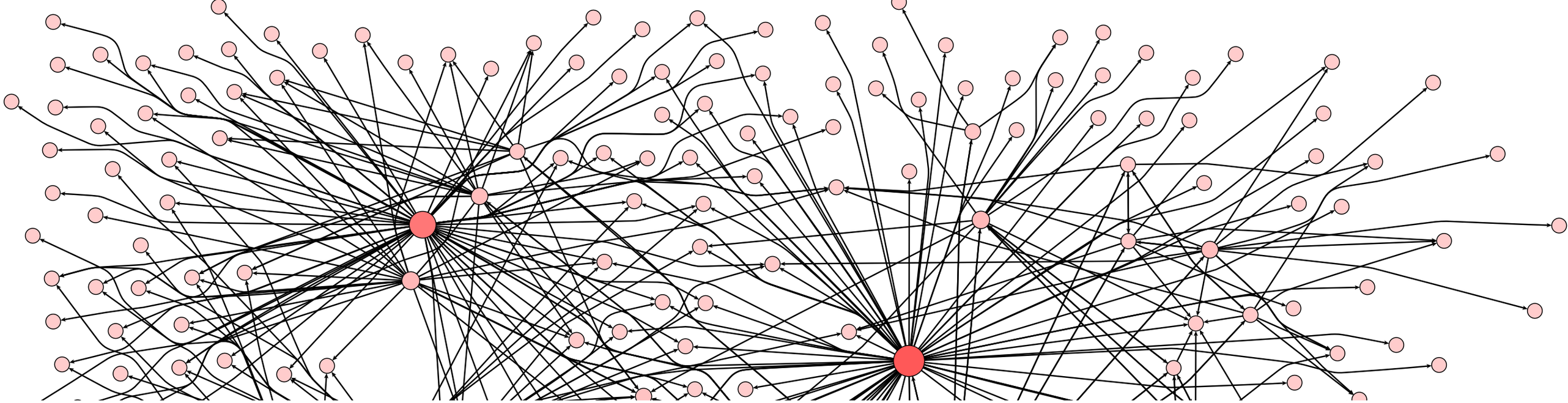
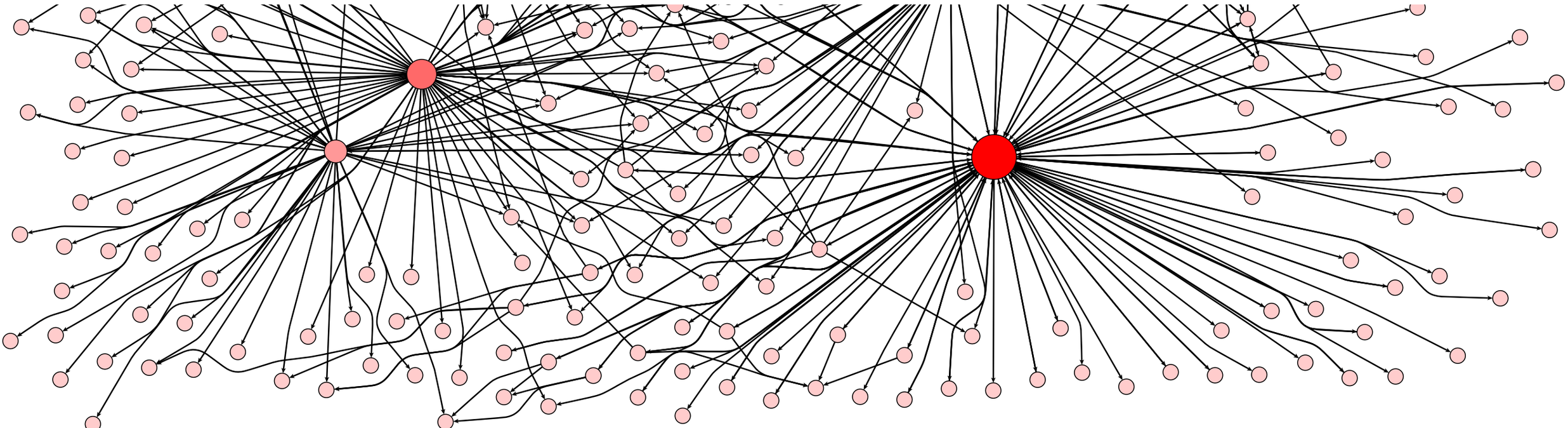
