



Friendship as a Health Factor

In a string of hot articles, two social scientists report that obesity, smoking, and other facets of health “spread” in networks. As the two friends expand their theory, doubters sharpen their questions

BOSTON—On the first snowy day in December, Nicholas Christakis and James Fowler are ensconced in Christakis’s rambling home in Concord, Massachusetts, plotting their next conquest. Christakis, at his desk, is nearly hidden behind two enormous Apple computer screens that beam dizzying network patterns of lines and circles representing community ties. Fowler sits cross-legged and barefoot on the couch, a laptop balanced on his knees. The pair are deep at work on their upcoming book, *Connected: The Surprising Power of Social Networks and How They Shape Our Lives*. On a mock cover taped to the wall, an orange goldfish leaps from one bowl of fish into another. The two men haven’t left the house in 48 hours, and Christakis’s watch stopped some time ago.

Christakis, a social scientist and hospice physician—cheerful, given his line of work—and Fowler, an easygoing political scientist, hatched a plan about 6 years ago to study how social relations influence health. Their initial scheme required a massive number of volunteers and \$25 million. It

didn’t take off, as funders balked at the price tag. But soon after, they stumbled upon something even better that would catapult their careers: a collection of loose-leaf papers locked in a record room in Framingham, Massachusetts, home to patient files of the nearly 15,000 participants in the Framingham Heart Study, begun in 1948.

Christakis, who has joint appointments at Harvard Medical School and in Harvard University’s sociology department, recalls as “delicious” the moment when a woman overseeing data collection for the Framingham study mentioned a critical detail. Christakis was wondering aloud how Framingham had kept its hold on so many people for so long. “Well, we have these tracking sheets,” Christakis recalls her explaining, as she pulled a green sheaf from a cabinet nearby. For each participant, the forms requested home address, family physician—and at the bottom asked, Name a close friend who can find you in case we can’t. Instantly, Christakis saw that a social network spanning 30 years was buried in that chart room. “Exactly the data that we

were planning to spend millions of dollars to collect going forward had already been collected,” says Fowler.

Since then, Christakis and Fowler, from his perch at the University of California, San Diego, have pieced together and computerized the Framingham network, matching it with health over time. In a provocative set of papers, they’ve documented that every facet of health examined so far appears to “spread” from person to person. Obesity spreads. Happiness and unhappiness spread. Smoking

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Jennifer Couzin.



Dynamic duo. Nicholas Christakis (left) and James Fowler are dissecting social networks, gaining fans and foes in the process.

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habits spread. The work has landed the two everywhere from the front page of *The New York Times* (which wrote that obesity can spread “like a virus”) to the TV news parody *The Colbert Report*. With the fame have come skeptics, who suggest that Christakis and Fowler are drawing conclusions that go beyond their data.

The work has also propelled the field of social networks and health into the spotlight—and, potentially, into medical care, for which findings could be used to modify behaviors that affect health. But the few efforts to apply network insights to patients have been mixed, in part because determining what causes network effects can be enormously difficult, and modifying them is even tougher (see sidebar, p. 456). Even if social interactions influence everything from heart disease to weight to mental health, intervening is far more daunting than proffering up a drug, says sociologist James Moody of Duke University in Durham, North Carolina, who has studied social networks among adolescents: “I can’t write a prescription script for getting new friends.”

Building blocks

Christakis, 46, and Fowler, 8 years younger, came to social networks from different starting points. Christakis, while caring for the elderly in their last months, became fascinated by the widower’s effect, a phenomenon first investigated in 1858 in which one spouse’s death is often closely followed by the other’s. Fowler, completing his dissertation at Harvard on voting patterns, was intrigued by how social interactions influence voter choice. One of Fowler’s advisers introduced the unlikely pair. “It was thrilling to be taken so seriously,” says Fowler now. These days, the two have a video link set up between their homes in Massachusetts and California and chat at all hours of the day and night.

Social networks have been studied for decades, but it’s only recently that researchers have aggressively applied them to health-related questions. Early studies in this field focused on schools: whether, for example, a child in a school filled with smart children is more likely to excel than one in a school of underperformers. “Everyone thinks that, but it’s darn hard to tell” if it’s true, says Ethan Cohen-Cole, an economist at the Federal Reserve Bank of Boston, who studies social networks. Because so many factors feed into school performance, or weight, it’s enormously difficult to separate out the effects of social interactions, says Cohen-Cole.

One tack is to minimize confounding

factors by searching for rare networks that form randomly. An economics professor at Dartmouth College took this approach, reporting in 2001 that freshmen who happened to be assigned roommates who were smarter than they were would perform better academically. Another method is to focus on individuals whose networks are unusually self-contained, such as teenagers, whose entire social scene tends to revolve around their high school.

