research design

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this version: Tuesday 22nd October, 2024 13:19

outline

intuition

research design basics

DID and program evaluation (Wheelan, 2013, ch13)

level of analysis

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level of analysis

statistics

- it's just storytelling! what data are telling? what i want to tell? what the audience needs to know?
- "statistics is the science of learning from data"
- "the science of collecting and analyzing data for the purpose of drawing conclusions and making decisions."
- good data are the key! GIGO (Wheelan, 2013, ch7): eg "shy trump", drug activity, prostitution, victimless crime
- what to study?:
  - what you're interested in (and usually knowledgable about)
  - what is doable (there are realtively easily accessible data)
  - what will further your career (think beyond graduation!)
  - [sth local/work related, applied, policy relevent]

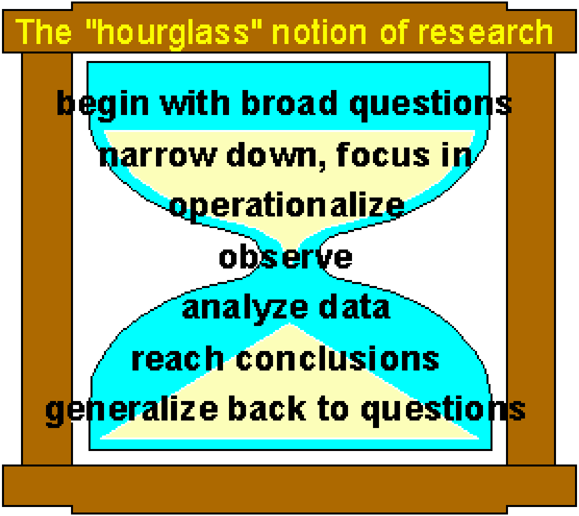
eg: use data to disprove your convictions!

- i knew it by heart that cities are places of largest inequalities `https://viewing.nyc/the-new-yorkers-interactive-maps-show-income-i` `#google_vignette`
- but so are unequal rural areas! `https://www.google.com/search?q=pew+inequalit+by+county&ie=utf-8&oe=utf-8`
- correlation of pop siz and gini just .1

setup: critique res, or better yet do it yourself

- design the problem: start with a question/res idea eg?
- then formulate hypothesis(es): brief testable statement(s) expressed with measurable vars eg?
- get the data: download or collect/IRB (takes time/discouraged)
- summarize/analyze the data (statistics)
- interpret, communicate
- many just summarize/analyze, but need to communicate/interpret!–what does it mean?
  - interpret in the most simple way possible
  - most people don't understand statistics

the hourglass (Trochim)



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narrow down, focus in

- tendency to overcomplicate/ grand research questions
  - start simple/can complicate later if resources/time
  - much easier/faster to contribute locally than scholarly
- be specific about what exactly/what aspect
  YOU are looking at...
- too broad ideas cannot be tested
  - may break it down into several specific hypotheses
- anyone having any hypotheses? give me few examples?
  - (note how it differes from research question!)

operationalize: have a hypothesis

- hypothesis: brief and clear statement that can be tested
  - measured with variables and specified "+" or "-" effect
- express your idea in observable/measurable terms
- translate words/idea into a mathematical relationship
- eg increase in X is associated with decrease in Y
  - where X and Y are specific variables
  - say, income increases happiness
- and then use research methods, interpret results
  - and answer initial questions

the trick/shortcut

- easiest way to do res is to just replicate exisiting one!
  - and add a little twist from yourself
  - find a paper you really like and replicate it with a little twist from yourself :)

- sure, do follow trochim's hourglass
- but can also just do it, dive in, and and poke around

- also even if you only do qual; it does help to sprinkle it with quant!

wrap-up

- end every class discussing what we covered and quick look at next week
- end with a review Q&A,
- give some examples (essp in pub pol and pub adm) for concepts covered
- students will discuss concepts from the class
-
- quick look at next class

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DID and program evaluation (Wheelan, 2013, ch13)

level of analysis

qualitative vs quantitative

- much of the following applies whether you do qualitative or quantitative research
- research design is a class itself
  - we will cover only basics; for more:
  - http://www.socialresearchmethods.net/kb/design.php

external validity (Wheelan, 2013, ch10)

