# Incentives and Collective Behavior

**Networked Life**
**NETS 112**
**Fall 2015**
**Prof. Michael Kearns**

# So Far We Have…

- Examined a *wide* variety of network types and specifics…
  - types: content, technological, social, physical, etc.
  - specifics: the web, Kevin Bacon graph, nervous system, etc.
- …but a rather *limited* variety of *processes* on networks
  - navigation: forwarding letters or messages
  - contagion: spread of disease, memes, content
  - search: finding relevant pages on the web
  - have primarily examined relatively *passive* activities
- In reality, many kinds of activities in (human) networks are:
  - based on *preferences, desires and goals*
  - involve direct or indirect *interaction* with others
  - entail *interdependent* behaviors
- Broadly speaking, we are entering the domains of
  - social science
  - psychology
  - economics and game theory

# Examples from Schelling

- Going to the beach or not
  - too few → you'll go, making it more crowded
  - too many → you won't go, or will leave if you're there
- Rubbernecking at a traffic accident
  - causes long delays
  - but once you've "paid", feel entitled to slow down and look
- Sending holiday cards
  - people send to those they expect will send to them
  - everybody hates it, but no individual can break the cycle
- Choosing where to sit this auditorium?

Seating Survey
Networked Life
CIS 112
Prof Michael Kearns
Spring 2009

Your Name:

Use the following two questions to describe approximately where you are sitting right now in the Levine Auditorium.

Check the single item below that best describes where you are you sitting:

\_\_\_ In one of the first three rows

\_\_\_ In the first 1/3 of the rows

\_\_\_ In the middle 1/3 of the rows

\_\_\_ In the last 1/3 of the rows

\_\_\_ In one of the last three rows

Now check the single item that best describes your left-right position. Use left and right as you face the stage of the auditorium.

\_\_\_ In the leftmost 1/3 of the seats

\_\_\_ In the middle 1/3 of the seats

\_\_\_ In the rightmost 1/3 of the seats

Do you sit in this same seat, or one very nearby, for just about every NW Life class?

\_\_\_ Yes

\_\_\_ No

Briefly describe how you generally go about choosing a seat when entering an auditorium, movie, play etc. Assume that when you enter there may already be people sitting, so your decision about where to sit may (or may not) be influenced by the pattern of those already sitting.

# Seating Survey 2009

- 67% sit in roughly the same spot each day

- 59% happy with their seat; 10% unhappy

- Frequently cited seating strategies:
  - be near friends
  - be far from strangers
  - have lots of open seats nearby ("buffer zone")
  - be on an aisle
  - be near a power outlet
  - be near front/middle/back
  - have a good view
  - be near pretty girls

- Others:
  - where I happened to sit the first day
  - follow others who care more
  - in a back corner
  - wherever Bill is sitting
  - away from laptop users
  - near laptop users browsing amusing sites
  - use a laptop without others looking at monitor
  - in an empty seat

# Strategies: Choice Quotes

- I don't like feeling completely engulfed by people.
- I tend to choose seats in the back where there are large amounts of empty space.
- I sat around here the first day so I just stayed here.
- I never sit next to a stranger unless it's the only seat left.
- I will choose a seat by considering several factors. I will look for a good vantage point, try to sit near friends, try to have an open seat directly next to me for extra space. I will choose to be at the end of a row to be able to easily use the restroom.
- I walk in the bottom main door and look up to see where open seats are or people I know as I walk up the stairs on the left. After about half way up, I see an area I want to sit and go into the row.
- Closest to the door cause I'm lazy.
- I approach the first available two seats with none bordering them (so four seats).
- Usually I enter class 10 minutes late and sit in the aisle.
- I tend to sit away from groups, an island in a sea of others.
- I dislike the middle (feel trapped).
- My contacts are the wrong prescription so I try to sit close.
- I think my behavior is only slightly influenced by where other people sit.
- I like the back where it is less conspicuous to talk or do other distracting things.