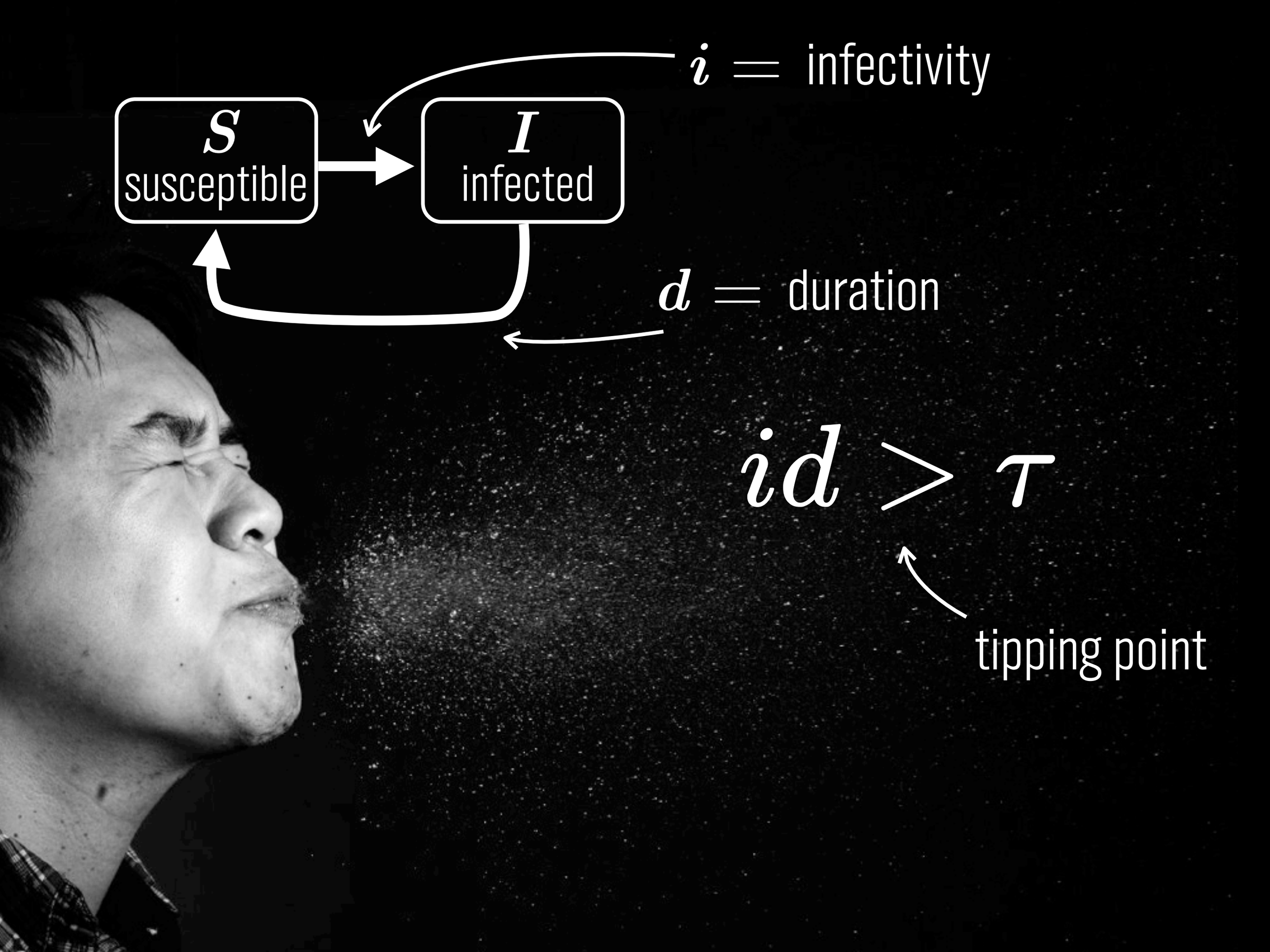
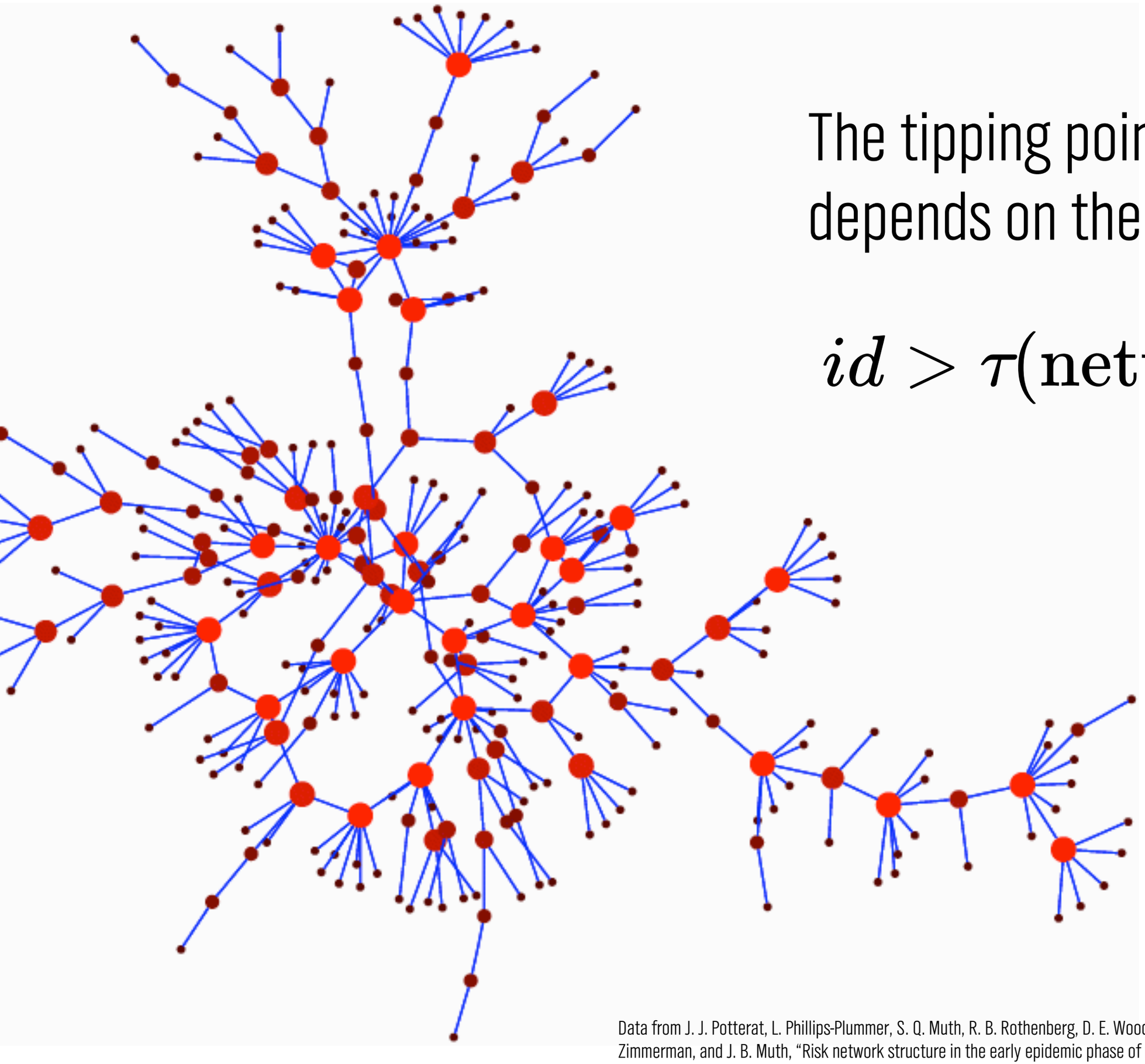