- external validity is about generalizability
  - can i say something about RU in general by analyzing you?
  - how about just RU-Camden ?
  - note: random sampling is different from randomization or random assignment (experiment)
  - https://sk.sagepub.com/reference/researchdesign/n146.xml
- let's have a thorough discussion like 15min, give examples, people confuse it and think it's sth more than just plain generalizability and representativness from sample to population, and often just sample=population

internal validity

- internal validity is about causality
- you have internal validity if you can claim that X causes Y
  - eg some drug X causes some disease Y to disappear
  - https://sk.sagepub.com/reference/researchdesign/n43.xml
  - https://sk.sagepub.com/reference/researchdesign/n192.xml

causality

- much of research design is about causality
  - want to show X $\rightarrow$ Y
- correlation is necessary for causality
  - but not sufficient (eg http://www.tylervigen.com/)
- careful! humans have illusion of causality:

  tend to see causality where there is none!
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4488611
- http://onlinelibrary.wiley.com/doi/10.1348/000712610X532210/abstract

INUS condition (Mackie, 1980)

- very useful way of thinking about causality:
  Insufficient but Non-redundant part of
  Unnecessary but Sufficient Condition
- most causes are INUS conditions
- eg a cigarette as a cause of forrest fire
  - it's Insufficient, because by itself it is not enough, eg you also need oxygen, dry leaves, etc
  - it is contributing to fire, hence Non-redundant
- and **along with other stuff** (oxygen, dry leaves etc) it constitutes Unnecessary but Sufficient Condition
  - it's not necessary for fire, it can be lightening, etc
  - but it's sufficient – it's enough to start the fire

INUS condition

- IN is your X
- US is set of X's (your X+other X's)
- the bottom line is that there are always:
  - multiple alternative causes
  - and multiple steps in causal process
- or you could say there is a train of causality:
  - multiple things have to happen for outcome to occur
- say airplane fall: multiple things had to happen:
  - pilot, traffic control, weather, etc
- same with everything: career success, marriage, etc

INUS in social science:

- nothing necessary–can have outcome with some other cause
- nonothing sufficient on its own–always need multiple things (often obviously present like oxygen in fire example)

basic concepts

- Y: a dependent variable, outcome
- X: an independent variable, predictor
- ◦ (T: (treatment), like X)
- Z: some other variable
- want to show $X \rightarrow Y$; X affects (causes) Y
- ◦ and not the other way round ($Y \rightarrow X$)
- ◦ and not $Z \rightarrow Y$; eg X(CO_2),Y(temp), Z(sun temp)
- ◦ it is difficult to argue !
- ◦ after all, there are unknown unknowns
  (Z's that we are unaware of)

the gold standard [ask IRB appr!]

- the experimental design give few examples
- only with experiment can confidently argue causality
- and it is because randomization takes care of the known and unknown predictors of the outcome (draw a picture of 2 groups of people)
  - in other words, it establishes a counterfactual (next slides)
- but wait !
  - most of the time we cannot have an experimental design because it is unethical and politically impossible eg we cannot randomly assign kids to bad school or to smoking http://www.socialresearchmethods.net/kb/desexper.php

causality without experiment?

- maybe, but you need to do lots of work...
- essentially you want to exclude alternative explanations
- so you act like a devil's advocate...
- and try to abolish your story / find an alternative explanation
- if you cannot find any, then your story is right ...
  - until disproved

The Problem put another way: Counterfactual

- esentially need to compare:
  - what happened to the outcome (Y) due to the treatment (T or X)
  - to what would have been (Y), had the treatment not happened
- eg we got a new teacher and now kids perform better on SAT
  - to know whether the teacher caused better performance we would need to know what would have happened to SAT scores without this teacher (scores might have gone up due to Z),
  - and compare it to what actually happened

The Problem put another way: Counterfactual

- the problem is that we do not observe counterfactual (we can try to infer it though)
- counterfactual is the effect of all knowns/unknowns
  - (incl. unknown unknowns)
- how do we deal with lack of counterfactual
- do an experiment!
- (or if you cannot, try to estimate or infer it somehow)

threats to internal validity

- can still argue causality, but think about threats!
- time: history, maturation, regression to the mean
  - things develop over time in a certain way
- selection bias, self selection
  - does smoking causes cancer ?
  - maybe less healthy people select to smoke ?
- something else (Z) happened that caused Y
- reverse causality
- http://knowledge.sagepub.com/view/researchdesign/n192.xml#n192

reverse causality OR chicken-egg dilemma

- try to find some other X that measures the same or similar concept and that cannot be caused by Y
- eg instead of education $\rightarrow$ wage; do father's education$\rightarrow$ wage (your wage can reverse cause your education, but not your father's education)
- find some exogenous (external) shock: policing$\leftrightarrow$crime
- but terror attack/alert $\rightarrow$policing$\rightarrow$crime; we know that policing$\rightarrow$crime; not the other way round