# The Unhappy Ones

- Some guy started sitting regularly in my friend's and my seats. He seems really competitive about his seat.
- Some kid stole my usual seat.
- Can't see left projector. Feel isolated. Alone. Seriously.
- There is a person beside me complaining about his seat, which decreases my enjoyment of sitting here, one seat over.
- Too far at the back. Smell of food makes me hungry.

# Micromanagers and Macrobehavior

- I would put all the people I like near me and everyone I don't know or dislike as far away from me as possible.
- People who talk a lot and are tall at the back.
- I would place people shorter than me in the rows below me so I could have a clearer line of vision. Notoriously noisy or people with a cold would be clustered at the front.
- I would arrange based on focus: more focused people toward front, less toward back.
- I'd like to sit where I can easily see the slides and hear the prof, but not be seen by him. I'd have all people similar to myself sitting around me. I'd also be somewhere that's not hard to get out of. Also near a pretty girl.
- I don't want the two guys who never stop talking to sit behind me.
- I would sit in the right 7th row aisle with friends sitting around me, and everyone else shifted as far left and down as possible to make it easier to leave through the top door.
- I would try to split up cliques to facilitate focus on class material.
- I would make everyone stand at the front of the room while I took the seat pretty much exactly in the middle of the room. Then they could fill in the rest of the seats, but not the ones next to, in front of, or behind me.
- I would have the least attractive students sit the farthest away from me, with students getting more attractive as they got closer, ending with the most attractive student sitting on my lap.
- Girls to the left, guys to the right. I would sit in the middle of the left.

# Global Conflict from Local Preferences

- If there are enough of you…
- You can't *all* sit in the back or front rows
- You can't *all* have too large a buffer zone
- If you like sitting on the aisle, but don't like being climbed over, you'll probably be unhappy sooner or later
  - e.g. from people who like sitting in the middle
- You can't have too many who are far from the crowd
- You can't all be in the back 1/3 with some behind you
- There may not be enough pretty girls for you all to sit next to them
- Etc. etc. etc.
- Everyone may have personal preferences that
  - are rather mild
  - can easily all be fulfilled with a small (or large) enough group
  - but are collectively impossible with the current group size
- The impossibility may be subtle and diffuse
  - think of an overconstrained system of equations