This was the strategy of the National Longitudinal Study of Adolescent Health, or Add Health. Begun in the 1990s, it surveyed 90,000 U.S. junior high and high schoolers. “We interviewed every kid at every school” and asked each to identify close male and



female friends, says Peter Bearman, a sociologist at Columbia University who helped design Add Health. “You could characterize the social structure of every school” and identify where each student sat—at the center or around the less popular edges.

Add Health, which is still following participants, has yielded hundreds of papers and many interesting observations about sexual health, drug use, isolation, and more. Bearman was struck by one in particular, that girls whose friends were not friends with each other—what he calls an “unbalanced network”—were much more likely to have suicidal thoughts than boys in the same situation. Bearman believes physicians ought to ask adolescents about the shape of their peer

group—but like most people studying networks in academia, he has no idea whether the work has been applied.

“For kids, their band, their friends, their work—it’s all in the same physical space,” says Moody, who also participated in Add Health. “If you try to do this for adults, it’s much more difficult.”

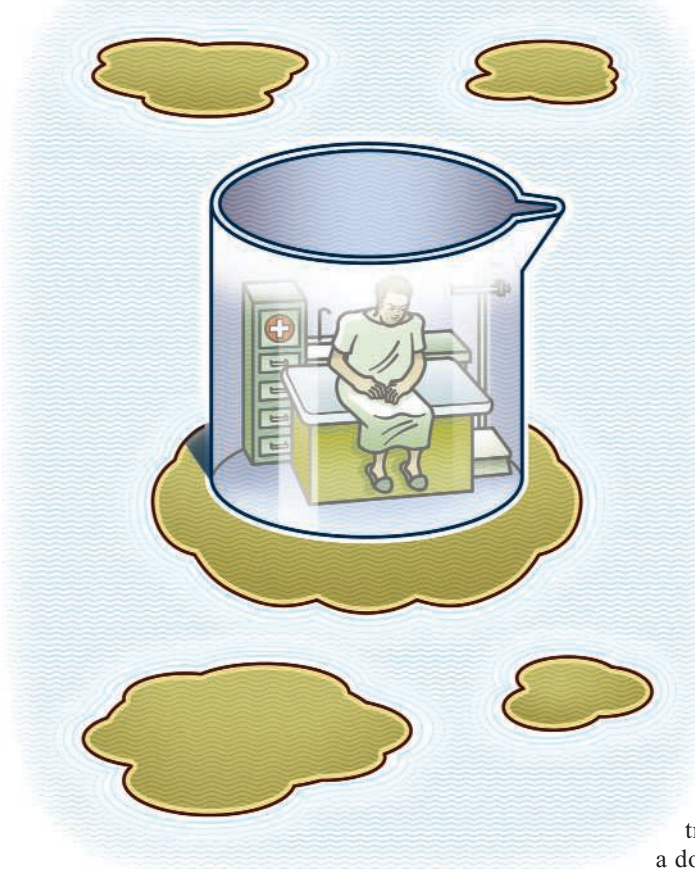
Triumph

Fowler speaks of his joint venture with Christakis in epic terms. “We have an opportunity to peer inside human society,” he says, “the same way Leeuwenhoek peered inside a cell” 3 centuries ago with the earliest microscopes.

That opportunity stems directly from the Framingham network. One great advantage it offered over earlier social networks is that participants were monitored roughly every 3 years for a long period, and Christakis and Fowler could see changes in participants’ weight as the years passed. This could include friends who gained weight at different times, making it easier to link one’s weight gain to the other’s.

Christakis and Fowler chose to focus first on obesity, because weight is an objective measure that was recorded for many years. In the summer of 2007, they described in *The New England Journal of Medicine (NEJM)* their analysis of 12,000 people. About half were offspring of the original 1940s cohort, and the rest were parents and children who also participated in the study (and had named their own friends); the group was followed from 1971 to 2003. Christakis and Fowler found that an individual’s chance of becoming obese increased 57% if someone named as a friend became obese in the same time interval. More surprisingly, the effect surfaced, but to a lesser degree, even when a direct friend wasn’t involved: Obesity in a friend’s friend (or any social contact) boosted the chance of obesity by 20%, and in a friend’s friend’s friend, by 10%. There was no effect beyond three degrees of separation—a pattern that the two have seen in subsequent studies of other health effects. The impact was also weaker among friends of the opposite sex, and there was no effect among neighbors.

The two researchers followed up with a paper the next spring, in May 2008, on smoking. (While obesity increased in the United States during the Framingham years, smoking became less prevalent.) Again writing in *NEJM*, the two showed patterns similar to those for obesity—if a spouse quit smoking,



WITH ISOLATION COMES ILL HEALTH

BOSTON—Epidemiologist Lisa Berkman has been fascinated for years by social isolation, the flip side of social networks. It's a state she and others believe has dire consequences, increasing the risk of certain diseases and earlier death. Attempts to transform this knowledge into action have been discouraging, however: The first ambitious efforts to blunt the harmful effects of solitude have not worked, but Berkman is still seeking ways to mitigate them. She's just beginning a 2-year, \$20 million intervention study funded by the U.S. National Institutes of Health (NIH).

