

The connected age and the small world problem

Social Networks (Soc 204)
Spring 2021
Princeton University

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Week 1, Lecture 2
Video 2/3: Small world



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Two times that people say this:

- ▶ See someone they know in an unexpected place

“Oh my goodness. It’s a small world!”

Two times that people say this:

- ▶ See someone they know in an unexpected place
- ▶ Meet someone and find out that they have an acquaintance in common

Let's think back to 1967



http://upload.wikimedia.org/wikipedia/commons/f/f5/1967_Ford_Fairlane_Ranchero.jpg



http://commons.wikimedia.org/wiki/File:Ericsson_Dialog_in_green.JPG



http://commons.wikimedia.org/wiki/File:Computer_in_County_of_Orange_offices,_1967.jpg

Fred Jones of Peoria, sitting in a sidewalk cafe in Tunis, and needing a light for his cigarette, asks the man at the next table for a match. They fall into conversation; the stranger is an Englishman who, it turns out, spent several months in Detroit studying the operation of an interchangeable-bottlecap-factory. "I know it's a foolish question" says Jones, "but did you ever by any chance run into a fella named Ben Arkadian? He's an old friend of mine, manages a chain of supermarkets in Detroit . . . "

"Arkadian, Arkadian" the Englishman mutters. "Why, upon my soul, I believe I do! Small chap, very energetic, raised merry hell with the factory over a shipment of defective bottlecaps." "No kidding!" Jones exclaims in amazement. "Good lord, it's a small world isn't it!"

Milgram (1967)

- ▶ What is the probability that two people chosen at random know each other?

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- ▶ What is the probability that two people chosen at random share a friend?
- ▶ Given two individuals selected randomly from the population, what is the probability that the minimum number of intermediaries required to link them is $0, 1, 2, \dots, k$?

Modeling approach (i.e., MIT approach)

vs.

Empirical approach (i.e., Harvard approach)



COMMUNICATIONS PROJECT

332 EMERSON HALL HARVARD UNIVERSITY CAMBRIDGE, MASSACHUSETTS 02138

We need your help in an unusual scientific study carried out at Harvard University. We are studying the nature of social contact in American society. Could you, as an active American, connect another American citizen regardless of his work affiliation? If the name of an American citizen were picked out of a hat, could you get to know that person using only your network of friends and acquaintances? Just how open is our "open society"? To answer these questions, which are very important to our research, we ask for your help.

You will notice that this letter has come to you from a friend. He has aided this study by sending this folder on to you. He hopes that you will aid the study by forwarding this folder to someone else. The name of the person who sent you this folder is listed on the Roster at the bottom of this sheet.

In the box to the right you will find the name and address of an American citizen who has agreed to serve as the "target person" in this study. The idea of the study is to transmit this folder to the target person using only a chain of friends and acquaintances.

<p>TARGET PERSON</p> <p>Sam G. Milner 35 Harold Street Somerville, Massachusetts</p> <p>Occupation: Investment Broker at McInerney & Co. 233 Congress Street Somerville, Mass.</p> <p>Harried: to the former owner of the former McInerney & Co. building from 1955-61; served in U.S. Air Force</p>

HOW TO TAKE PART IN THIS STUDY

1 ADD YOUR NAME TO THE ROSTER AT THE BOTTOM OF THIS SHEET, so that the next person who receives this letter will know who it came from.

2 DETACH ONE POSTCARD. FILL IT OUT AND RETURN IT TO HARVARD UNIVERSITY. No stamp is needed. The postcard is very important. It allows us to keep track of the progress of the folder as it moves toward the target person.

3 IF YOU KNOW THE TARGET PERSON ON A PERSONAL BASIS, MAIL THIS FOLDER DIRECTLY TO HIM (HER). Do this only if you have previously met the target person and know each other on a first name basis.

4 IF YOU DO NOT KNOW THE TARGET PERSON ON A PERSONAL BASIS, DO NOT TRY TO CONTACT HIM DIRECTLY. INSTEAD, MAIL THIS FOLDER (POST CARD AND ALL) TO A PERSONAL ACQUAINTANCE WHO IS MORE LIKELY THAN YOU TO KNOW THE TARGET PERSON. You may send the folder on to a friend, relative, or acquaintance, but it must be someone you know on a first name basis.

Remember, the aim is to move this folder toward the target person using only a chain of friends and acquaintances. On first thought you may feel you do not know anyone who is acquainted with the target person. This is natural, but at least you can start by moving in the right direction! Who among your acquaintances might conceivably move in the same social circles as the target person? The real challenge is to identify among your friends and acquaintances a person who can advance the folder toward the target person. It may take several steps beyond your friend to get to the target person, but what counts most is to start the folder on its way! The person who receives this folder will then repeat the process until the folder is received by the target person. May we ask you to begin!

Every person who participates in this study and returns the post card to us will receive a certificate of appreciation from the Communications Project. All participants are entitled to a report describing the results of the study.

Please transmit this folder within 24 hours. Your help is greatly appreciated.