# Local Preferences and Segregation

- Special case of preferences: housing choices
- Imagine individuals who are either "red" or "green"
- They live on in a grid world with 8 neighboring cells
- Neighboring cells either have another individual or are empty
- Individuals have preferences about demographics of their neighborhood
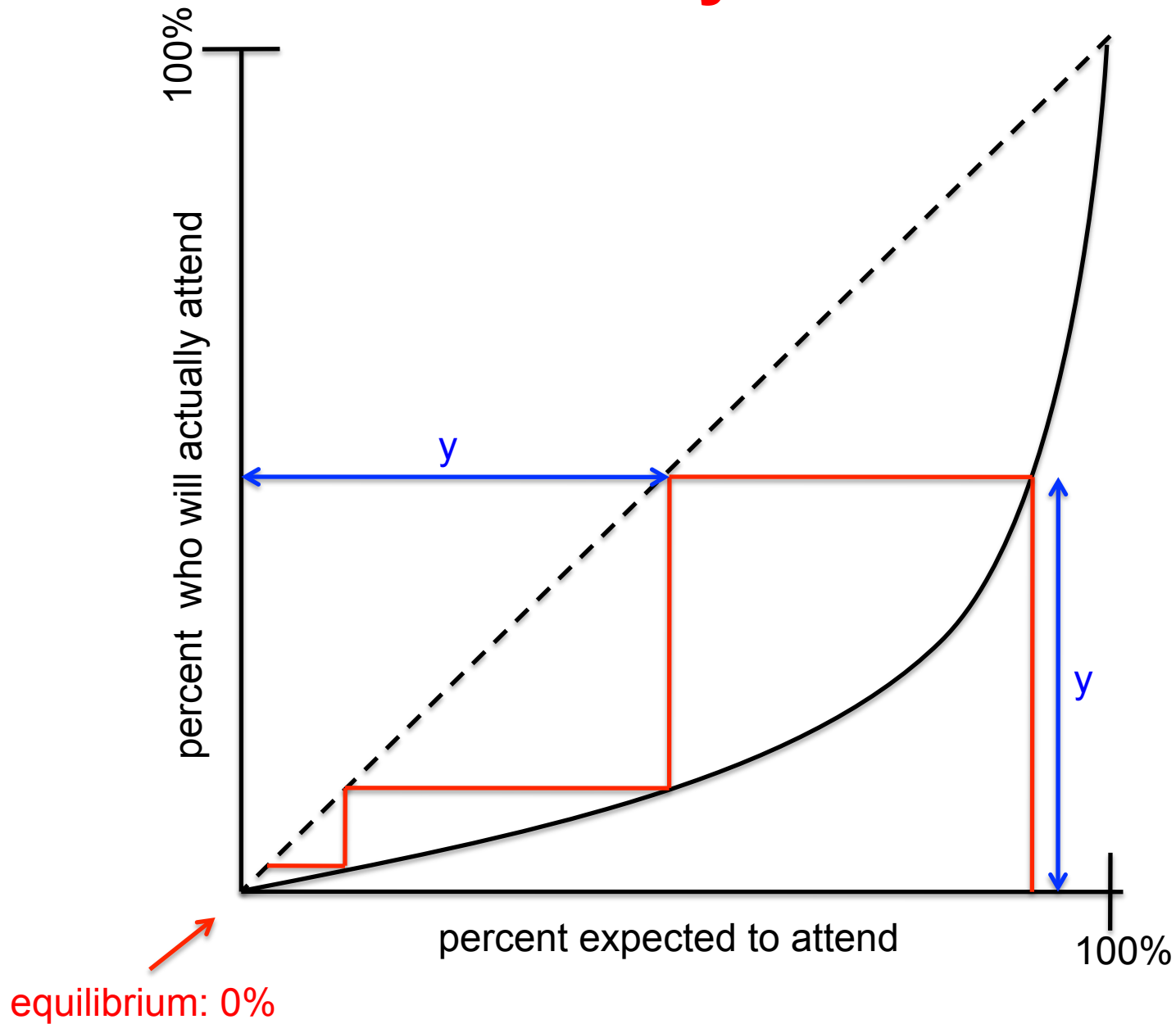- Let's look at this simulation

# Schelling's Morals

- Cannot infer individual preferences from global outcome
  - due to frequent *unilateral* nature of equilibrium/outcome
  - individuals may be "trapped in the system"
- Global outcome may violate everyone's *common* wishes
  - we might *all* be trapped
  - then how did we get here, and why can't we escape?
- The prevalence of *critical mass* phenomena
  - what happens when not enough or too many engage in some behavior
- Social systems often show *cascading* and *tipping*
  - we become trapped by incremental, myopic, self-interested behavior
  - final result can be highly influenced by *initial conditions*

