Session 2: Segregation and Peer Effects

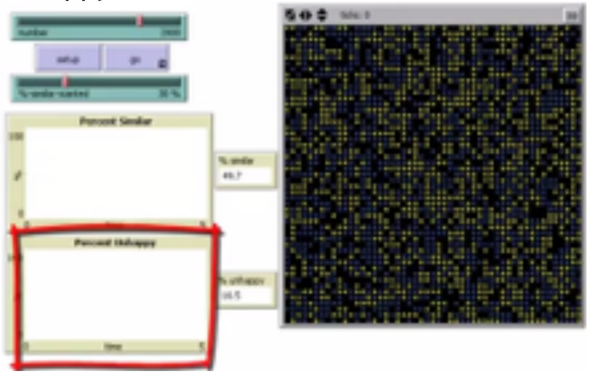
2.1 – Sorting and Peer Effects Introduction

Sorting – people who think, act, alike; Examples • **SORTING** - Detroit segregation. (homophily) • **PEER EFFECTS**- Stop smoking because of peer influences (looking, acting like peers)	• **Schelling's** segregation model (Schelling's Tipping Model), economist at U of Maryland • **Granovetter** (participation in collective behavior) • **Standing Ovation** (extension of Granovetter to adopting the behavior of those around you) • **Identification** (observe similar behavior - why? sorting or peer effect) **Methodology:** • **Equation-based: e.g.** Score = 50 + 5 hr, linear model • **Agent-Based-** Individuals, Behaviors (game theory, irrational, etc.), Outcomes

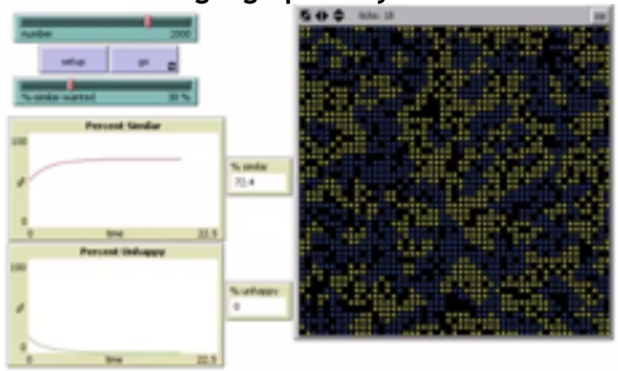
2.2 – Schelling's Segregation Model

• **Segregation studies** (race and income). NY (by race & city block: Red = Caucasian, blue=black, yellow=Latino, green=Asian) • **By Income:** (red=wealthy, light blue=poor, mid blue = mid income)  • Schelling explored why using ***Agent-Based Model*** addressing 'where do I want to live?' Model (agents, behavior, outcomes)	• **Neighborhood Checkerboard Model:** Schelling's simple rule model based on checkerboard overlay. A person (rich=red) lives at X with 8 neighbors. #3 (white) is empty home & dark squares are 'poorer' neighbors. 3 of 7 (not 8 because of empty house) are like X. • **Schelling 'Threshold' rule:** At ≥ what percent (S_o %) of *like-me* neighbors do I have to have to stay ***vs.*** at ≥ what per cent (L_o %) *not-like-me* neighbors do I choose to leave? For Schilling's model S_o = 1-L_o, i.e., S_o is the stay/leave threshold. **Quiz:** Suppose a person's current threshold is 35%, i.e., she needs at least 35% of her neighbors to be of the same type in order for her to remain at her location. If a person currently has four of eight neighbors of the same type, how many would have to relocate in order for her to want to move? (a) 1, (b) 2, (c) 3, (d) 4. **Ans:** (b) 2, at 2/6 = 33% < 35%, whereas at 3, 3/7 = 43% > 35%. ***Note the assumption*:** relocation by a neighbor creates an empty 'residence' hence reducing the no. of neighbors; instead of switching to a 'not-like-me' resident.

NetLogo Simulation. Initial Conditions: Random dist. at start 49.5% of neighbors similar, threshold = 30%, and 16.5% unhappy as a result.