Modeling Network Diffusion: From Pathogens to Products

PJ Lamberson
Kellogg School of Management and NICO




$i =$ infectivity
S
susceptible
I
infected
$d =$ duration
$id > \tau$
tipping point

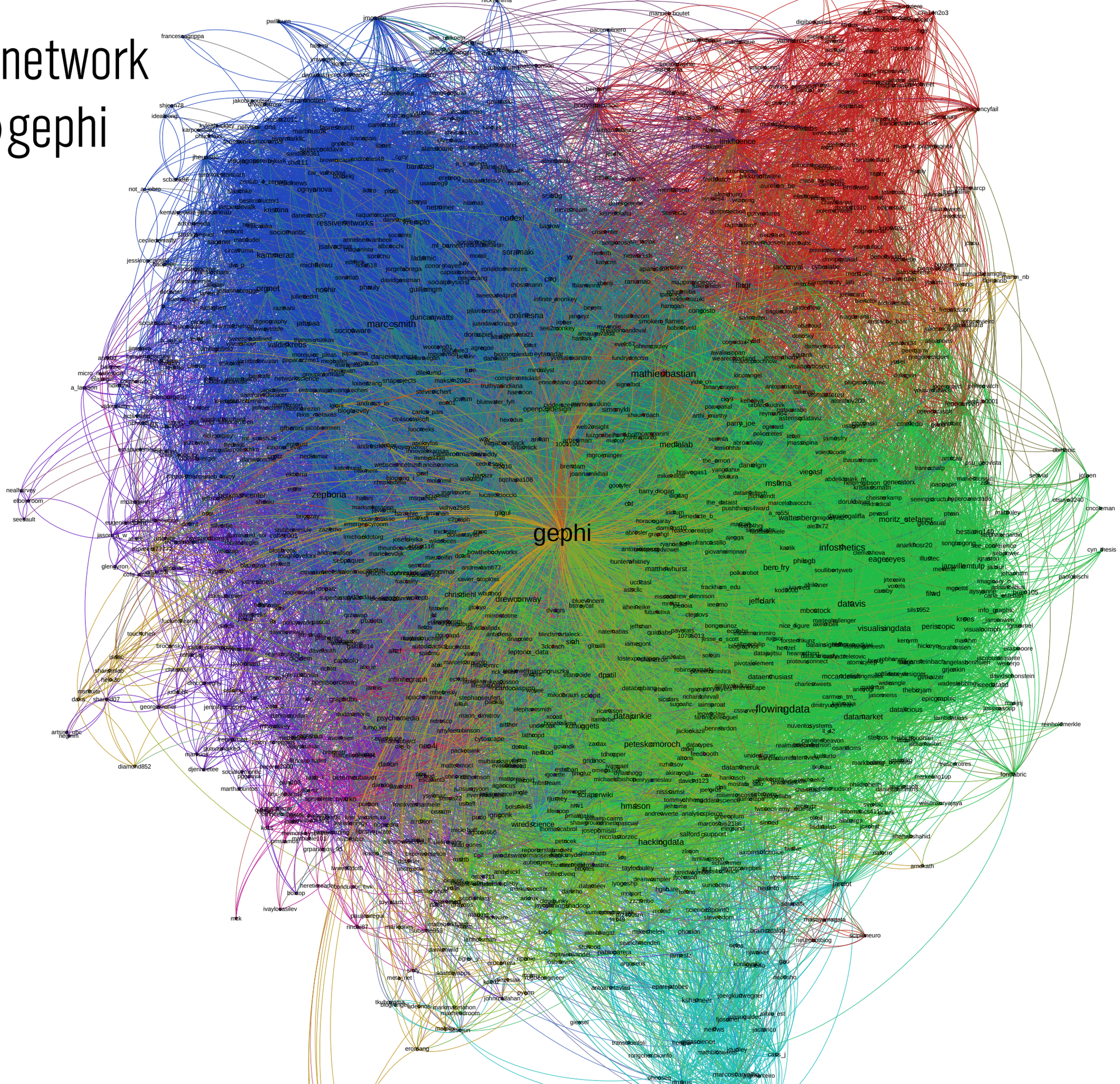


The tipping point
depends on the network

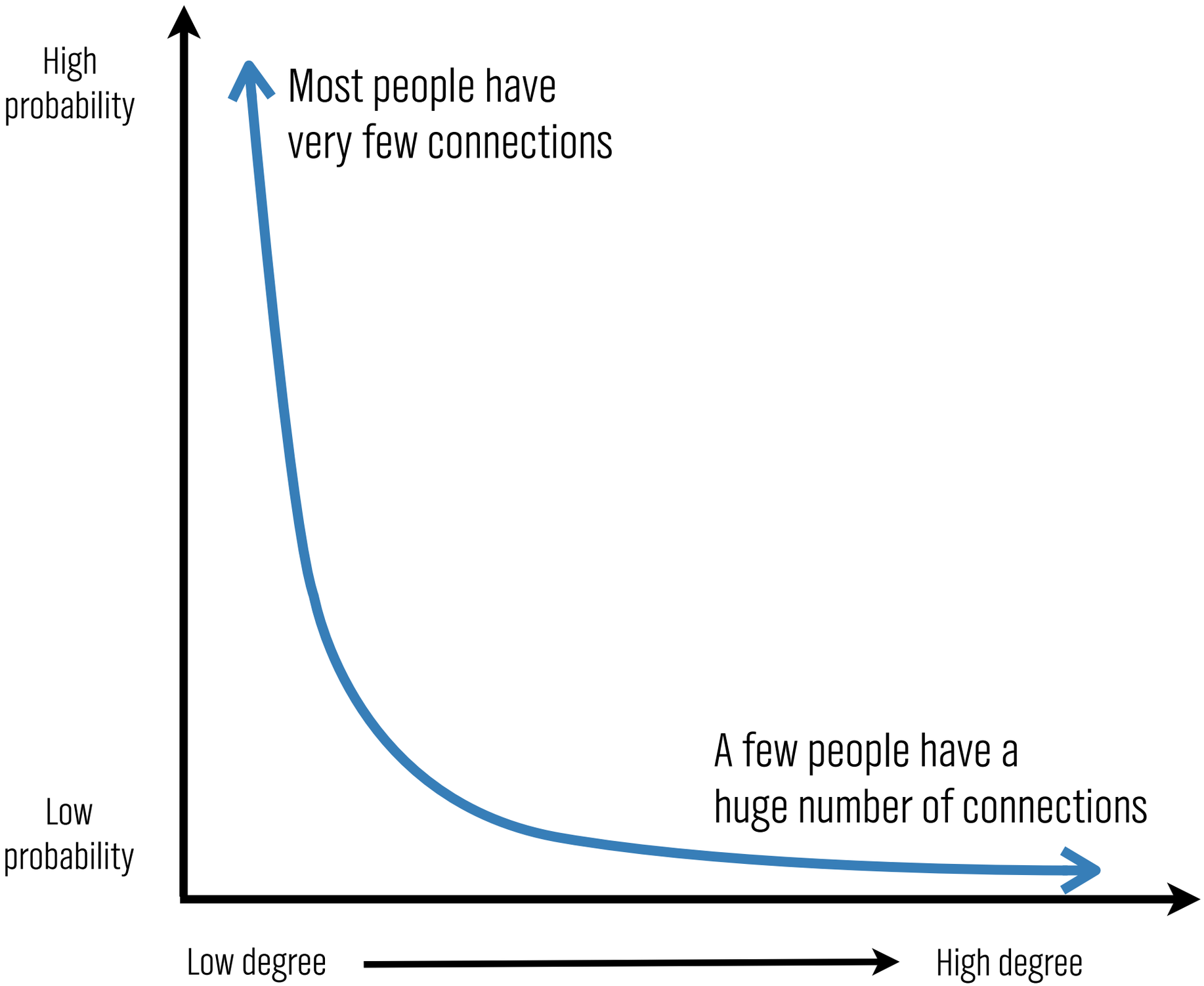
$$id > \tau(\text{network})$$

Data from J. J. Potterat, L. Phillips-Plummer, S. Q. Muth, R. B. Rothenberg, D. E. Woodhouse, T. S. Maldonado-Long, H. P. Zimmerman, and J. B. Muth, “Risk network structure in the early epidemic phase of HIV transmission in Colorado Springs,” Sexually Transmitted Infections, 78 (2002), pp. i159-i163.
http://www-personal.umich.edu/~mejn/networks/

