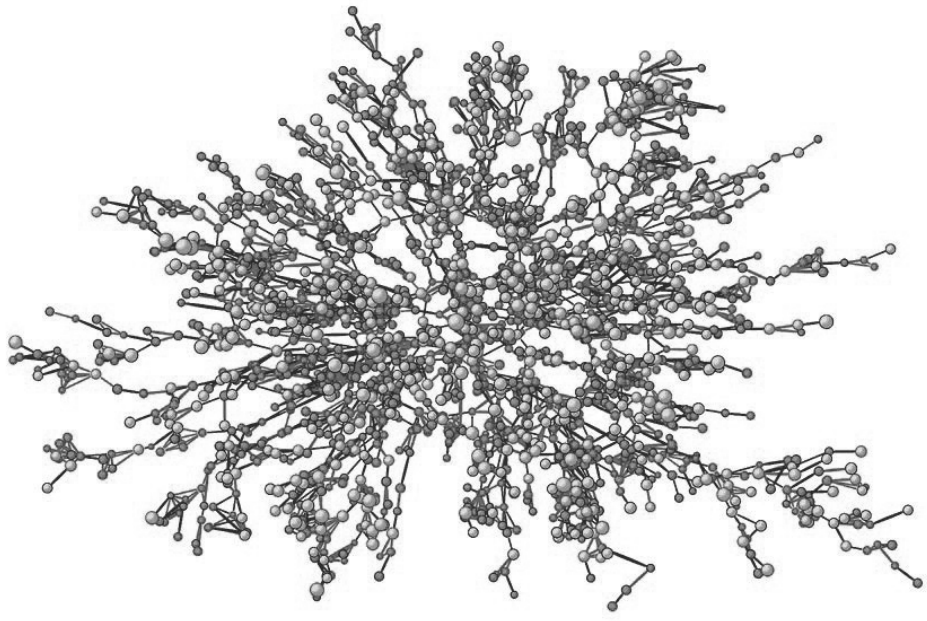
The Genetics of Human Social Interaction

By Francis Deng

Your genes play a fundamental role in shaping your social network, according to a recent study conducted by researchers at Harvard University and the University of California, San Diego (1). The paper, published in February in the *Proceedings of the National Academy of Sciences*, sheds light on why some people are in tight-knit cliques where everyone knows each other, while others have several different groups of friends with no overlap. The study suggests that there is evidence of a genetic basis for popularity, whether someone's friends are friends with each other, and whether someone is an integral member of a social group.

The researchers based their findings on data on 1,110 twins from the National Longitudinal Study of Adolescent Health, a survey that included questions on social involvement given to some 90,000 students in 142 different school friendship networks in 1994. "We show that there is greater similarity in social network position and architecture in monozygotic twins than in same-sex dizygotic twins, which is evidence for a genetic basis," says co-author Nicholas Christakis, Professor of Sociology in the Harvard Faculty of Arts and Sciences and Professor of Medical Sociology at Harvard Medical School (2).

Christakis and colleagues constructed social networks from lists of friends and found that certain attributes of the social networks of identical twins (or monozygotic twins, who share all of their genes) were significantly more similar than the those of same-sex fraternal twins (or dizygotic twins, who share only 50% of their genes on average). By separating, to some degree, nature (genes) from nurture (environment and upbringing), the scientists found that genes account for 46% of the variation in how popular someone is (i.e. the frequency that someone is named as a friend), also known as "in-degree," for 47% of the variation in how connected someone's friends are to each other (node transitivity), and for 29% of the variation in whether someone is



Important metrics in social network analysis include in-degree (number of times a person is nominated as a friend), out-degree (number of friends a person nominates), betweenness centrality (the extent to which one person connects other people indirectly by being between them), and clustering/transitivity (likelihood that two friends of one person are also friends with each other).

credit: (6)

in the middle of a social network or on the edges (betweenness centrality).

The finding that in-degree has a genetic basis is made in the context of many previous twin studies that suggest that genes play a role in personality (3) and some small studies on the genetic inheritance of popularity (4). "Some people are shy, some are gregarious," says Christakis, "and it wouldn't strain credulity if this would be partially genetically heritable" (2).

But the findings extend beyond what people usually think about the genetic influence on behavior, to an influence on the entire structure of someone's social network. "It turns out where you're located in a network topologically speaking also has a partially genetic basis," according to Christakis (2). He proposes that variation in social and environmental conditions might provide an impetus for the evolution of a genetic basis for popularity and position within a network. While it would be advantageous to be on the edges of a network if a deadly infection is spreading through the population, Christakis says, you would want to be in the middle of the network if a valuable piece of gossip is circulating (2). Thus, he explains, genetic variation arises from the different advantages that arise in different situations.

Further supporting the implication that genes influence more than just how outgoing or shy one is, another novel finding of the study is that node transitivity of the network a person is a part of has a significant correlation with that person's DNA. "Whether your friends know each other depends on your genes," remarks Christakis. "That's a very bizarre kind of observation" (2).

To explain this phenomenon, the authors propose a new mathematical social network model called the "Attract and Introduce" model, which more closely resembles actual human networks by accounting for both passive and active ways in which genetics may affect network formation (5). Genetics influence passive traits like attractiveness, physical or otherwise, which change how people act towards someone and whether others create friendships with that person. On the other hand, genes also influence active characteristics like how gregarious someone is and whether she is likely to introduce her friends to each other. Taking into account active traits fits the model better to actual human networks, in which high transitivity and clustering is a defining feature. The paper notes that there are many reasons the propensity to attract or introduce friends may be heritable. For example, more friends means more social support or more conflict depending on the context, and more interconnectedness means greater solidarity but perhaps also group isolation.

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The results of the paper suggest that evolution may have acted on the architecture of social networks, and modeling of human networks in the fashion Christakis and colleagues propose would be important for understanding the way genetics affect social behavior as well as how behavior spreads through the network. Previous work by the authors has indicated many heritable traits are also spread through social networks, such as obesity (6), smoking behavior (7), and happiness (8). Thus, a deeper understanding of social network formation may have important implications for large-scale social endeavors, such as improving public health. H

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