# Volleyball, Critical Mass and Tipping

- Consider activities where the number/percent who will participate depends on the (expected) number/percent participating
- Schelling's examples: volleyball and seminars
  - but also going to the movies, Internet downloads, voting,…
  - "individuals" may be (e.g.) computer programs
- May prefer crowds, solitude, or some precise balance
- Different people may have different preferences
- Dynamics can often be conceptualized in a diagram (see next slide)
- To compute what will happen from a given starting point:
  - go up to the curve from the starting point
  - go from current point on curve *horizontally* (left or right) to diagonal
  - go from diagonal *vertically* (up or down) back to curve
  - keep repeating last two steps
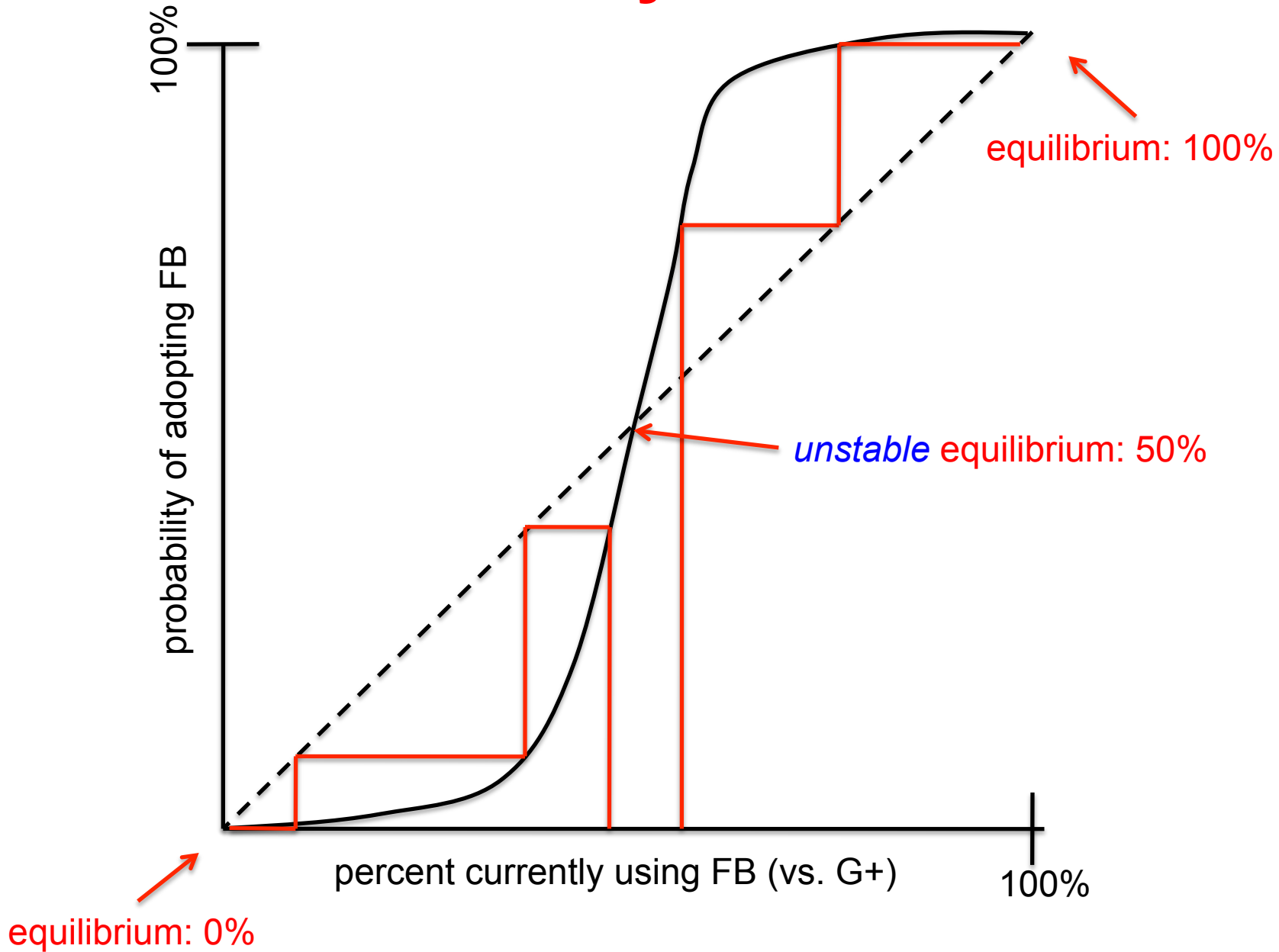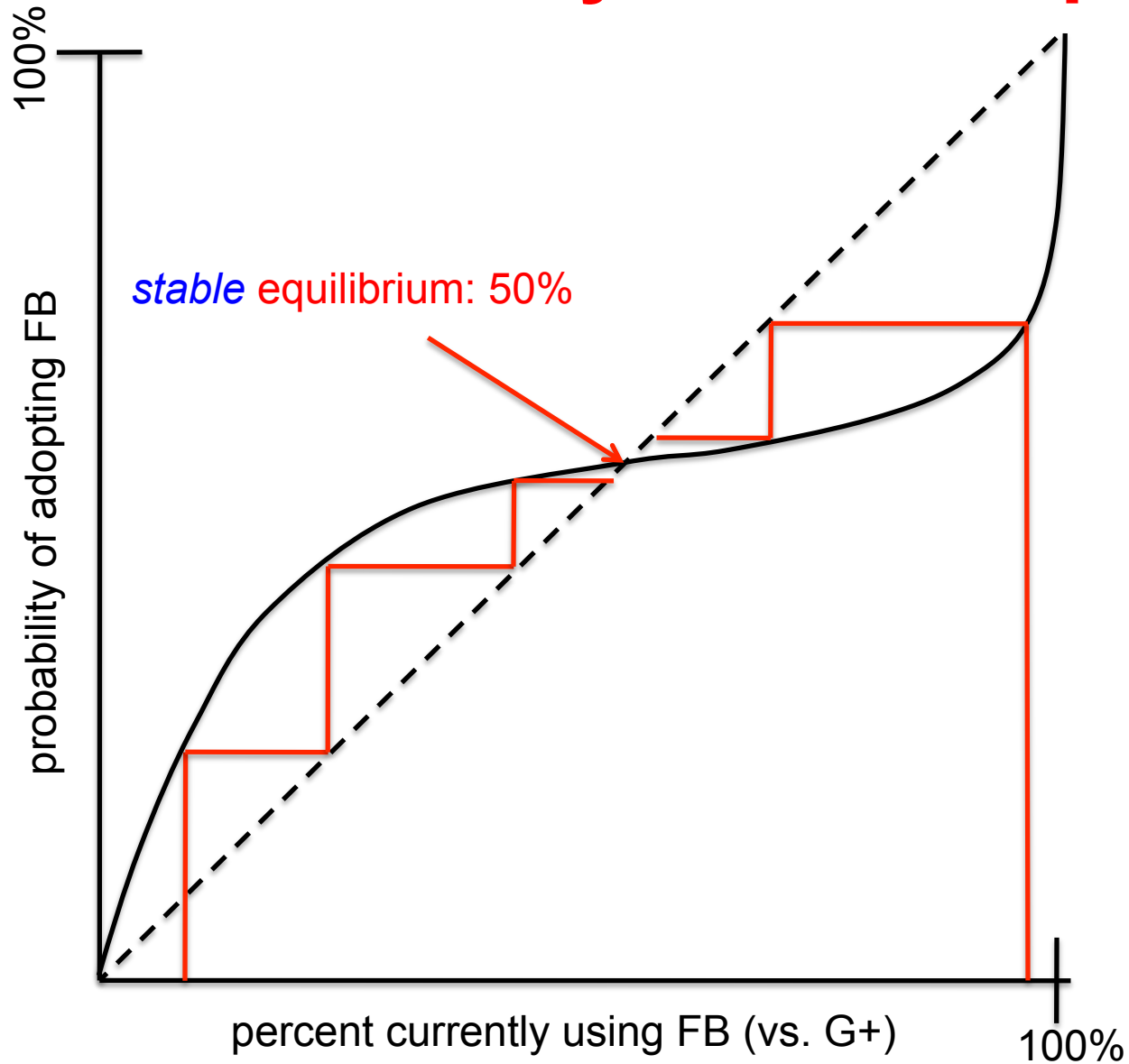- Can get equilibria (stable or unstable), cycles

