helped isolate how social networks drive political behavior (*5*), individual preferences (*6*), and the formation of social norms (*7*).

Yet, despite advances in data and computational power, there has been a persistent lack of causal understanding of the SWT theory. This highlights the many core challenges that researchers must overcome, even when armed with massive amounts of observational data. A correlation between the prevalence of weak ties in one's social network and their job outcomes does not mean that the two are causally linked.

Consider a dream experiment, where the prevalence of strong and weak ties within social networks was randomly varied to see whether these variations cause any changes in the probability of finding a job.

[1]Center for Science of Science and Innovation, Northwestern University, Evanston, IL, USA. [2]Northwestern Institute on Complex Systems, Northwestern University, Evanston, IL, USA. [3]Kellogg School of Management, Northwestern University, Evanston, IL, USA. [4]McCormick School of Engineering, Northwestern University, Evanston, IL, USA. Email: dashun.wang@northwestern.edu

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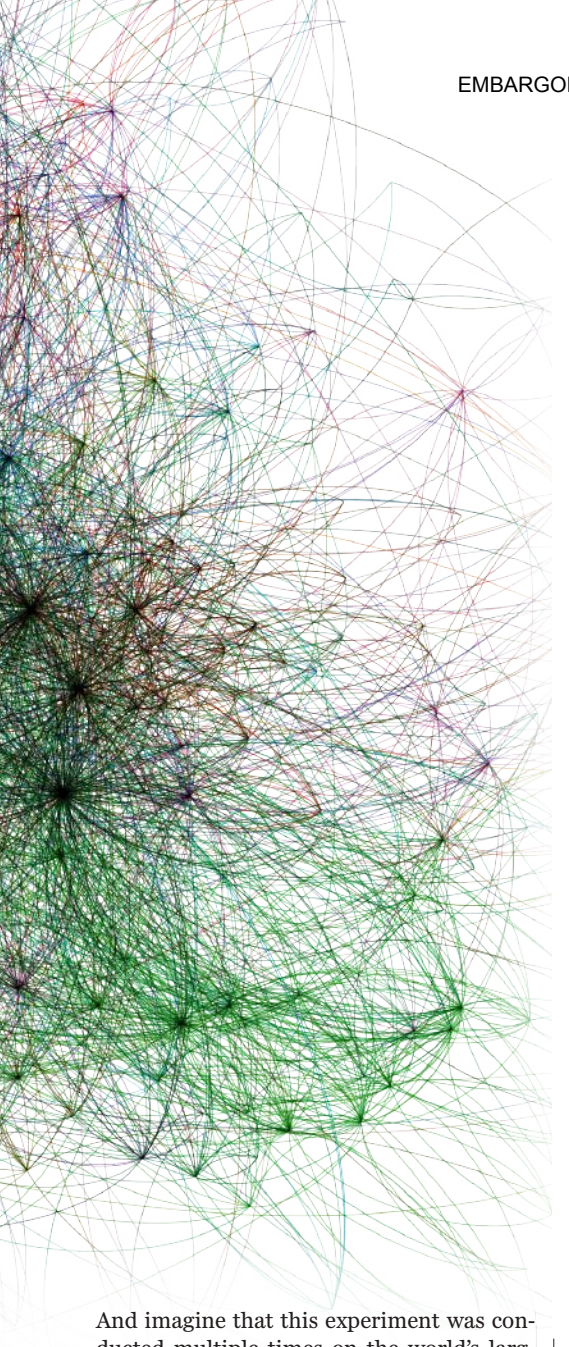

Data from Rajkumar *et al*. (*2*) comprise all worker transitions recorded on LinkedIn. For the sake of illustration here, those data were down-sampled as follows: (i) Nodes are limited to companies with at least 10,000 employees. (ii) Edges are limited to those with at least five transitions between two companies. (iii) Companies are limited to a representative sample from the 30 largest industries. Transitions were then plotted, with colors representing industries.

And imagine that this experiment was conducted multiple times on the world's largest professional social network, with tens of millions of subjects in a global context. That dream just came true, thanks to a clever use of data from LinkedIn.

One key feature of social networking platforms is the so-called People You May Know (PYMK) algorithm, which recommends new connections to users. Social network companies frequently conduct experiments to tune their tie recommendation engines. As LinkedIn tried out different versions of their PYMK algorithms, it created random variations in the prevalence of weak ties in the professional networks of more than 20 million LinkedIn users over a 5-year period, during which ~2 billion new ties and 600,000 job changes were recorded. Rajkumar *et al.* harnessed these exogenous variations of weak ties and conducted retrospective analyses of these PYMK experiments by LinkedIn. Specifically, to infer causality, the authors used the random assignment of users to seven different variations of PYMK algorithms as an instrument, which varied each user's exposure to fewer or greater numbers of weak or strong ties depending on the experimental variants to which the user was assigned. They examined job outcomes by measuring both job applications and job transitions (see the illustration). They approximated tie strength between two individuals using two common measures—calculating the number of their common friends and the intensity of their interactions.

Their findings confirm Granovetter's thesis but also add further nuance. First, they found that weak ties do matter. For example, ties with just one mutual friend—i.e., very weak ties—are more likely to lead to job changes than strong ties, such as those with 25 mutual friends or more. Yet, at the same time, they also uncovered an inverted U–shaped relationship between tie strength and job outcomes. For example, compared with those very weak ties with one mutual friend, a tie with 10 mutual friends nearly doubles the probability of changing jobs. That is, moderately weak ties appear to be the most beneficial for job outcomes.