Twitter network of @gephi


gephi
marcosmith
mathieubastian
medialab
onlinesna
nodexl
sorayaki
ressivenetworks
kammerait
orgnet
valdiskrebs
zephoria
duncanjwatts
socioaware
openp2pdesign
linkfluence
jacomyal
flingr
datavis
visualisingdata
infosthetics
flowingdata
datajunkie
datamarket
drewconway
christliehl
peteskomoroch
hmason
wiredscience
hackingdata
infinitegraph
psychemedia
neo4j
kdnuggets
barabasi
netminer
bodyspacesuit
mstrama
viegasf
moritz_stefaner
eagereyes
bento_fry
jeffclark
genecatorx
perisscopic
fontfabric
jacomot
scipyneuro
braincatalog
neurobotblog
bio4j
digitalwanderer
jamesslz
pablobareja
antoanetavlad
pyeom
johnrcallahan
tkuhlgama
giessel
matthewhurst
hunterwhitney
xavier_otoploss
andrewlamb77
semotic
mauicelfin
howthebodyworks
andrewcallsop
setpaquet
timchadwick
theunbounded
marielevijk
josefolerka
wildbees
thuggiloveforix
blossbrook
stubbornmule
coffee001
jasonfry
glenmyron
flygutwo
blazezaz
pinkkett
cofa_ambient
jamesconrad
ivaylovasilev
mek
rinchus87
paulsaregui
tsubame953
marcjones
mariaburkhalter
jamesmahon
mrmarkmahon
meanlab
seosiun
eromang
tkuhgama
blogmarkmahon
jadewards
jmark