Simulation goes to stability with 72.4% similar and 0% unhappy. **Implication: tolerant people with still sort geographically.**



- **Threshold = 40%:** => initially 28.8% unhappy and sorting yeilds 79.5% similarity to neighbors and 0% unhappy

- **Threshold = 52%:** initially 50.6% similar & 57.4% unhappy. Sorting yields 93.8% similar with 0% unhappy. Note ‘black’ boundary (empty) homes.

- **Threshold = 80%:** Initially 50.6% similar and 89.6% unhappy. Sorting is not stable as happiness threshold cannot be met. In reality this suggests people move continuously. Moving continuously, churning

- **Key point: MICROMOTIVES ≠ MACROBEHAVIOR**
  That is: observed macrobehavior does not automatically imply biased micromotives!
  Book: *Micromotives and Macrobehavior,* Schelling

- **Tipping Points in the Schelling Model:**
  - **Exodus Tip:** If a *like-me* neighbor leaves, X’s threshold may triggered by a decrease in the numerator of the ‘threshold’ equation, N/D is OK but (N-1)/D is not so I move. Recall D is number of neighbor homes occupied.
  - **Genesis Tip:** If a not-like-me neighbor moves into an empty neighboring residence, then X’s threshold may be trigger by a denominator increase, N/D is OK but N/(D+1) is not.

- **Bottom Line:** Even though people might be comfortable with only 30 to 40% of their neighbors being like them, the mathematics of that preference shows that sorting of the sort seen in the New York map above is the natural consequence. The acceptable micropreferences (microbehavior) does not produce the macrobehavior that is believed to be desireable by politicians or even what X believes they would like in diveristy.

- **Questions:** How low a *like-me* preference is necessary to create the desired macro distribution? The models show only *like-me* and *not-like-me* – is that fully representative since *not-like-me* can be a mix of *not-like-mes*?

2.3 – Measuring Segregation

- **Measures of Dissimilarity:**

  Segregation studies (race and income). NY (by race & city block: Red = Caucasian, blue=Black, yellow=Latino, green= Asian)

- **LA**

- **Wash DC**

- **Chicago**
  Wealthy (green),
  Poor (red) ,
  income disparity

- **Index of Dissimilarity:** Rich (blue), Poor (yellow), 50/50 (green)

- **10 people/block** =>
  Rich = 10*12 + 5*6 = 120 + 30 = 150,
  Poor= 10*6 + 5*6 = 60 + 30 = 90
- **Example #1:**
  b=# blue in block, B=# blue total (150)
  y=#yellow in block, Y=#yellow total (90)
  |b/B – y/Y| distortion in the block with (b+y),
  e.g., block (Blue=5, Yellow=3) => |5/150 - 3/90| = 0 or the block is perfectly representative block.
  block (Blue=10, Yellow=0) => |10/150-0/90|=1/15 block (Blue=0, Yellow=10) => |0/150-10/90|=1/9
  block (Blue=5, Yellow=5) => |5/150-5/90| = 1/45

- **Index of Dissimilarity: ½ (ΣN_iR_i)**
  From *Example #1*:
  ID'= ½ { 6(1/45) + 6(1/9) + 12(1/15)} = ½{72/45} = ½ {1.60} = 0.8 for normalized metric
  R_i = distortion metric i, |b/B – y/Y|
  N_i = number of blocks with R_i value
- **I.E.:** for perfect 50/50 mix, $\Sigma N_iR_i = 0$ and for 50% of block all poor and 50% all rich, $\Sigma N_iR_i = 2$. Thus $0 \le \Sigma N_iR_i \le 2$. So should normalize by 2 to have a range 0 ≤ Index of Dissimilarity ≤ 1.
  ID = ½ (ΣN_iR_i)
- **From Example #1:** ID = 1.60/2 = 0.8
- Philadelphia => 0.8, Detroit => 0.6

<u>**Quiz:**</u> Consider a city consisting of four city blocks of equal populations. One block consists of all rich people. One block consists of all poor people. Two blocks consist of half rich and half poor people. What is the index of dissimilarity? (a) 0.25, (b) 0.33, (c) 0.5, (d) 0.75

<u>**Analysis:**</u> N = people/block
P_R=N(1)+N(0)+2(½ N) = 2N = P_P = N(0)+N(1)+2(½ N)
½ {|p_R/P_R - 0/P_P| +|0/P_R - p_P/P_P | + 2|p_R/P_R - p_P/P_P|}
= ½ {N/(2N) + N/(2N) + 2(0) } = 1/2

