

TRENDING[Artemis III crew revealed](#)[Italian teenagers find Roman villa](#)[Feynman's restaurant proble](#)[Physics & Mathematics](#) > [Mathematics](#)

The 'friendship paradox' doesn't always explain real friendships, mathematicians say

The paradox says that on average, your friends have more friends than you do.

BY [YASEMIN SAPLAKOGLU](#) PUBLISHED 11 JUNE 2021 IN [NEWS](#)



(Image credit: Shutterstock)



Your friends are on average more popular than you are, according to a phenomenon known as the "friendship paradox." Now, a group of mathematicians has come up with a new theory that takes the friendship paradox beyond averages, and they found that their equations describe real-world popularity differences among friends.

Sociologist Scott Feld first explained the idea of the "friendship paradox" in 1991 in a journal article titled "Why Your Friends Have More Friends Than You Do." The general idea — based on a simple calculation — is that the number of friends of a person's friends is, on average, greater than the number of friends of that individual person.

But "averages are often highly misleading or at least can fail to describe people's experiences," said lead author George Cantwell, a postdoctoral fellow at the Santa Fe Institute in New Mexico. "Some people are less popular than their friends, others are more so."

Related: [Images: The world's most beautiful equations](#)

To understand why, think about a person with just two friends contrasted with a person who has hundreds of friends. Now imagine entering this social bubble: You are more likely to be friends with the social butterfly than the wallflower, simply because there are more "chances" that you are one of the hundreds of the social butterfly's friends than one of the wallflower's two best buds. But it's still possible for you to become friends with the wallflower, and focusing on averages can obscure when that might happen.

YOU MAY LIKE

Stephen Hawking's black hole paradox could be solved — if the universe has 7 dimensions

Richard Feynman's forgotten notes on 'the restaurant problem' finally deciphered

Physicists find possible errors in 100-year-old model of the universe

Now, Cantwell and his colleagues have developed new mathematical equations to make the friendship paradox better match the range of situations found in real social networks. They based their equations on two assumptions from real-world studies: There's a significant degree of variation in how many friends people have, depending on the social network

analyzed; and popular people are more likely to have popular friends, whereas unpopular people are more likely to have unpopular friends.

The researchers also developed a new mathematical theory to explain another variation of the friendship paradox known as the "generalized friendship paradox," which states that, on average, your friends are not only more popular than you but also richer and better looking. That's based on the assumption that popular people are more likely to be rich and good looking than unpopular people.

Sign up for the Live Science daily newsletter now

Get the world's most fascinating discoveries delivered straight to your inbox.

SIGN ME UP

- ☐ Contact me with news and offers from other Future brands
- ☐ Receive email from us on behalf of our trusted partners or sponsors

By submitting your information you agree to the [Terms & Conditions](#) and [Privacy Policy](#) and are aged 16 or over.

Their new equations, which accounted for these assumptions, could explain 95% of the variance in real-world situations, Cantwell told Live Science in an email.

Their equations show that the friendship paradox tends to be stronger in social networks that are made up of people with very different popularities. If a person with only two friends is in the same social network as a person with 100 friends, for example, in general, the friendship paradox will be stronger in that network than one where the most social person in a network has 10 friends and the least "friended" has three.

The takeaway is that "our social circles are biased samples of the population." It's not exactly clear how that bias may play out in specific cases, but in most cases "it's probably not appropriate to compare ourselves to our friends," Cantwell said.

'If astrological compatibility exists, its effects should be observable': How one study of 20 million people shows star signs have no influence on romantic compatibility

'The chances of you living 50 years are very small': Theoretical physicist explains why humanity likely won't survive to see all the forces unified

New tweak to Einstein's relativity could transform our understanding of the Big Bang

Such mathematical equations can help to explain other aspects in society such as election polling and infectious disease spread. "There are several interesting things to explore next," Cantwell said. Some studies have shown that election polling can be improved by asking about people's "social circles," but the findings are observed and haven't mathematically been calculated, he said.

In addition, the people who you are in close physical contact with are statistically more likely to be in such close physical contact with many other people. So the friendship paradox equations could also help shed light on the spread of an infectious disease. For instance, the friendship paradox has been used in flu surveillance to detect outbreaks on average two weeks earlier than traditional surveillance methods, according to a 2010 study in the journal [PLOS One](#).

"How, exactly, does this affect the dynamics of disease?" he asked.

The findings were published on May 27 in the [Journal of Complex Networks](#).

Originally published on Live Science.

Yasemin Saplakoglu Staff Writer



RELATED CONTENT

- [The 11 most beautiful mathematical equations](#)
 - [Photos: large numbers that define the universe](#)
 - [13 numbers that rival the number 13](#)
-

Yasemin is a staff writer at Live Science, covering health, neuroscience and biology. Her work has appeared in Scientific American, Science and the San Jose Mercury News. She has a bachelor's degree in biomedical engineering from the University of Connecticut and a graduate certificate in science communication from the University of California, Santa Cruz.

READ MORE

BLACK HOLES

Stephen Hawking's black hole paradox could be solved — if the universe has 7 dimensions

PHYSICS & MATHEMATICS

Richard Feynman's forgotten notes on 'the restaurant problem' finally deciphered

COSMOLOGY

Physicists find possible errors in 100-year-old model of the universe

HUMAN BEHAVIOR

'If astrological compatibility exists, its effects should be observable': How one study of 20 million people shows star signs have no influence on romantic compatibility

LATEST IN MATHEMATICS

MATHEMATICS

How likely are you to find a message in a bottle?

MATHEMATICS

Pi has been calculated to trillions of digits — is that completely irrational?

MATHEMATICS

AI just verified a proof that earned one of math's most prestigious prizes. Math will never be the same

MATHEMATICS

'Proof by intimidation': AI is confidently solving 'impossible' math problems. But can it convince the world's top mathematicians?

LATEST IN NEWS

WHALES

Scientists discover 5 million-year-old whale graveyard stretching for hundreds of miles in the Indian Ocean

CANCER

Scientists were excited about a blood test for many cancers — but it failed a big trial. Here's what to know.

HEALTH

Artificial turf contains 400 chemicals tied to cancer and hormone disruption. But is it unsafe?

QUANTUM COMPUTING

In a first, scientists translated an entire viral genome so a quantum computer could read and analyze it

USEFUL LINKS

FEED YOUR CURIOSITY

[Life's Little Mysteries](#)

[Earth from space](#)

[Diagnostic dilemmas](#)

[Astonishing artifacts](#)

GROW YOUR KNOWLEDGE

[Jaw-dropping James Webb Space Telescope images](#)

[Amazing women in science and math](#)

[Explore the periodic table of elements](#)

[Uncanny facial reconstructions from history](#)

SCIENCE IN YOUR LIFE

[Science quizzes and games](#)

[Beginner's guide to wildlife photography](#)

[The best telescopes for spotting stars and planets](#)

[Mind-blowing science facts](#)

LIVE

Live Science is part of Future US Inc, an international media group and leading digital publisher. **Visit our corporate site.**

[Accessibility
Statement](#)

[Terms And
Conditions](#)

[Advertise With Us](#)

[Contact Future's
Experts](#)

[Privacy Policy](#)

[Web Notifications](#)

[About Us](#)

[Cookies Policy](#)

[Careers](#)

[Editorial Standards](#)

[How To Pitch A Story
To Us](#)

[Do Not Sell Or Share
My Personal
Information](#)

© Future US, Inc. Full 7th Floor, 130 West 42nd Street, New York, NY 10036.