Class 15: Complex contagion

Matthew J. Salganik

Sociology 204: Social Networks
Princeton University

1/2 Simple and complex contagion

Greensboro Four (L-R: David McNeil, Franklin McCain, Ezell Blair, Joseph McNeil)

https://en.wikipedia.org/wiki/Greensboro_sit-ins#/media/File:Greensboro_Four,_Feb_1960.jpg

Distinguish between:

- spread of information and disease
- spread of behavior, especially high-risk activism

Two interrelated themes:

- How do things spread?
- What does this network look like?

Centola work builds on a lot of the things we read before spring break. I hope you could see that.

1995), and the coordination of collective action (Macy 1990). As Granovetter puts it (1973, p. 1366), "whatever is to be diffused can reach a larger number of people, and traverse a greater social distance, when passed through weak ties rather than strong." This insight has become one of the most widely cited and influential contributions of sociology to the advancement of knowledge across many disciplines, from epidemiology to computer science.

What are the scope conditions for this claim?

- simple contagion: 1 source of contact may enable activation

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- complex contagion: 2 or more sources of contact needed for activation

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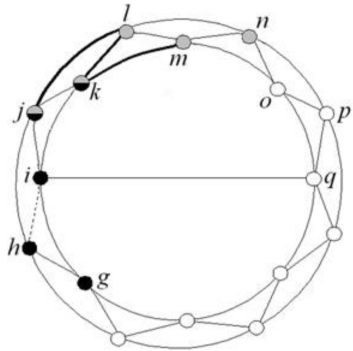
- complex contagion: 2 or more sources of contact needed for activation (behavior)

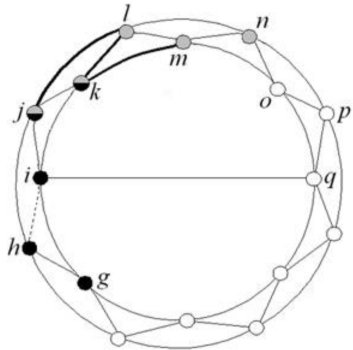
Threshold model $\tau = \frac{a}{z}$ where

- τ is the threshold
- a is the number of activated neighbors
- z is the degree

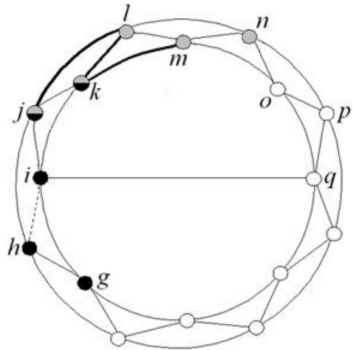
$\tau = \frac{1}{8}$ is different from $\tau = \frac{6}{48}$



- Simple contagion: l and m are sick,



- Simple contagion: *l* and *m* are sick, which infects *k*



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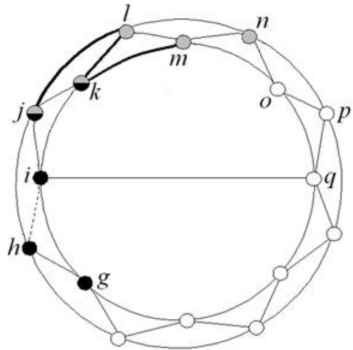

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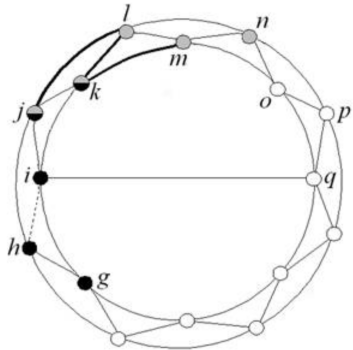

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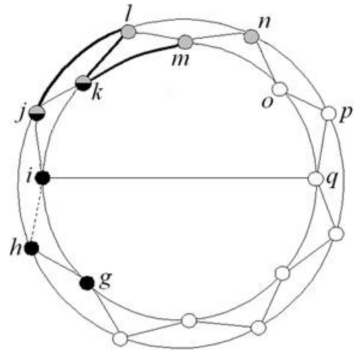

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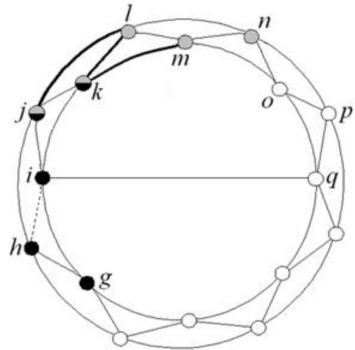

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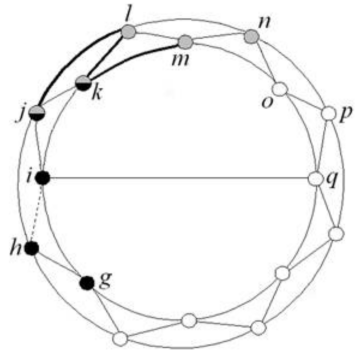