These results are fascinating for several reasons. First, amid the rise of online social networks, which has substantially altered the meaning of "friend" or "friend of a friend," it seems that online social networks today are just as relevant in explaining economic outcomes, such as job mobility, as the offline social network studied by Granovetter some 50 years ago.

Further, although this inverted U–shaped relationship is not inconsistent with Granovetter's findings, it suggests a need for further conceptualization. That acquaintances, with whom you share few connections or experiences, are nevertheless willing to help you is not only sociologically interesting, but it also speaks to a set of social psychology findings. Research shows that people are more likely to help someone with whom they share something in common (*8*), even if sometimes these shared identities are random, such as sharing the same birthday. This is especially interesting considering that tie strength follows a long tail distribution (*4*), which means that there are a lot more very weak ties than strong ties. However, the finding suggests that weaker social ties are not always better, which has implications for how to best manage one's social network. It suggests that on LinkedIn, your most valuable contacts for finding a better job are not the persons you are closest to or the thousands of contacts you accepted an invite from, but rather lie somewhere in between. These persons share some contacts with you that can motivate them to help and are, at the same time, distant enough to expose you to new and useful job information that your close contacts and you do not already have.

Among the many directions for future work, two broad opportunities are particularly noteworthy. First, how does the role of social networks differ for people of different genders, races, or other demographic characteristics? SWT implies that social connections are key sources of inequality in job mobility. For example, given that weak ties involve having diverse contacts outside your strong ties, groups that tend to form social networks within their enclave may have few opportunities to connect with weak ties outside their community. Hence, understanding a community's culture and constraints may hold the key to reducing inequality in the workplace. This is something that the authors could not examine because demographic information was not available.

The absence of demographic information also means that the authors could not address how job attainment through social network differs for men and women. A recent study of graduate student placement in science, technology, engineering, and mathematics (STEM) and other professional fields showed that the weak tie hypothesis appears to hold only for male students (*9*). All else being equal, female students competing for the same jobs seem to need both weak and strong ties to other women to get the best jobs, presumably because the strong ties conveyed employer information regarding the company's cultural orientation toward women in leadership positions. These findings echo Granovetter's initial focus on inequality and further highlight the importance of social networks in understanding inequality across the many facets of society (*10*).

It is also important to recognize that social network literature has disproportionately focused on how networks drive success while ignoring failures that frequently occur with individuals, teams, and organizations. For example, people rarely land their dream job through their first interview; rather, they often have to endure round after round of rejections. Research on job loss suggests that strong ties are the contacts that supported

job seekers through failed tries (*11*). These possibilities highlight fruitful research opportunities while raising the broader question of whether insights obtained by analyzing success tell the full story of the role of failure in breeding success in the labor market and beyond.

Fortunately, the situation is improving radically, thanks to newly available large-scale datasets that record ubiquitous yet often neglected failures—as well as their successful counterparts—that span social, scientific, and technical domains (*12*). New research that pays specific focus to failures has begun to uncover a range of fascinating insights that challenge the way success is thought about. For example, when people experience negative shocks in their job, they tend to tap their strong ties rather than adaptively activating weak ties to obtain new information (*13*). And, despite the widespread evidence supporting the idea that success breeds success, failure seems to have rather powerful, offsetting effects, propelling individuals to greater long-term success (*14*). Combined with mathematical tools and modeling, analyzing failures—the precursors of success—could help to identify detectable early signals embedded in failures that will lead to ultimate victory or defeat (*15*). A systematic understanding of failure may transform our thinking around not only failure, but also success.

Although science may have succeeded in understanding how networks help us succeed, it has failed to understand how networks sustain us through failures. And that highlights a profound opportunity. Indeed, many scientists study success to learn the sources of inequality. But our failure to take failure seriously may be the reason why inequality has not yet been solved. ■

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WATER MANAGEMENT

The "water machine" of Bengal

A data-driven and policy-supported strategic use of aquifers for irrigation is needed to maximize their benefits

By **Aditi Mukherji**

For decades, millions of farmers in Bangladesh have been capturing more water than even the world's largest dams. They did so simply by irrigating intensively in the summer dry season using water from shallow wells. The ability to use groundwater to irrigate rice paddies during the dry seasons (January to May) helped Bangladesh become food self-sufficient by the 1990s, which was no small feat for one of the most densely populated countries in the world. Researchers proposed that lowering of the groundwater table as a result of intensive irrigation practices in the dry season created conditions for recharge from monsoon rains (June to September), which then replenishes the groundwater (*1*). On page 1315 of this issue, Shamsudduha *et al.* (*2*) present a quantitative analysis of this depletion-replenish process and show that this recharge has indeed been happening at a large scale, in a process they call the Bengal Water Machine (BWM).

The name of BWM pays homage to the Ganges Water Machine, which was coined in the 1970s. Both "water machines" describe a process in which the underground water table is lowered during dry seasons by human activities. This creates more space in the alluvial aquifer (made of loose sediments) for taking in heavy rainfall during the monsoon season. Such replenishment has the double benefit of helping farmers to grow dry-season crops and also increasing water storage capacity in underground aquifers for flood mitigation. In Bangladesh, Shamsudduha *et al.* observed an increase in annual intake, or "recharge," after farmers started intensive irrigation from shallow wells (2011 to 2015) as compared with before (1976 to 1980). However, the authors also note that BWM is neither ubiquitous nor unlimited and can be affected by a number of factors, including local geology, land use, and year-to-year variations in rainfall.

Although Bangladesh is endowed with fertile land and a favorable climate that allows cultivation throughout the year, the country has faced food shortages throughout its history. These can be attributed to the complex colonial history of the region, but it is undeniable that Bangladesh's population density