◦ Wheelan (2013, p227) is giving the same example!

natural experiment

- again most of the time you cannot have an experiment
- but there are natural experiments or exogenous shocks
- exogenous meaning that they are caused externally (like an experimenter's randomization) and somewhat randomly (at least with relation to a problem at hand)
  - eg earthquake (any weather, eg storm); terrorist attack; policy change (less random)
- any other examples of natural experiments?
- also see Wheelan (2013, p231-)
- a pretty cool one is with schooling$\rightarrow$lexp
  - natural experiment is different min school requirement
  - by state and over time

examples of designing research

- say a major employer comes in,
  - say Subaru in its block group
  - or Salvation Army in its block group
- look at housing prices (can proxy economic development)
- https://www.zillow.com/research/data/
- or gentrification, eg race by census tract in the area
  https://www.policymap.com/maps
- can get many variables at census tract level!

>>>probably stop here and pick up next wk

- or before designs shown in graphs

ex post facto: very common; *no* design

- observational, correlational; most likey do or read this
- we start investigation "after the fact"
- no time involved, don't know whether X precedes Y
- both, X and Y are observed at the same time examples?
  - (but X must precede Y in order to be causal)
- practically impossible to argue causality here
- but cheap and big N, and good external validity
- useful! many "causes" discovered in observational studies
- eg smoking→cancer
- http://knowledge.sagepub.com/view/researchdesign/n145.xml
- http://knowledge.sagepub.com/view/researchdesign/n271.xml#n271

before-after (pre-post)

- measured Y, then do X, and then measured Y again
- eg measured readership at the library, buy some cool stats books; measured readership again
- eg measured crime rate, put more police on the streets ; measured crime again
- eg measured soup consumption, changed soup; measured soup consumption again
- anyone did pre/post? eg working at school?
  - tried new programs, new approaches?
  - or simply pre-post without T, say to identify highest and lowest gain students

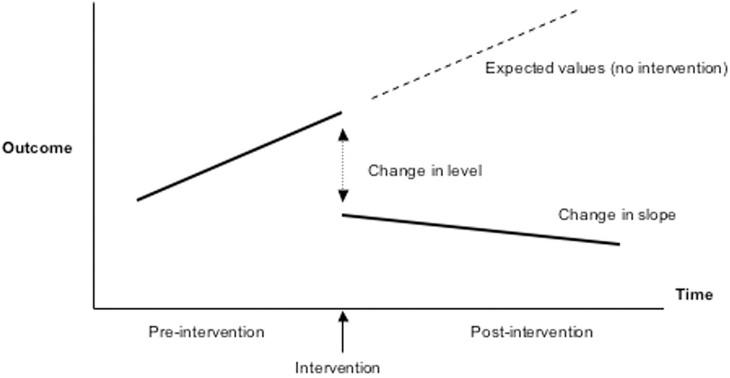
(two group) comparative change

- eg H_0 police with better guns fights crime better
- measured crime rate in 2010 in Camden and Newark
  - in 2011 get super guns in Camden (not Newark)
  - in 2012 measured crime rate again in both cities
- if crime rate dropped more in Camden than in Newark, then we have evidence that the guns worked
  - `https://www.stata.com/why-use-stata/i/boxplot.png`

interrupted time series:

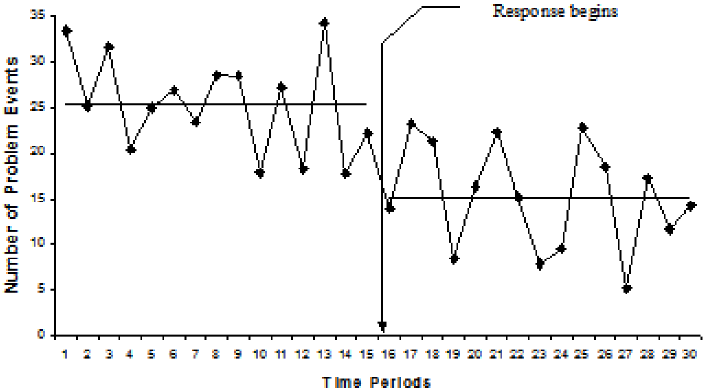
- eg H_0 : the new anti-unemployment program in Camden decreased unemployment
- get data about unemployment in Camden 1990-2010
- say the unemployment program began in 2001
- produce a time series plot (mark a vertical line in 2001: intervention/treatment)
- if there was a change in trend after 2001, conclude the program worked

interrupted time series:

- 

- in general look at the trend

interrupted time series:



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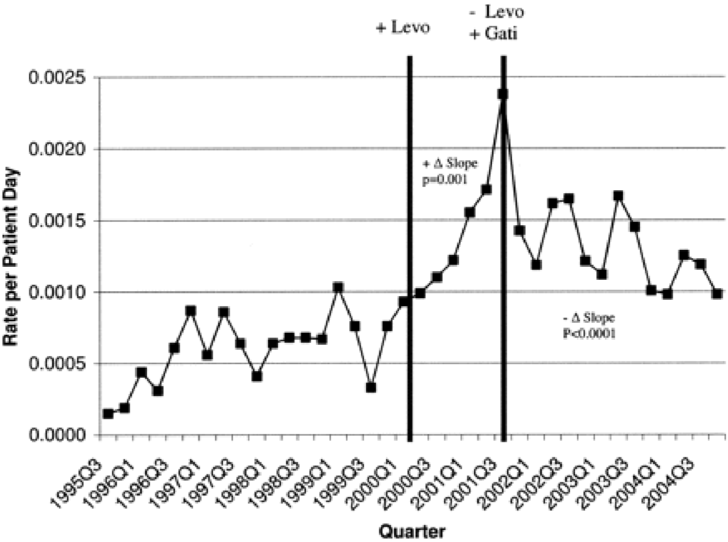
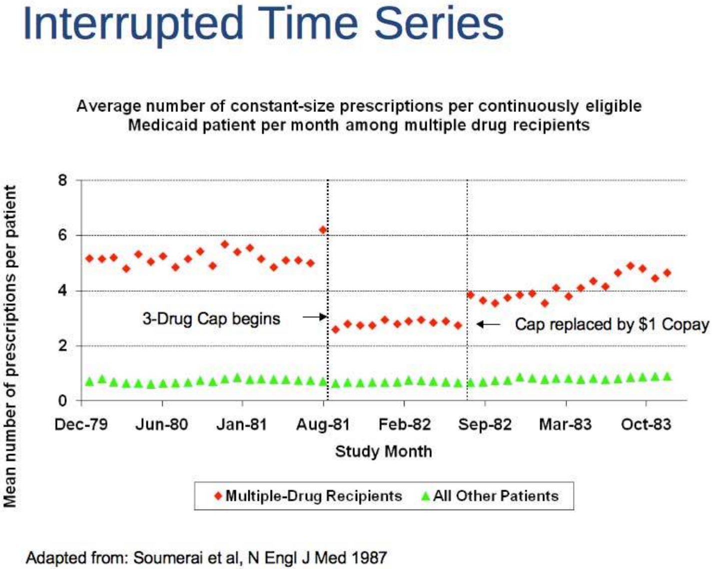
- look at the trend: may be difficult to see response

interrupted time series:

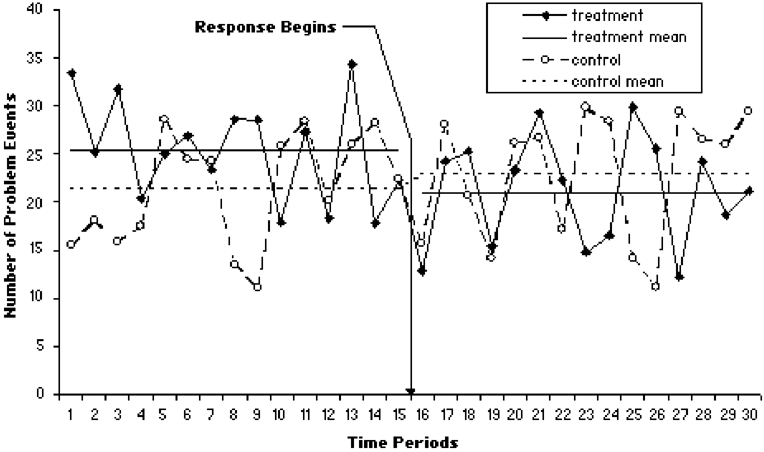


- more powerful: take away T→ effect dies

interrupted time series with a control



interrupted time series with a control



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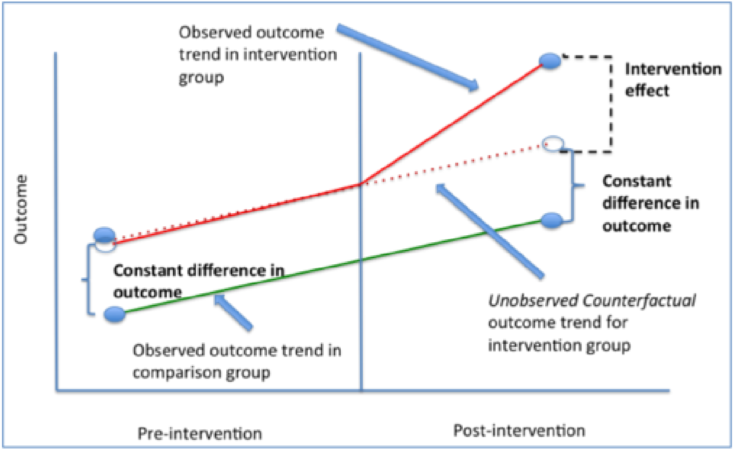
level of analysis

difference in difference (p.235 Wheelan, 2013)

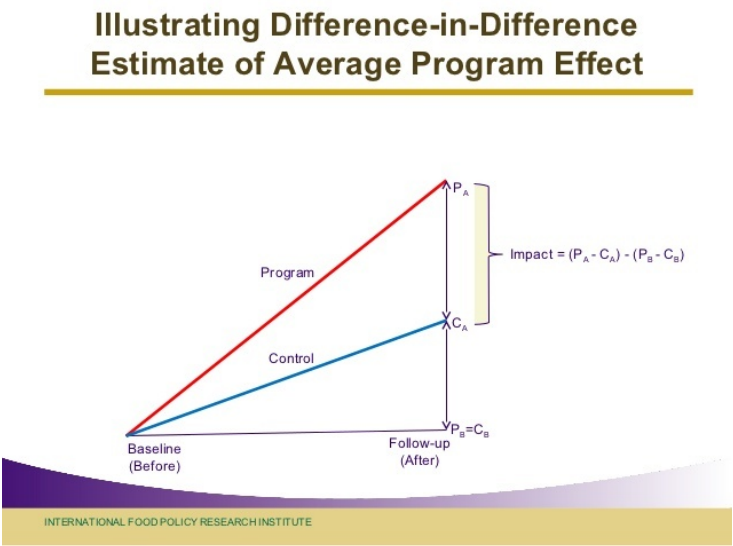
- just 'before after' with a comparison group
- did sth to one group, and not to the other group
  - over time (pre post) see if there is any difference
- like we discussed earlier
- blackboard: fig: first from p236, and then from p237
  - and pictures similar to those follow

DID

- 

Observed outcome trend in intervention group
Intervention effect
Outcome
Constant difference in outcome
Constant difference in outcome
Unobserved Counterfactual outcome trend for intervention group
Observed outcome trend in comparison group
Pre-intervention
Post-intervention

DID

- 
Illustrating Difference-in-Difference
Estimate of Average Program Effect
P_A
Impact = $(P_A - C_A) - (P_B - C_B)$
Program
C_A
Control
$P_B=C_B$
Baseline
(Before)
Follow-up
(After)
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discontinuity analysis (p.238 Wheelan, 2013)

- can use when there is some rigid cutoff for something, say:
  - remedial program for F grades
  - prison sentence for a crime
- then compare those who just made it (C-, or a ticket)
  - v those who didn't (F, prison) and were just next to the cutoff
- the thing is that the two groups are similar, especially:
  - not really any difference whatsoever with respect to cause of treatment (prison, F, etc)!
  - so the treatment is arbitrary (random)–have experiment!

a general example of using res des

- new jersey state government workforce profile 2010
- http://www.nj.gov/csc/about/publications/workforce/pdf/wf2010.pdf
- p37: minorities in state govt over time
- how increase internal validity?
- compare to PA, DE, NY etc
- factor in minority population; applications
- do experiments! many already done! again, read lit!!
  - say people with black names apply for jobs
  - students with Asian names email professors
- and both, employers and professors discriminate against!