Berkman, of the Harvard School of Public Health located here, says she was drawn to study isolation back

in the 1980s, when she traced social patterns among 7000 people in Alameda County, California. She found that those who scored low on a scale measuring social integration were 2.5 to 3 times more likely to die over the next 7 years than those who scored high. That in itself wasn't a shock, because it's reasonable to assume that isolation is associated with risky behaviors. But Berkman ruled out specific risks, such as drinking alcohol, one by one—and the risk of death stayed high, about 2 to 2.5 times the norm. "What social isolation was doing was making you more susceptible or less resilient to any disease you might get," she says. The work has been replicated in more than a dozen studies around the world.

an individual's chance of quitting increased 67%, and for a friend the figure was 36%. There were subtle distinctions, too. Those with more education were more influenced by others and had a greater influence themselves. The same "spread" pattern held, with friends of friends having an effect. Christakis and Fowler wrote in the *British Medical Journal* in December that happiness and unhappiness disperse in much the same fashion.

They also have papers on alcoholism and depression in the works. Early this year, they expect to publish research on twins from the Add Health study, showing that the structure of one's social network, such as interconnections between friends, is partly inherited.

The research has gotten a remarkable amount of attention. Top medical journals, which don't normally feature social-network research, have published all three of Christakis and Fowler's Framingham papers, in which they describe noninfectious disease with terms such as "person-to-person spread." And the attention has transformed the authors' careers. Christakis and Fowler landed a 5-year, \$11 million grant from the National Institute on Aging in April to study cardiovascular disease, cancer, obesity, violence, and substance use in networks. Their book, slated to appear in early 2010, is expected to be

translated into more than a dozen languages. They've appeared 2 years running in *Time Magazine's* Year in Medicine. Even Fowler's high school in tiny Seminole, Oklahoma, in September inducted him into its hall of fame.

Pushback

Before the first Framingham paper appeared, Christakis's wife warned her husband that he'd be accused of wasting taxpayer money by looking at such a simple, obvious question, because of course friends influence one another. He and Fowler girded themselves for such an attack. Instead, people were incredulous, Christakis says. "We get, 'Outrageous! How can you be claiming obesity spreads?'"

That, say the doubters, is because identifying patterns among friends is not the same as proving that one friend causes another to do something. "They really have not shown adequately" that one person's obesity, or efforts to quit smoking, explain why another person gains weight or quits smoking, says Theodore Iwashyna, a critical-care specialist and social scientist at the University of Michigan, Ann Arbor, and one of Christakis's first graduate students. Iwashyna, who stresses that such challenges are faced in any social-network study, is enthusiastic about the "freaking cool" connections his mentor has demonstrated. But, he asks, what's behind them?

Social scientists point to two other possible explanations for the clustering of friends

with similar characteristics. The first, called "homophily," is the tendency of individuals to associate with people similar to themselves. The second is shared environment. For example, a fast-food restaurant might pop up in a neighborhood, contributing to weight gain among people living nearby. In both cases, one person's weight gain is not the reason for another's.

Christakis and Fowler acknowledge both pitfalls in their writings and emphasize that they've accounted for them. Indeed, says Fowler, "there's not a single argument a critic has made to us that we haven't thought of." Homophily, they have determined, can't explain all the effects because of changes in the Framingham participants that show up over time. For example, two contacts might start off slender; over time, one gains weight, followed by the other. Shared environment has its own limitations. Some clustering, particularly for smoking and obesity, pops up across geographic distances (as when members of the Framingham study moved out of town) but doesn't appear among neighbors on the same block. Furthermore, Christakis and Fowler find that the strength of an effect depends on the strength of a friendship. The weight gain, for example, or boost in happiness, only occurs when one person named another as a friend; the effect did not run in the other direction if that person did not name the other. "It's really subtle," says Christakis. And, Fowler chimes in, "completely ignored by all our critics."

But unlike her social science colleagues Nicholas Christakis of Harvard Medical School and James Fowler of the University of California, San Diego, who beam confidence that social effects are causing changes in health (see main text), Berkman is not certain that a cause-and-effect linkage has been proved, at least where social isolation is concerned. She concedes that isolation may be a result rather than a cause of disease.