**Attendance Dynamics: Concave**

equilibrium: 100%

percent who will actually attend

percent expected to attend

100%

100%
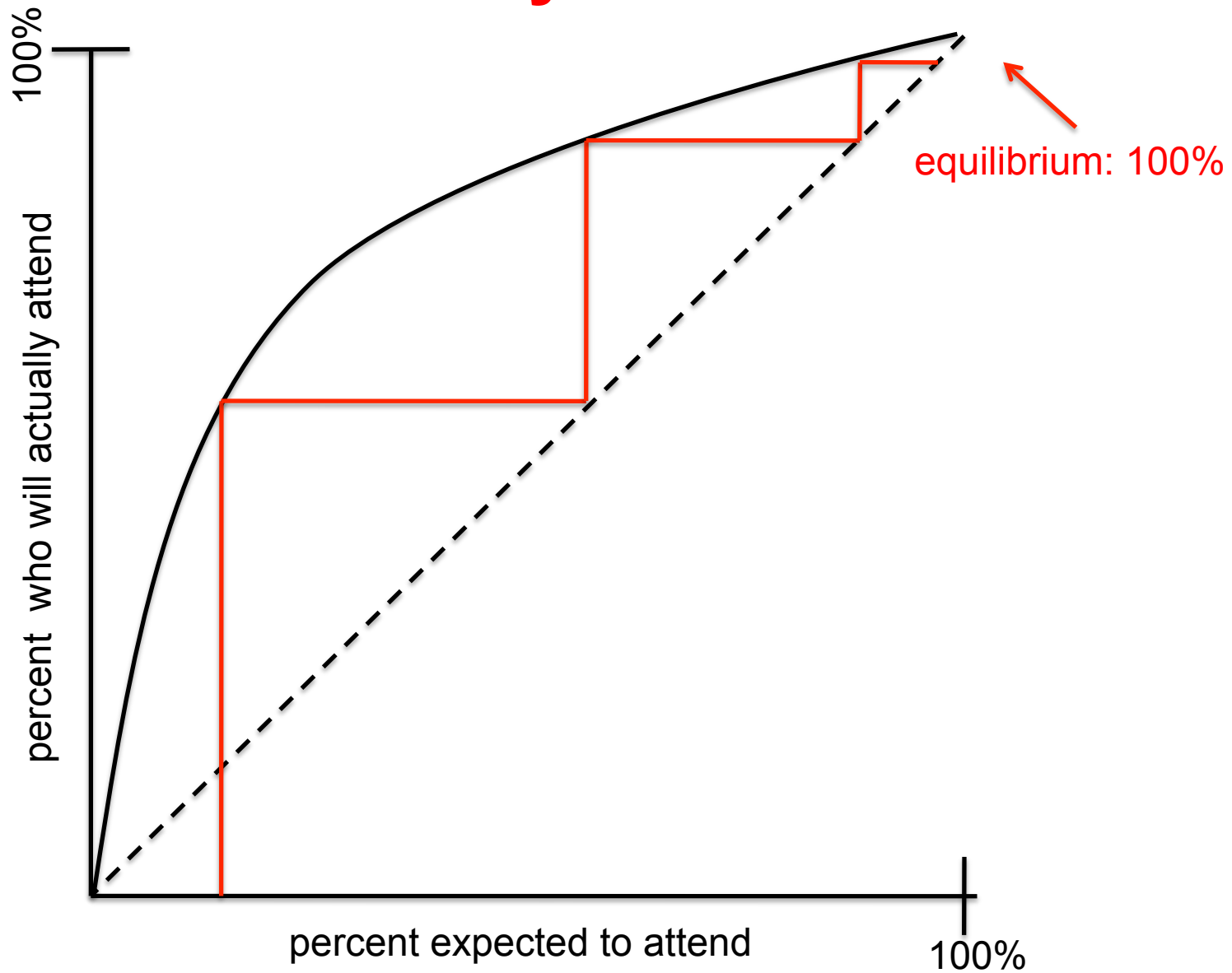
# Equilibrium Analysis

- Have a complex system of interacting individuals
  - each with his or her own preferences, desires, goals, etc.
  - each adjusting their behavior in response to others
  - each trying to selfishly improve their own situation
- Equilibrium:
  - a *global* situation (choice of individual behaviors)…
  - … in which no individual wants to change their behavior *unilaterally*
- A *stable state* or *fixed point* of the behavioral *dynamics*
- Not necessarily *desirable:*
  - for individuals
  - for the global population
  - just a situation nothing can do anything about (by themselves)
- But without equilibria, it's difficult to
  - describe how the system will evolve
  - judge the goodness or badness of collective outcomes
  - discuss how we might influence collective outcomes