<u>**Ans:**</u> **(c) 0.5,**

2.4 – Peer Effect

• **Granovettor's Model:** (Stanford) Unpredictable tipping events: Berlin Wall, Arab Spring (MLO Note, chart on food cost vs. unrest)	• **Model:** N individuals, Each with a Threshold (T_j for person j), **Rule:** join if T_j others join • **Wear a purple hat (or not):** (a) Thresholds for 5 people, [0, 1, 2, 2, 2]: Person with T_j=0 buys hat. Thus Person Two T_j=1 buys hat. Now two people have a purple hat, so Persons 3, 4, and 5 with T_j=2 will now buy purple hat, so all have a purple hat. (b) Thresholds for 5 people, [1, 1, 1, 2, 2]: No one ever buys a hat. (c) Thresholds for 5 people, [0, 1, 2, 3, 4]: Sequential propagation to buy hat so all five end up with a hat. Note: even though average dislike is higher in (c) than in (b), the trigger of the first threshold in (c) starts a hat-buying epidemic. i.e., Tail wags dog (avg)

Quiz: Suppose that there are 10 people who have the following thresholds for joining a volunteer project: 2 will volunteer even if no one else does. 6 require 5 others to volunteer. And 2 will volunteer so long as anyone else does. How many people will volunteer total? (a) 4, (b) 3, (c) 10, (d) 0

Ans: (a) 4, T_j matrix = [0, 0, 1, 1, 5, 5, 5, 5, 5, 5], => the first four people with volunteer for a total of 4 volunteers, but no others will since their thresholds are not met.

- **Collective Action:** More likely **(a) if lower thresholds** and **(b) if more variation in the thresholds**
  Note that more variation implies more likely to have some lower thresholds in the population to trigger and epidemic of behavior change. Not just average thresholds but distribution of thresholds determines cascades.

2.5 – The Standing Ovation Model

• **Builds off of Granovettor's Model:** people ***may optimize*** *<u>when they have time to think about it</u>*, but also may just follow simple rules when they don't – as in a standing ovation.
 	
• **Assumptions:** (a) Peer Effect, (b) Information – assume other's competence
• **Model:**
  • Threshold to Stand (T),
  • Quality of show (Q),
  • Signal (S = Q + E) where E = error (noise)
  • Initial Rule: If S > T => Stand
  • Subsequent Rule: Stand if > X% stand
• Model driven by your thresholds: T and X.
	• **Claims:**
	1. ***Higher Q*** => more people stand, Stand if S = Q + E > T
	2. ***Lower T*** => more people stand, Stand if S = Q + E > T
	3. ***Lower X*** (% people standing for me to stand)
	=> more ovations
	X Big (takes large % standing for you to stand)
	X Small (takes small % standing for you to stand)
	4. ***If Q < T***, increased variation in E => more stand => more likely to cascade into standing ovation
	Stand if Q + E > T with large E , (E ~ diversity)
	(See Signal: S = Q + E next)

• **Signal: S = Q + E**
E = Error or, equivalently, **=> diversity**
• **Example 1:** 1000 people, T=60, Q=50, E = 0, thus
S < T and nobody stands
• **Example 2:** Now let E = ±15, thus 35 < S < 65 and for those with S ≥ 60 will stand. So unless X is really small, no standing ovation.
• **Example 3:** Now let E = ±50, thus 0 < S < 100 and for those with S ≥ 60 will stand. So on T alone, assuming E is uniformly distributed, 40% will stand. Then if X<40% = standing ovation.
 	
Note: Q=50 & T=60 ∀ audience, E=±50, so if E uniformly distributed across audience ➔40% stand. If X < 40% ➔ standing ovation.
	• **Causes for Large E:**
	  • Audience: (a) Diverse, (b) Unsophisticated
	  • Performance: (a) Multidimensional, (b) Complex
	
	• **Summary: *<u>Standing Ovation more likely</u>*** if:
	  • ***Higher Quality (Q)***
	  • ***Lower Threshold (T)***
	  • ***Lower X*** (Larger Peer Effects-more influenced by)
	  • **Larger E** (More Variation in perceived quality, S)
	  • **Use Celebrities** (see Other Considerations below)
	  • **Big Groups** (see Other Considerations below)

