

EXERCISE CONTAGION IN A GLOBAL SOCIAL NETWORK

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It turns out you can catch the exercise bug. Our study, which analyzed precisely recorded daily workout routines shared digitally by more than a million runners worldwide over five years, showed that exercise is socially contagious. The running habits of a social network friend can influence another runner to run farther, faster or longer.

The idea of social contagion—the notion that just like an infectious disease, behaviors can spread through groups of individuals—has recently ignited a great deal of interest in disciplines as diverse as economics, sociology, medicine, computer science, political science and physics. Knowledge about the interdependence of behaviors across human social networks could prove extremely useful in a range of domains.

Social contagion is particularly intriguing to scientists, business organizations, and policy makers seeking to understand whether individual actions and decisions around health can be affected by peers. Understanding the mechanisms of influence in social networks might enable us to transition from independent intervention strategies to more effective interdependent interventions that incorporate individuals' social contexts into their treatments. It is a line of inquiry with tremendous potential to improve social, economic and business policy.

Moving from correlation to causation in studying social contagion requires new methodologies in data gathering and analysis.

Investigating the idea of social contagion is not a simple matter. Empirical challenges often prevent researchers from demonstrating cause and effect and identifying precisely how behaviors change in real-world networks.

Scientists may spot linkages between certain behaviors and outcomes within social networks, but they cannot offer

evidence that one individual's specific behavior changes another's behavior, or triggers a cascade of like behaviors among peers. These kinds of correlated behaviors might be due to the confounding phenomenon of homophily—the tendency of individuals to gravitate toward others like themselves.

Studies of social contagion have also suffered from substantial measurement error, relying, for instance, on inaccurate self-reports of behavior. Some experiments conducted digitally tap into potentially meaningful online behaviors such as the adoption and use of social apps and internet memes, only to find that these do not serve as a good proxy for offline behaviors that impact public health. In addition, laboratory experiments aimed at detecting behavioral influence in groups do not reveal the kinds of social network conditions that emerge naturally in the real world.

Our study set out to overcome these empirical challenges to understanding behavioral interdependence in social networks. Specifically, we hoped to study social influence in a way that might hold potential for public health interventions.

IN THIS RESEARCH BRIEF

- There is strong statistical evidence that exercise is socially contagious.
- Employing an econometric inference method, it is possible to estimate unbiased causal behavioral influence in a worldwide network of runners.
- Both men and women influence men, while only women influence other women. Less active runners influence more active runners, but not the reverse.
- Analyzing data based on real-world behaviors, rather than laboratory situated or online experiments, offers greater potential for understanding human behavior and social influence at scale.
- Identifying mechanisms for social contagion suggests new approaches to effective social intervention strategies in public health and other domains.



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We sought data on actual exercise behaviors and real relationships interacting in their natural states, with the goal of examining generalized peer effects, such as the effect of individuals' overall exercise behaviors on their friends. By exploiting naturally occurring, rather than experimentally created, random variation across network ties, we identified causal social influence in these networks.

We gained access to a proprietary data set of ~1.1 million individuals who ran ~359 million kilometers in a global social network of runners over five years. This data set contained the daily distance, duration and pace of, as well as calories burned, during runs undertaken by these individuals, as recorded by a suite of digital fitness-tracking devices.

EMPIRICAL CHALLENGES OFTEN PREVENT RESEARCHERS FROM DEMONSTRATING CAUSE AND EFFECT AND IDENTIFYING PRECISELY HOW BEHAVIORS CHANGE IN REAL-WORLD NETWORKS.

The data also tracked ~3.4M social network ties formed among runners to connect and keep track of each other's running behaviors. Ties in this network linked runners who followed each other's running habits. Running information was not self-reported. When a run was completed, it was immediately digitally shared with a runner's friends. Runners could not choose which runs they shared but rather comprehensively shared all new running information with their friends upon connecting their device to the platform.

These data gave us unique insight into the daily, coevolving running and social network patterns of these individuals over five years. Estimating progressively more sophisticated statistical models, we found correlations between an individual's running behavior

and that of his or her geographically separate friend's behavior: distance, speed, duration of workout routines appeared similar, day to day, and over many months.

Deploying an econometric methodology enabled the study to rule out confounding bias.

But to find evidence of actual causation of behaviors, we needed to rule out the possibility of bias created by social processes such as homophily. To accomplish this, we leveraged an inference technique used by econometricians to identify causal effects across a variety of phenomena, called the instrumental variables (IV) framework.

To adapt the IV framework to our network setting, we needed to identify a naturally occurring source of variation in individuals' running behavior that was uncorrelated with the behavior of their peers. For our purposes, the weather was an ideal instrument. As social ties span geographies, our data record many relationships in which peers experience uncorrelated weather. In these relationships, the weather experienced by one person is an excellent source of external variation that perturbs her running behavior without affecting the running behavior of her geographically distant friends.

Using records of daily global temperature and precipitation patterns experienced by the runners over time, recorded by more than 47,000 weather stations in 196 countries, we were able to estimate causal social influence effects in running behavior.

FINDINGS

Our results showed unmistakable evidence of social contagion. Runners paid attention, and responded to, the specifics of their peers' workouts. For instance, if an individual increased the customary distance of a run, so would a friend, even by a few tenths of a kilometer. We found that runners were more influenced by peers whose

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performance was slightly, but not far worse, than their own, as well as by those who performed slightly, but not far better, than they did.

In the context of exercise, a debate exists about whether we make upward comparisons to those performing better than ourselves or downward comparisons to those performing worse than ourselves.

Comparisons to those ahead of us may motivate our own self-improvement, while comparisons to those behind us may encourage competitive behavior to establish one's own superiority. Our findings are consistent with both arguments, but the effects are much larger for downward comparisons than for upward comparisons.

AS SOCIAL TIES SPAN GEOGRAPHIES, OUR DATA RECORD MANY RELATIONSHIPS IN WHICH PEERS EXPERIENCE UNCORRELATED WEATHER.

We also found strong evidence that social influence depends on gender relations. Men strongly influence men, and women moderately influence both men and women. But women runners seemed indifferent to the workouts of male network friends, and changed their training regimens only in response to female network friends. This may be due to gender differences in the motivations for exercise and competition. For example, men report receiving and being more influenced by social support in their decision to adopt exercise behaviors, while women report being more motivated by self-regulation and individual planning. Moreover, men may be more competitive and specifically more competitive with each other.

Our analysis also showed that the number of mutual friends shared by runners strongly affected their running behaviors. People along this social chain keenly monitored each other,

rewarding positive behaviors (such as a longer or faster run), and sanctioning misbehavior (such as shortening runs or shirking exercise altogether). The number of friends amplified opportunities for social reinforcement or disapproval.

CONCLUSION

Our study demonstrates the importance of moving beyond conventional approaches to understanding social influence in human behaviors. Research aimed at developing a robust, generalizable and precisely measured understanding of human health interdependence must examine data on actual behaviors and real relationships interacting in their natural states. People simply do not behave the same way in a laboratory or online as they do in the real world.

Our study also suggests the broad importance of not focusing exclusively on average social effects. Different subsegments of the population react differently to social influence. Such differences suggest that policies tailored for different types of people in different subpopulations will be more effective than policies constructed with only average treatment effects in mind.

With specific, detailed measurements of social influence, we believe it will be possible not just to test the validity of theories of contagion, but to generate realistic projections of the outcomes of social and behavioral policy interventions.

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