Scale Free Networks



My Facebook network

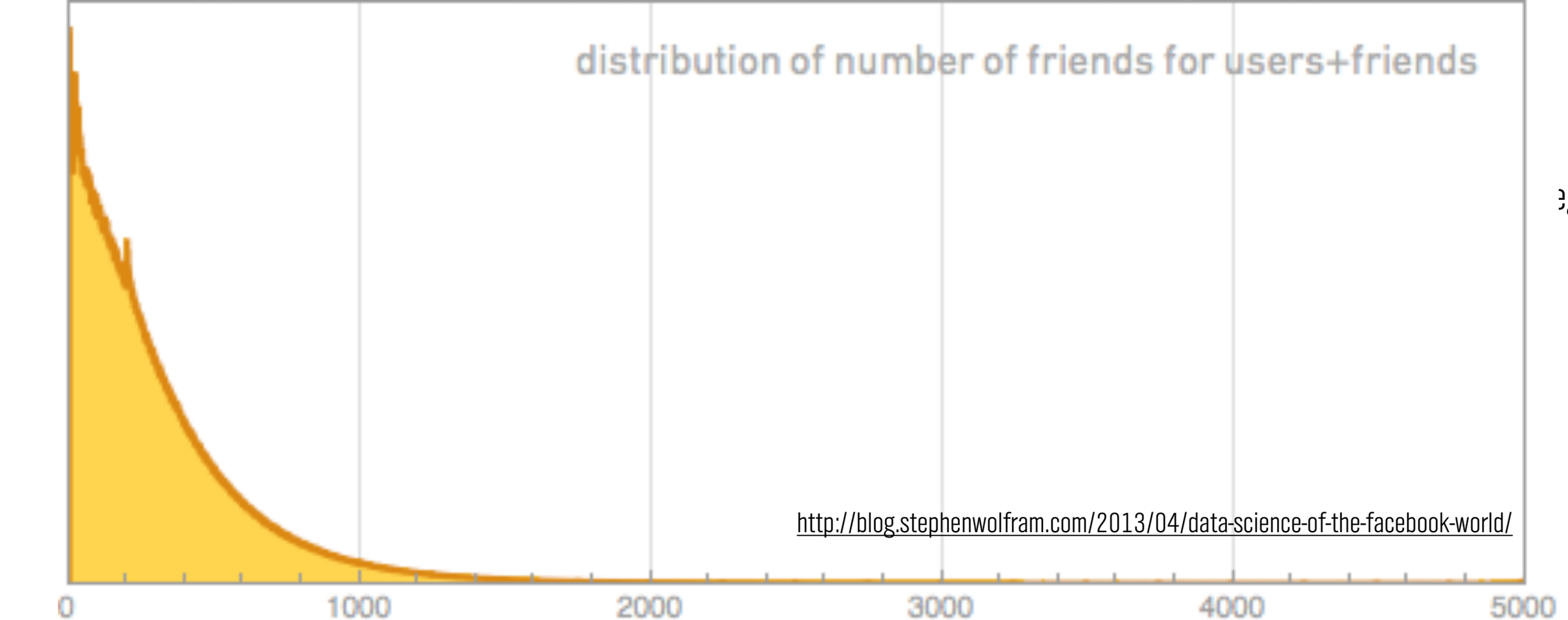
non-band high school friends

cycling friends

younger high school kids

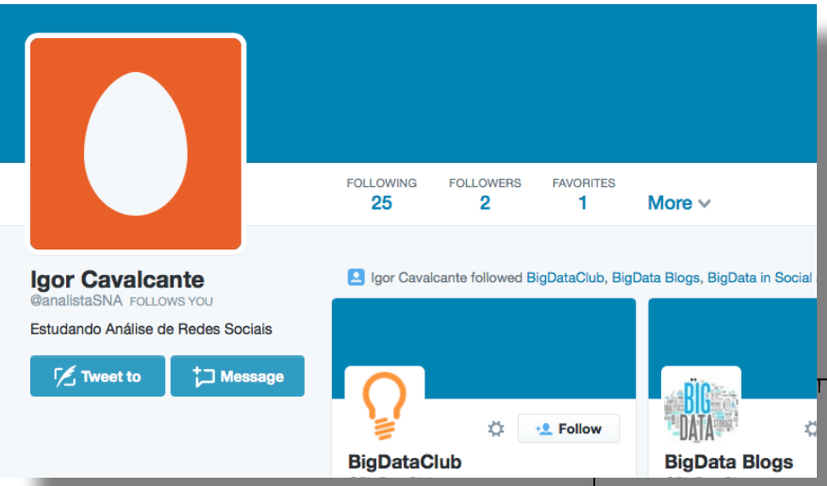
NICO