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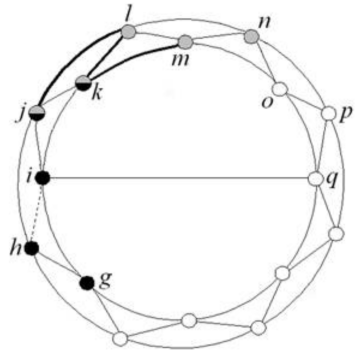

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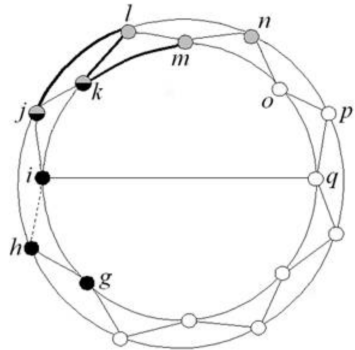

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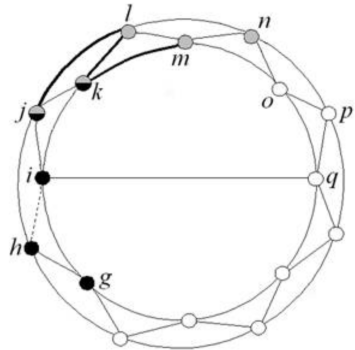

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- Shortcuts that help with simple contagion cab block complex contagion

Granovetter talks about bridge *length*

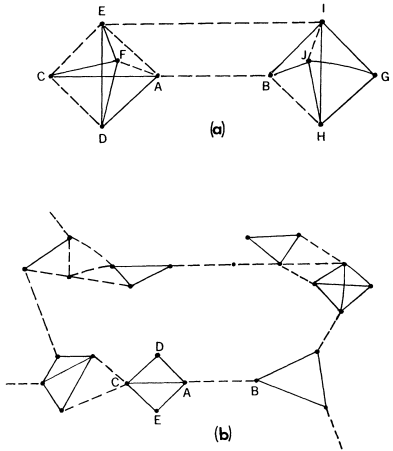
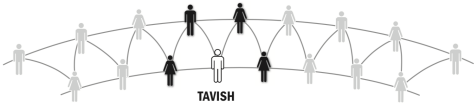


FIG. 2.—Local bridges. *a*, Degree 3; *b*, Degree 13. ——— = strong tie; — — — = weak tie.

Centola talks about bridge *width*



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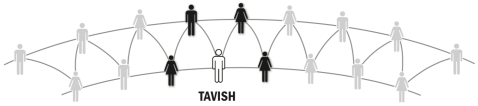

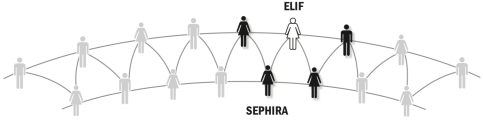

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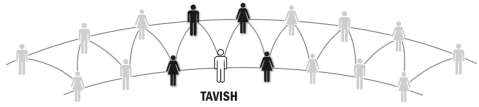

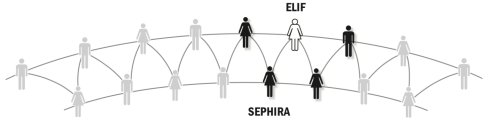

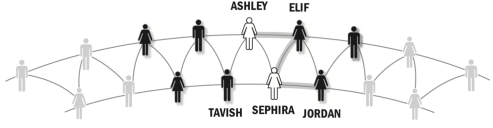

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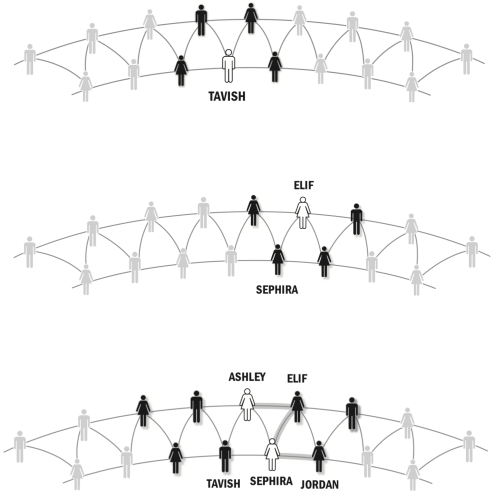

Ties between Tavish's neighborhood and Elif's neighborhood: 3 (bridge width)

Centola (2018)