Adding to her mixed feelings is that she's had "some really spectacular failures." In 1995, Berkman chaired a nearly \$40 million NIH study designed to bolster social networks to prevent a second heart attack in those who'd had one before. The intervention did improve social support and reduced depression but had no effect on

heart disease. A second network intervention to help stroke victims had equally dismal results. It's a "totally legitimate interpretation" that the studies failed because social isolation doesn't cause cardiovascular disease after all, says Berkman, but that is not what she believes. Her theory is that the "exposure"—isolation—had already done too much harm, so that late intervention accomplished little physiologically. She also says it's difficult to change a social network enough to make a difference.

In the new NIH-funded study, Berkman and others are turning to workplace interventions, focusing on 3000 nursing home employees and information technologists. Half of the 60 sites will implement family-friendly policies and half will not. The idea is to see if giving



Determined. Lisa Berkman aims to blunt the negative health effects of social isolation.

employees more time to spend at home and with friends will bolster their social networks. Berkman acknowledges that the outcome seems obvious—presumably having an amiable boss and a flexible work environment is good for one's health.

But "the truth is we don't know, and the truth is we've been lousy at producing change," Berkman says. "In fact, I'm incredibly wary that we're going to show health effects." Many more scientists believe "that we should be thinking of molecular biology to solve these problems than to think about how work is organized, or how our social world is organized." She and her colleagues will be following workers, their spouses, and their children, examining everything from heart disease and cancer to biomarkers of health such as levels of cholesterol, blood pressure, and C-reactive protein. If changes in the workplace can modify these physiological effects, says Berkman, "that's huge. That's totally huge."

—J.C.

Some of the most vocal detractors of Christakis and Fowler's work are economists who study social networks, in particular Cohen-Cole and his graduate school friend Jason Fletcher, a health economist at Yale University. Working with data from Add Health, the study of teens in high schools around the country, the two tried and failed to replicate the published obesity results. (Two other groups say they have replicated Christakis and Fowler's findings using Add Health, but one noted that evidence for obesity's contagion was "only suggestive at best.") In December, Cohen-Cole and Fletcher published a damning paper in the *British Medical Journal*, applying Christakis and Fowler's methodology to three traits they did not consider transmissible: acne, height, and headaches. Again turning to the Add Health school networks, in which students were surveyed three times over the years, they reported that all three "spread," although in some cases the effects were weak.

Differences with critics run deep. Whereas Cohen-Cole and Fletcher express disbelief that acne or height could appear to spread, Christakis and Fowler think it's quite plausible, especially because Add Health relied on teenagers to report their own health habits. They say that a teen whose friends have acne, for example, may be more aware of his own and more likely to mention it—or the group might share a similar diet that leaves them prone to, or protected from, bad skin. Those with tall friends might be more likely to exaggerate their height. But they also

might be more likely to exercise together, which has been shown to boost height slightly in growing adolescents, says Christakis.

So what traits should not be altered by social networks? Well, says Christakis, eye color and birth order, and anything else that is wholly genetic. Everything else, they agree, is fair game.

Network makeovers

Those wishing to intervene in real-life social networks must first settle on what's behind the health changes documented. "If kids are getting fatter because their friends are getting fatter, what you need to do as a policymaker is very different than if they're getting fatter because there's a McDonald's nearby," says Cohen-Cole.

Even though there's no unanimity yet, interest in applying network findings is keen. Christakis says that he and Fowler have been contacted by companies interested in smoking cessation, by the White House drug policy office, and by an eating-disorders clinic wondering whether to include girls with varying weights in group therapy sessions in hopes that those who are a bit heavier will help shift the lightest ones to a healthier weight.

But few people have actually tried to modify networks to change health, and those who have have experienced mixed results. Psychologist Rena Wing of Brown University reported that when one spouse participated in a weight-loss program, the other lost nearly 5 pounds, compared with no weight

loss for spouses of nonparticipants. Whether the effects spread beyond one person wasn't examined. Still, such ripple effects, which Fletcher is also studying in smoking cessation, have strong implications. "We know the costs of the pill," he says, "but we're not counting all the benefits."

Physicians are still a long way from adopting any of this work. The implications "are often not translated into messages that resonate with people who are delivering medical care," says Carol Ford, an adolescent medicine physician at the University of North Carolina, Chapel Hill. In efforts to prevent the spread of sexually transmitted diseases, she says, networks can reveal which partners are most important to focus on.

"I do think people in medicine are paying attention," says Duke's Moody, but "it's one thing to show something matters. It's another to show you can do something with it," especially in a world where most doctors spend mere minutes with each patient.

But he and some others see networks adding an entirely new dimension to considerations of health. "For so long, science, medicine, and lots of other fields have succeeded by cutting things into small pieces," he says. "The way science works is isolating smaller and smaller microunits. ... What the network model does is say, that can only take you so far. There's an effect that occurs at the population level," even if capturing it, understanding it, and making use of it still has a long way to go.

—JENNIFER COUZIN