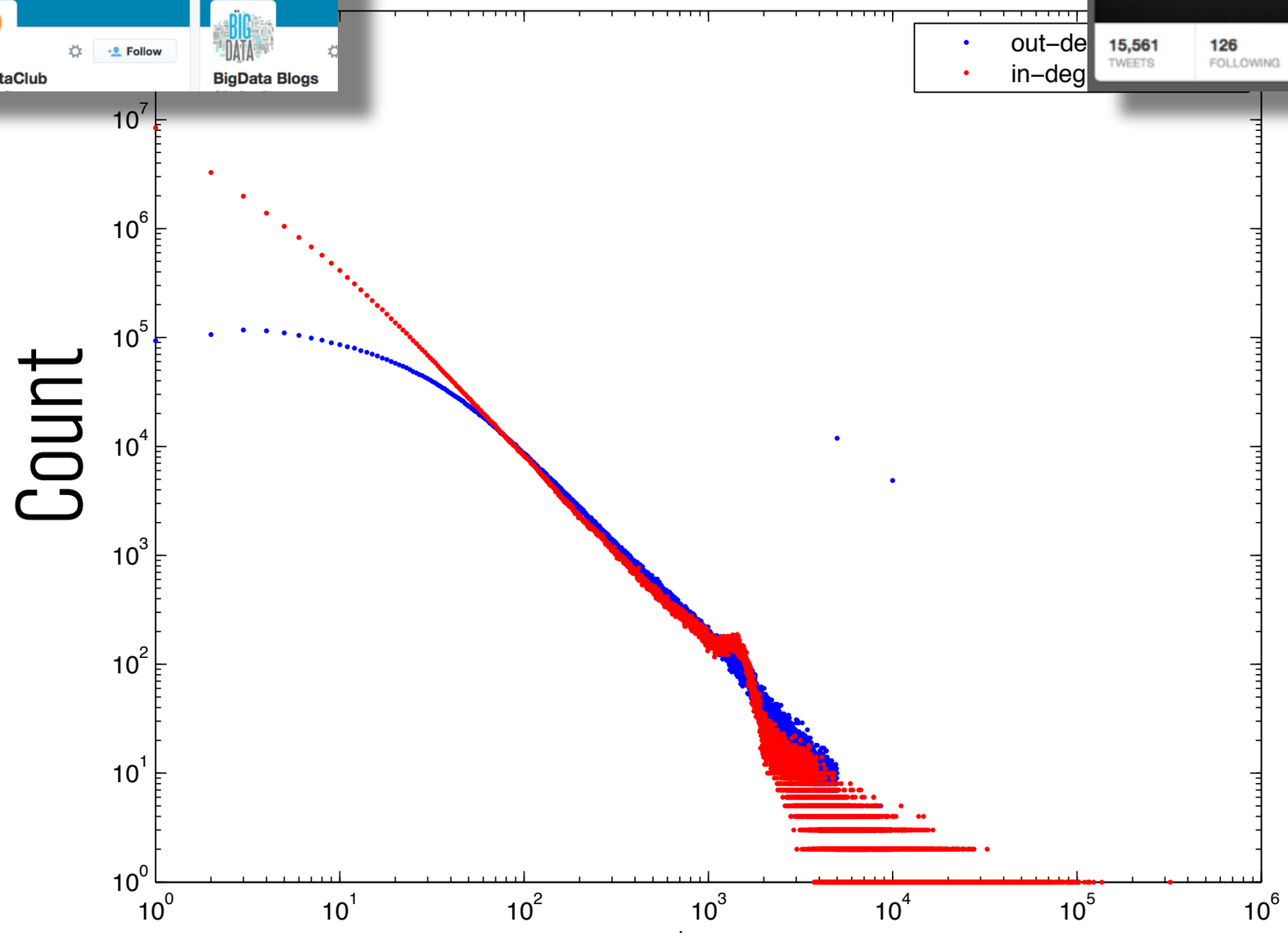
Rogers Park neighbors



http://blog.stephenwolfram.com/2013/04/data-science-of-the-facebook-world/

Twitter Degree Distribution

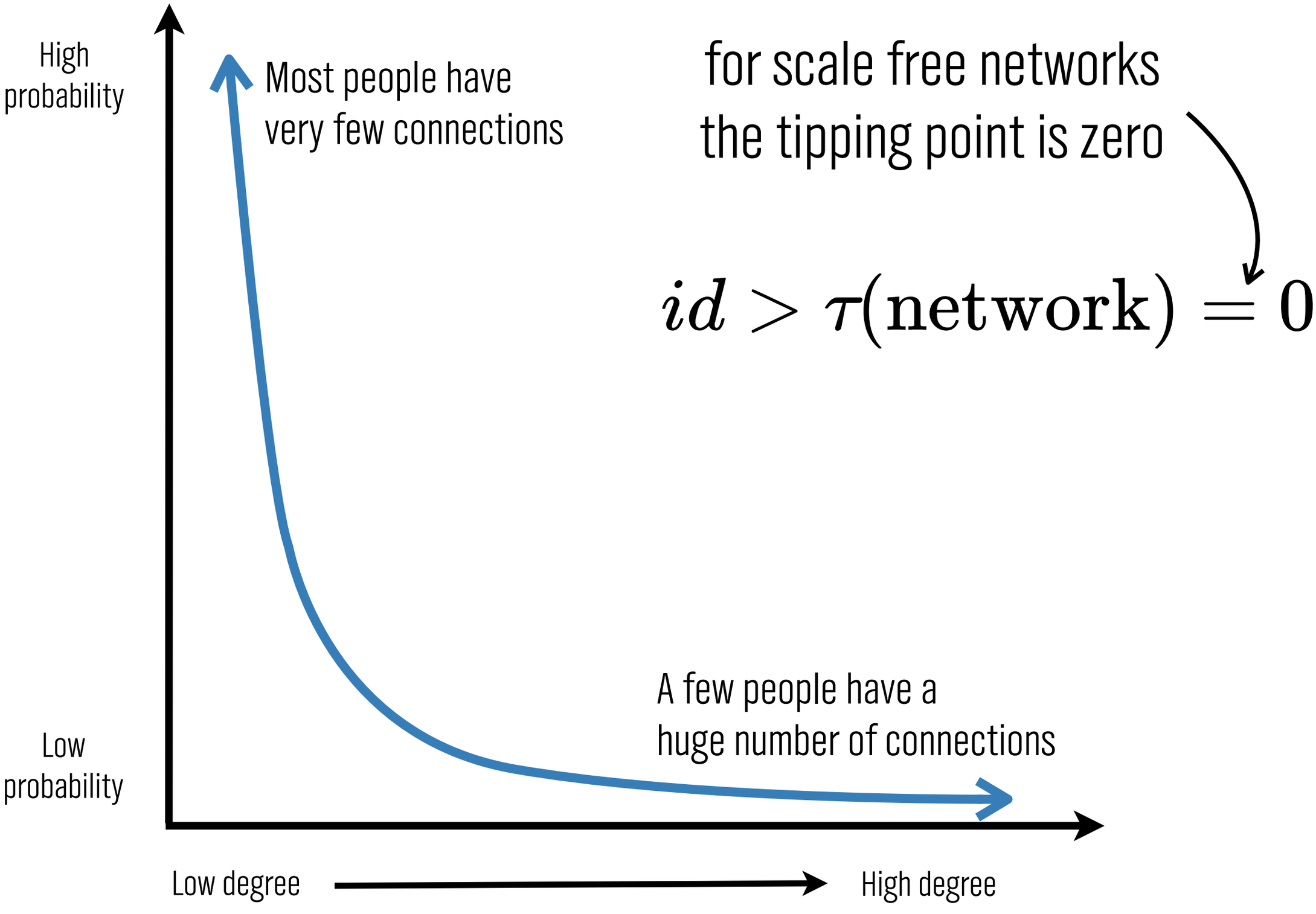




(from crawl of 25m nodes)

