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Using E-Mail to Count Connections  
By SARAH MILSTEIN

THE "six degrees of separation" theory has been used to explain everything from why it is likely that your neighbor went to school with your doctor to why every film actor in Hollywood is closely linked to Kevin Bacon. The theory was developed in the 1960's by Stanley Milgram, a social psychologist who suggested that every person in the United States is connected through a chain of, at most, six people.

Although Dr. Milgram's theory has been accepted as applying worldwide, his famous results have not been replicated, nor have they been tested globally. Now a team of sociologists at Columbia University led by Duncan Watts, an assistant professor of sociology and author of "Small Worlds: The Dynamics of Networks Between Order and Randomness," is trying to assess the six-degrees hypothesis on a large scale, using e-mail as the medium for building the chains.

The researchers hope not only to learn how social networks are structured, but also to investigate whether useful parallels can be drawn between human social webs and engineered systems like distributed computer networks.

Dr. Watts and his team have begun to test the hypothesis electronically and over the next few years will send thousands of e-mail messages to as many as 20 target individuals around the world. The goal is to wind up with hundreds of completed chains per target.

To build a large database of people interested in taking part as links in the chain, Dr. Watts's team has set up a Web site ([smallworld.sociology.columbia.edu](http://smallworld.sociology.columbia.edu)). A small amount of demographic data is requested of registrants and will be kept confidential. Participants will receive e-mail messages asking them to help locate a target person by forwarding e-mail to a personal contact who might be likely to know the target. Eventually, the results of individual chains will be available to the people who are part of them. The site is available in Russian and may be translated into other languages.

"Broadcasting, where you send all your friends a message and they send all their friends a message and so on, would be a good way to learn where the shortest paths exist," Dr. Watts said. "But we'd be creating a computer virus, and we'd get arrested by the F.B.I. Instead, we're going for a lot of individual chains because with enough of them, we'll learn how messages move through the social space."

In his original study done in 1967, Dr. Milgram mailed a letter to 200 people in Omaha and 100 people in Boston who were told to forward the letter to one personal contact. The goal was to try to reach a target person in Boston. Dr. Milgram, who died in 1984, called his study the Small World Problem and wound up with 60 completed chains of letters that averaged six senders.

His findings were fixed in the popular imagination by the John Guare play "Six Degrees of Separation" and by the trivia game Six Degrees of Kevin Bacon, which challenged players to find the shortest list of movie casts linking Mr. Bacon to any other actor.

"The issue is regarded as settled," Dr. Watts said, "but it really isn't, either theoretically or empirically." He said that Dr. Milgram's pool of participants was too small to allow the drawing of universal conclusions and that not all the participants were randomly selected.

The new study will try not only to make a more reliable determination of the length of social chains, but also to learn how people find the short paths that do exist. Using the demographic data collected when people register at the Web site, the researchers will choose targets with specific attributes and will analyze each chain along several axes, looking for matches from link to link in categories like religion, occupation and highest level of education. By asking how participants know the person they choose to help reach the target, the researchers will also track the relationships between the links.

"We'll be able to look at which social dimension people are using," Dr. Watts said, "be it work, family, friendship."

By conducting the study online, the researchers are limiting participants to people with e-mail, but Dr. Watts said he did not think that was a problem. "E-mail is no longer the preserve of the tech elite," he said.

With their resulting chains, the project team hopes to have not only solid data about the structure of social networks, but also a model of naturally occurring, decentralized networks that can be applied to computer systems.

Peer-to-peer networks, in which there is no central server, like those networks using the file-sharing system Gnutella, often suffer from overload when too many users request one piece of data. Dr. Watts says he hopes that by deriving search algorithms from decentralized human networks that function smoothly, his team will be able to create useful models for solving the problems of congested computer networks.

Jon Kleinberg, an associate professor of computer science at Cornell University who has studied the applicability of the Milgram experiment to computer networks, believes the Columbia research could prove valuable to developers. "People seem to be very good at this task of using information they know to locate individuals they don't," he said. "If we could better understand what strategies they use, it could certainly be useful."

For now, the biggest hurdle is working with variables of human behavior. In pilot tests, the researchers found that many participants had not passed along the e-mail messages and that some simply deleted the messages without reading them.

Dr. Watts attributed some of the dropping out to what he called the "I-can-look-them-up mentality." The challenge, however, lies not in being able to find the target through publicly available records but in using only guesses about personal contacts to become part of a short chain.

"You don't know who your friends know," Dr. Watts said. "So if you don't know the target, whether you can find that path is not obvious. People think that with the Internet and phones, everyone is connected. But it's not necessarily easier today than it was in Milgram's day."