<u>Quiz:</u> Imagine you are at a concert for which Q is greater than T. If X is less than 50%, does increasing E increase the chance of a standing ovation? (Hint: Draw a plot, and assume signals are uniformly distributed between 0 and 100 (MLO, [Q-E, Q+E]) .) (a) Yes, (b) No, ~~(c) Sometimes, (d) Not enough information~~

<u>Ans:</u> (b) No

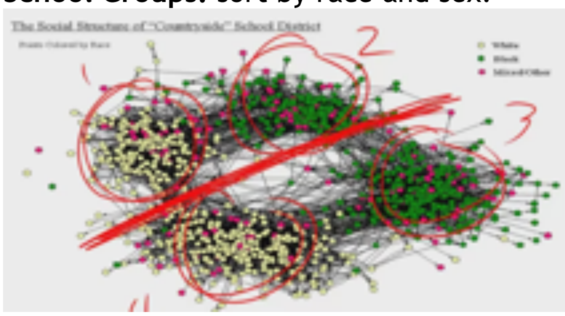
<u>Explanation:</u> No. Q > T means that more than half of the audience perceive the quality of the show to be above their threshold (more than 50% will stand up). If X% is less than 50%, there will always be a standing ovation (so long as Q > T), regardless of the variance. (MLO, I think this needs some clarification?? *Q is greater than T at the median of the audience??*) In Example 2, mentions make T and Q the same for all of the audience.

• **<u>Other Considerations:</u>** (a) layout of the auditorium, (b) group you are with (e.g., date) • **<u>Layout:</u>** (a) Celebrity Effect – people in front see far fewer ‘standing’ signals from the audience behind them. They ‘don’t care’ what the others are doing, BUT others see them and are thus, ‘influenced’ by whether they stand or not: hence, the Celebrity Effect. (b) Those in the back see a large portion of the audience and are thus more prone to stand, triggered by their X% threshold. But whether the back row folks stand or not, has significantly less effect than front rowers. Note “they see what’s going on but nobody pays any attention to them [academics].” • **<u>Group (dates, pairs, groups):</u>** More likely to do what your ‘group’ does. • <u>Ways to foster standing ovation</u>**: 1) Higher Quality, 2) Lower Threshold, 3) Larger Peer Effects, 4) More Variation (E), 5) Use Celebrities, 6) Many Big Groups**
• **<u>Fertility:</u>** the Standing Ovation model is a useful template for other problems, e.g., (a) ***Collective Action***: (consider the value of celebrities), (b) ***Academic Performance***: (celebrities, groups, raise quality, lower thresholds), (c) **Urban Renewal:** (‘fixing up your house’, small amounts of $ for everyone may not trigger T, but large $ for a few homeowners (E) may trigger a cascade as others try to match their neighbor’s improved home), (d) ***Fitness / Health***: (peer effects, information by seeing other’s results, ..) (e) ***Online Course*** (celebrities, etc.)

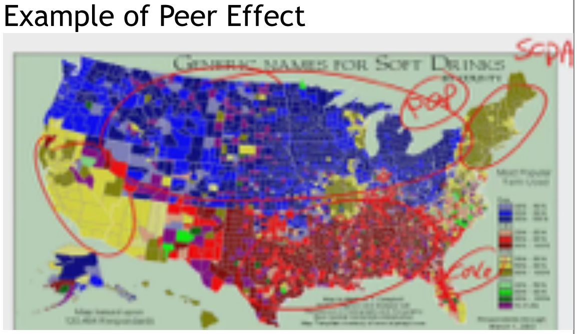
2.6 – The Identification Model

- **Schelling or Standing Ovation?:** i.e., **<u>Homophily</u>** (sorting - associate with people like yourself) or **<u>Peer Effect</u>** (adopt the behaviors of groups you want to join)?

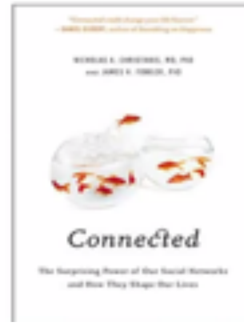
- **School Groups:** sort by race and sex.