http://jakehofman.com/talks/hadoopworld_20091002.pdf

Scale Free Networks

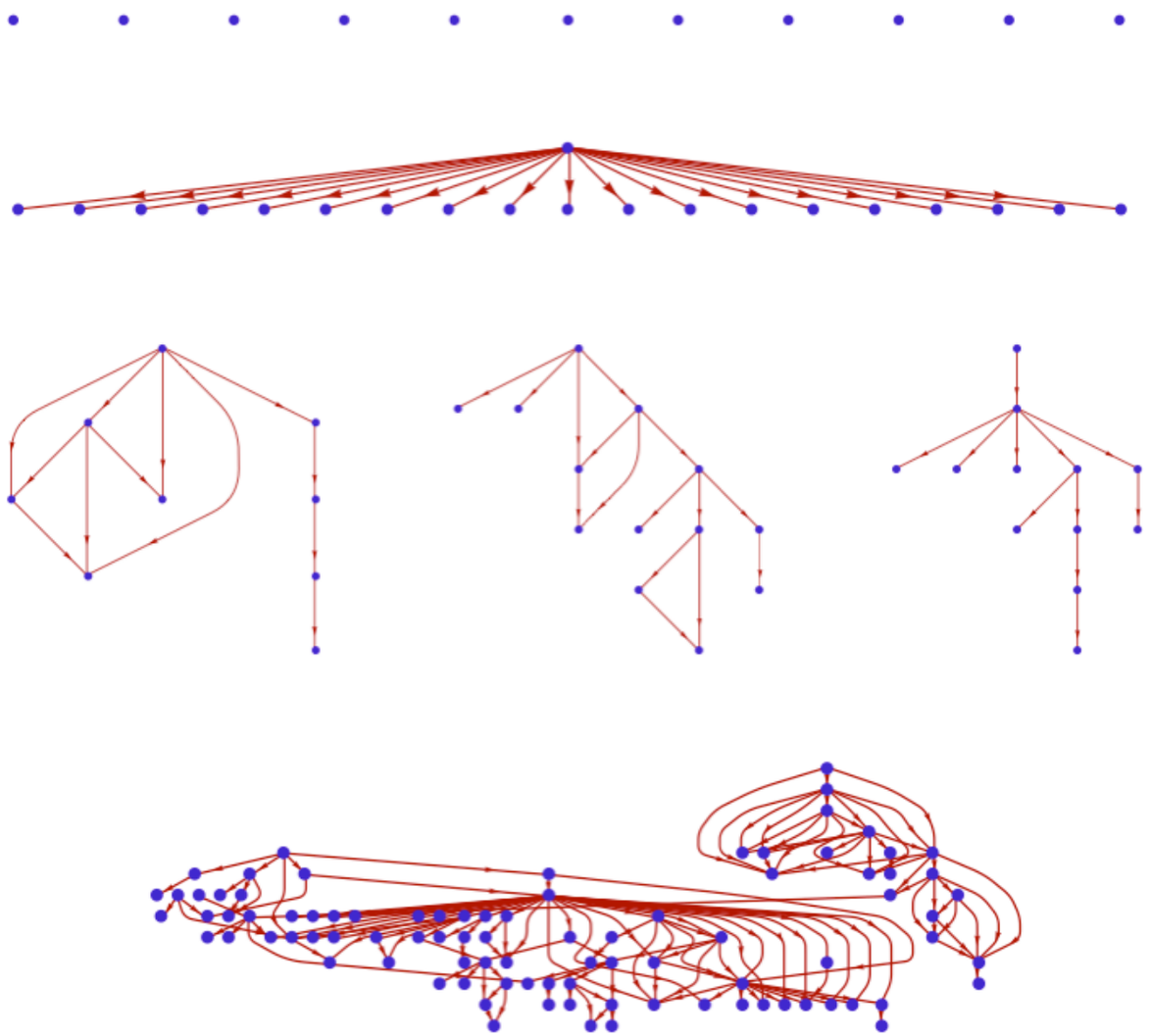


for scale free networks
the tipping point is zero

$$id > \tau(\text{network}) = 0$$

Twitter Cascades

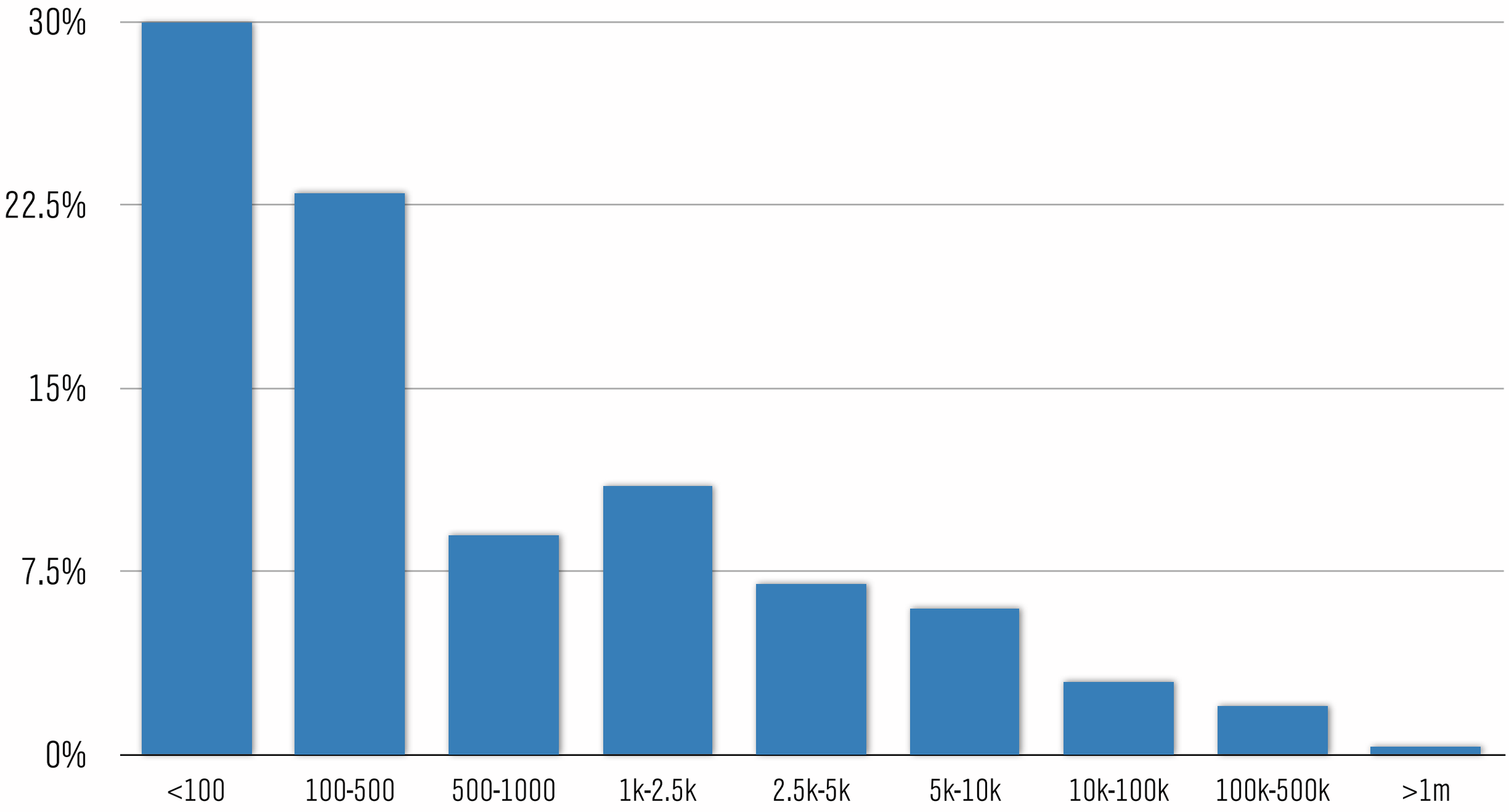
74 million chains initiated by more than 1.6 million users during two months in 2009