Yours sincerely,
Stanley Milgram
Stanley Milgram, D.
Director, Communications Project

ROSTER

1. ALBERT GORER
2. LEO RICHARDSON
3. Stan Milgram
4. ALBERT GORER
5. SAM G. MILNER
- 6.
- 7.
- 8.
- 9.
- 10.
- 11.
- 12.

225 N.Y. 5

Business Reply Mail

No Postage Needed if Mailed in the United States

Postage will be paid by
Dr. Stanley Milgram
COMMUNICATIONS PROJECT

First Class
Permit
No. 38145
Cambridge
Mass.

This procedure is elegant.

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- ▶ provides a view of the big invisible social network of Americans

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- ▶ provides a view of the big invisible social network of Americans
- ▶ flexible in choice of starters and targets
- ▶ tracer cards provide data on incomplete chains (and demographics of participants)

Results

Result 1

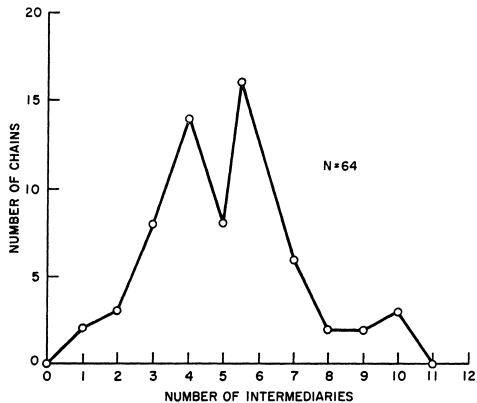


FIGURE 1

Lengths of Completed Chains

Mean number of intermediaries: 5.2

Result 1

- ▶ 1 intermediary = 2 “degrees of separation”

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- ▶ 5 intermediaries = 6 “degrees of separation”

Result 2

- ▶ Travers and Milgram: 29% of chains reached target

Result 2

- ▶ Travers and Milgram: 29% of chains reached target
- ▶ Kleinfeld: 71% of chains did not reach target

Result 2

- ▶ Travers and Milgram: 29% of chains reached target
- ▶ Kleinfeld: 71% of chains did not reach target

Be careful as you read.

Result 3

Means	
Starting Population	Mean Chain Length
Nebraska Random	5.7
Nebraska Stockholders	5.4
All Nebraska	5.5
Boston Random	4.4
All	5.2

Result 4

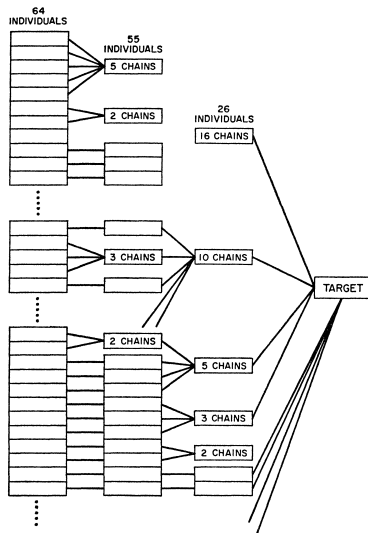


FIGURE 3

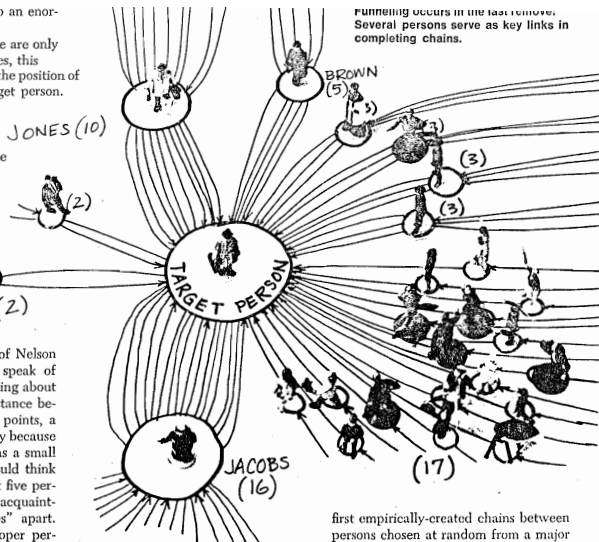
Common Paths Appear as Chains Converge on the Target

Result 4

arch extends to an enormous number of persons. If we state there are only a few acquaintances, this is a function of the position of the person and the target person.

The degree measure of the diffusion of information in different frames of reference shows that two persons are not directly acquainted, they are connected. Almost everywhere in the United States is a person who has been in contact with the target person.

If a person is removed from the network, the network does not, in any sense, break apart. This is in contrast with that of Nelson and others, when we speak of the network as being a psychological distance between the target person and the target points, a network is small only because we regard "five" as a small number. We should think of it as being not five persons but five "structures" apart. Let it be in its proper perspective.



first empirically-created chains between persons chosen at random from a major

Funneling, will be the subject of future work

This is just one of many possible small world experiments. Milgram choose to do others. Let's see what he did. . .