- **Soft Drink Names by Region:** Coke, Pop, Soda, Other
Example of Peer Effect

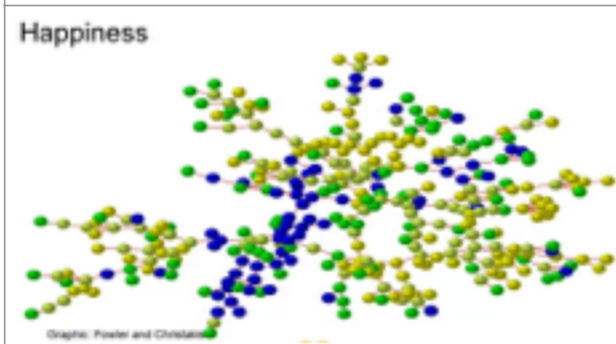


- **Books:** (sorting -- peer effects)

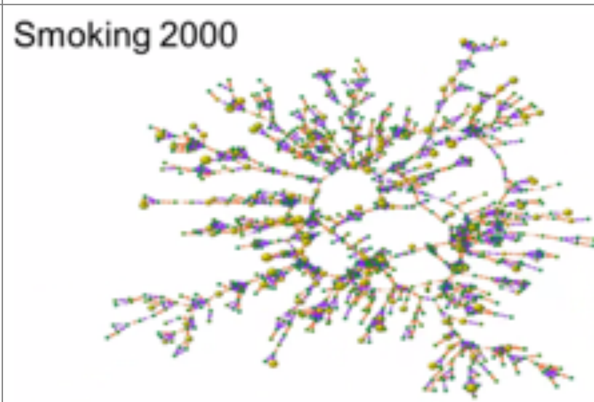


- Political Sorting over 28 years (1976-2004)
Dem=Black, Rep=Gray. May also have peer effects

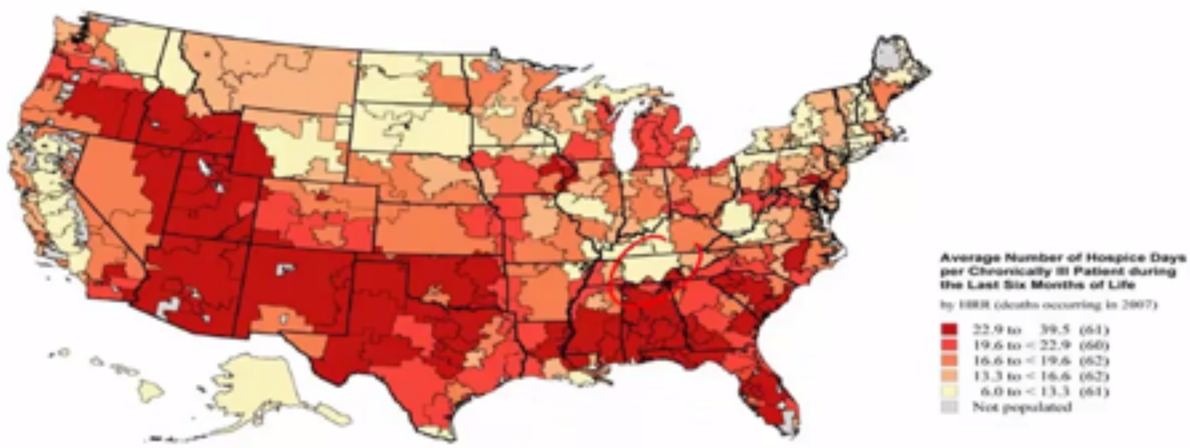
- Examples of clustering, but not so clear whether sorting or peer effects below



Blue = Unhappy, Yellow=Happy



- **Days in Hospice:** Note some clustering, but also sharp boundaries in adjacent (nearly identical) socio-economic regions. Could be either sorting or peer effects.



Sorting or Peer Effect?

Why can't tell by just looking at the data as shown.

- **Sorting:**
  B's move down, A's move up. <u>Result is one row of A's and one row of B's.</u>

- **Peer Effects:**
  B's in upper row switch to A's. A's in lower row switch to B's. <u>Result is one row of A's and one row of B's.</u>

- **Outcomes the same!**
  AAAAAA & BBBBBB

- ***Need to observe the dynamics in action to identify correct process.***
  i.e., Need microlevel dynamic data to determine if sorting or peer effect.