98% of URLs were never reposted

Bakshy et al. 2011

YouTube Views

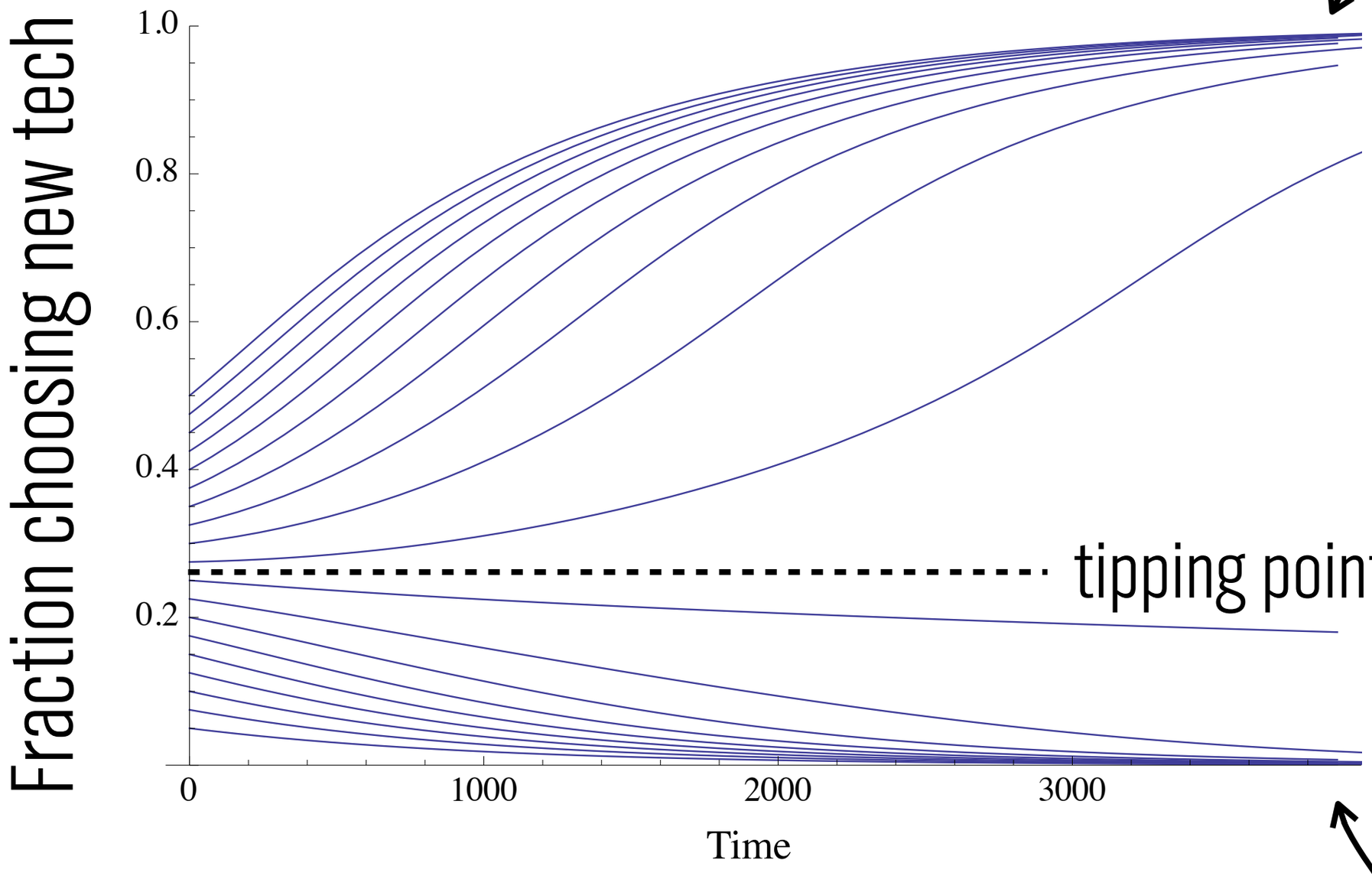


Threshold Model

Adopt once threshold number of friends adopt

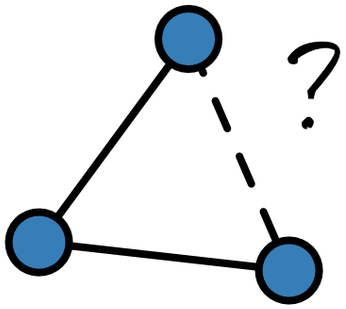
Threshold Model

everyone chooses new tech

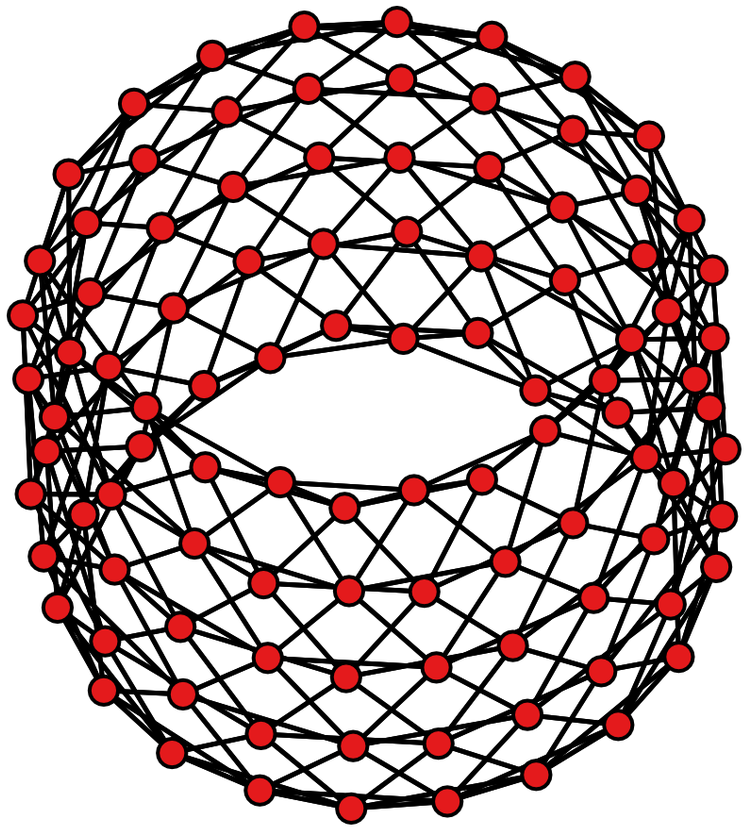


tipping point (critical mass)

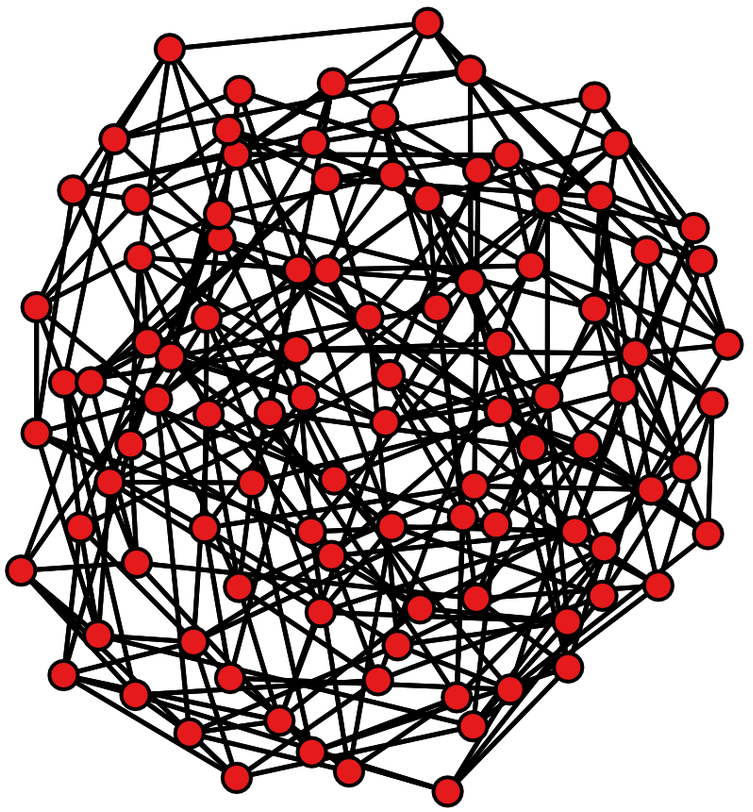
everyone chooses status quo



clustering coefficient: the probability two people with a mutual friend are friends with each other



clustering: .4

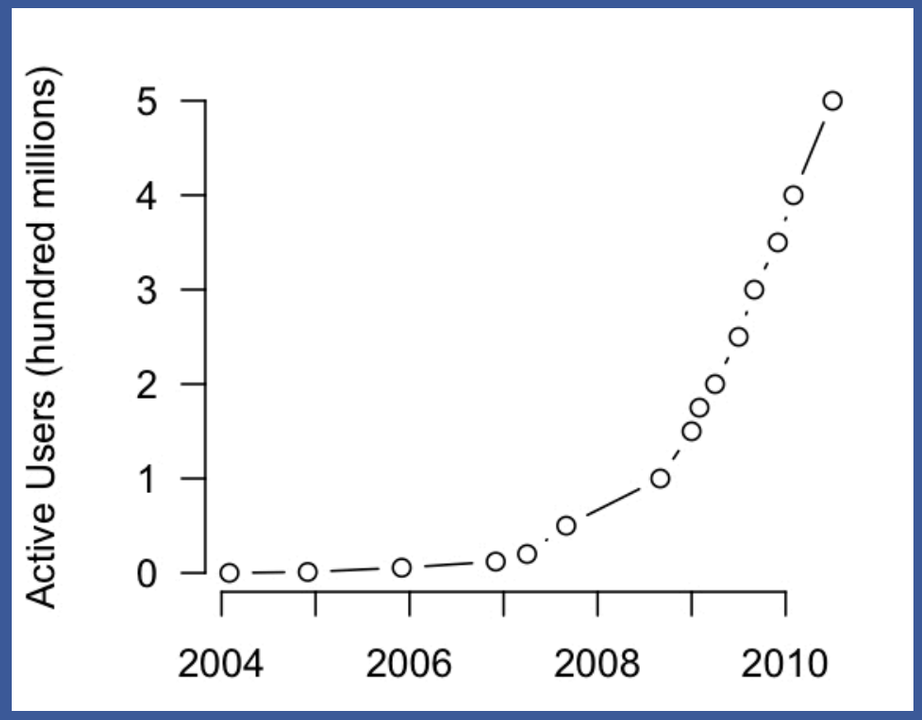


clustering: .0375

Increased clustering makes the critical mass lower for the better technology

"Once the exclusive online stomping grounds of college students, social networking site Facebook.com is throwing open the doors to rest of the world.

The growth move is fraught with risk for the company, whose more than 9.3 million registered users are intensely attached to the site because it lets them connect to a select group of peers. ... the company risks being viewed as a second-rate version of MySpace, the famously open social network that now receives more than 46 million visitors per month."



Forbes.com 9/11/06

http://www.forbes.com/2006/09/11/facebook-opens-up-cx_rr_0911facebook.html