Creating shortcuts can hurt complex contagion if it breaks local redundancy

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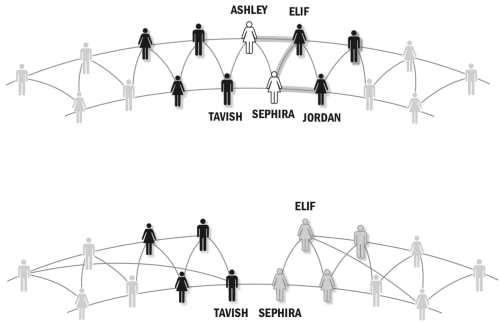


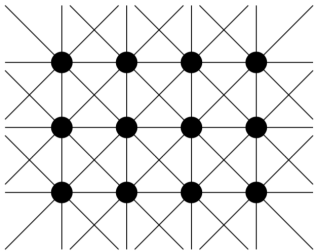
Ties between Tavish's neighborhood and Elif's neighborhood: 1 (bridge width)

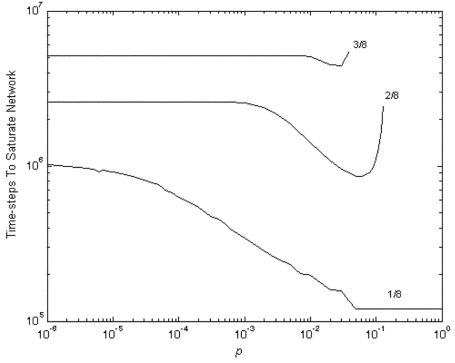
Centola (2018)

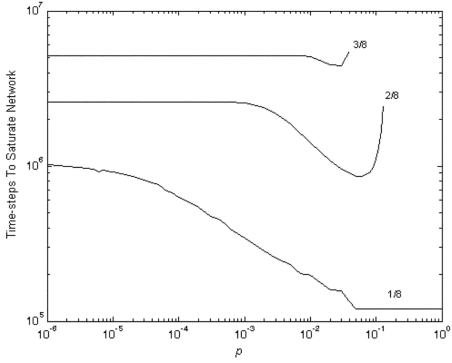
Next step:

- Move from Ring lattice to two-dimensional lattice with Moore neighborhoods
- Requires switch from analytic results to simulation.

Here's an example of a two-dimensional lattice with Moore neighborhoods




Time-steps To Saturate Network
p
3/8
2/8
1/8
10^7
10^6
10^5
10^-6
10^-5
10^-4
10^-3
10^-2
10^-1
10^0



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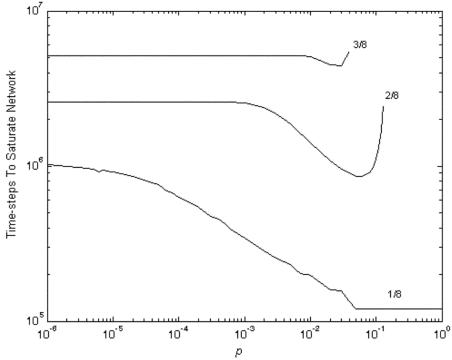

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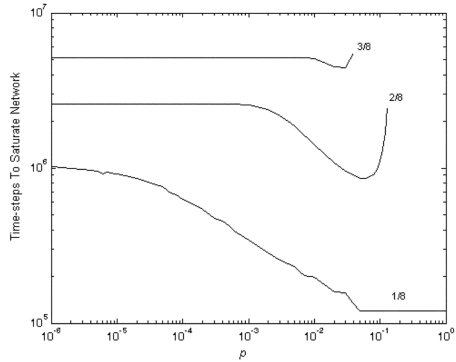

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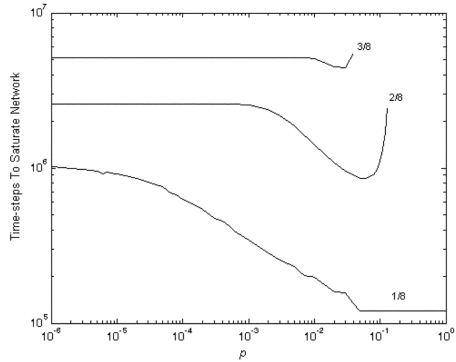

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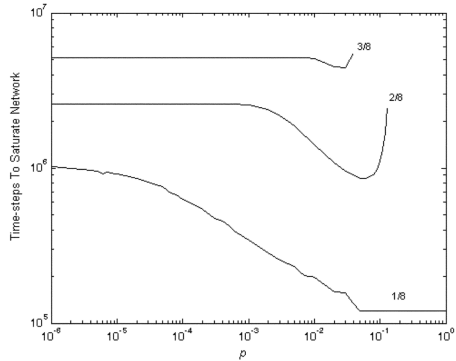

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Notice a research strategy of "replicate and extend"

Robustness results

- threshold heterogeneity
- heterogeneity of influence
- strong and weak ties
- heterogeneity of degree

Results in Centola and Macy are based on simple models, could something like this really happen?