next step

- if you are interested in program evaluation:
  - quick http://www.socialresearchmethods.net/kb/evaluation.php
  - in-depth, advanced: Mohr (1995), Shadish et al. (2002)

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level of analysis

levels of analysis

- you are familiar with term Unit of Analysis (U/A)
- there are many levels
- there are states, counties, metropolitan areas, cities, etc
- and you often get different and even opposite conclusions depending on what level you are looking at

aggregate data

- in regional development much of data are aggregate
- eg income, home ownership rate at county level are sums of person-level values divided by population
- with aggregate data you are losing information
  - you don't know the variability and the distribution

ecological fallacy

- when you make conclusions about individual units based on group data
- eg you meet a person from Colombia
  - and you think: “she must be a criminal”
  - that Colombia has high crime rate and criminal history, Pablo Escobar etcdoes not mean that all Colombians are criminals
- or say you meet a Harvard graduate
  - and you think “she must be a genius”
  - again, just because Harvard is a great university, does not mean that every Harvard graduate is a genius
- `http://www.socialresearchmethods.net/kb/fallacy.php`

atomistic fallacy

- an opposite of ecological fallacy
- making inferences about groups based on individual data
- eg you found that rising individual income reduces risk of coronary heart disease (eg people stress out that they are relatively poor, they are missing out etc)
- but it does not mean that increasing incomes of states would decrease coronary disease rate for a state

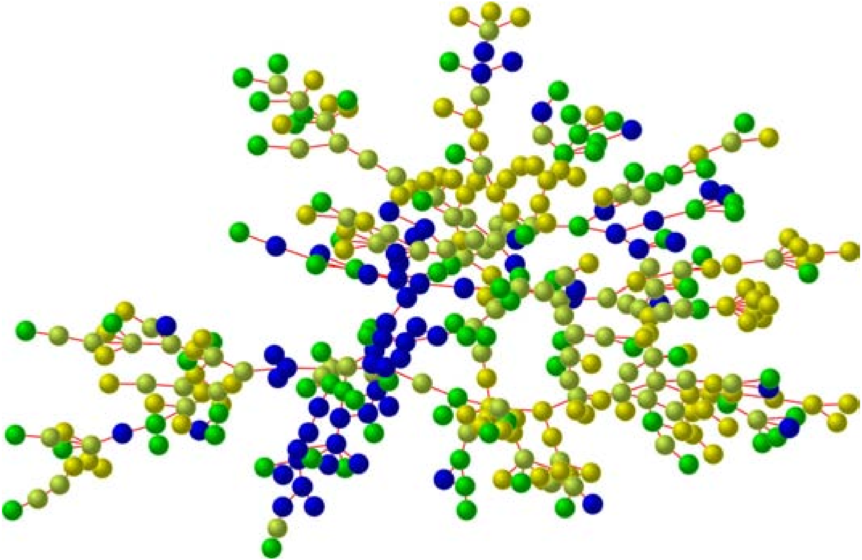
different levels, different effects

- variables at different levels may have opposite effects
- eg if i increase your salary, you'll be happier
- but if i increase salary in your area you'll be less happy
- would you like to live in a world where:
  - you make \$100k and the average is \$150k
  - make \$75k and everybody and the average is \$50k
- people chose the 2nd
- "a rich guy is a one who makes more than his wife's sister's husband"

contextual effects

- whatever you study takes place somewhere and place matters
- not only attr of the U/A predict your outcome
- context matters (attr of larger units in which U/A is nested)
- student nested within classroom, classroom within school, etc
- company nested within city; city nested within a state, etc

happiness is contagious (Fowler and Christakis, 2008)



your research project

- you should address some of the above issues in your research project
- again, a useful thing to do is be devil's advocate
  - ask yourself how/why what you are saying is not true
  - think about alternative explanations
  - what are the limitations of your study

wrap-up

- end every class discussing what we covered and quick look at next week
- end with a review Q&A,
- give some examples (essp in pub pol and pub adm) for concepts covered
- students will discuss concepts from the class
-
- quick look at next class

Fowler, J. H. and N. A. Christakis (2008): "Dynamic Spread of Happiness in a Large Social Network: Longitudinal Analysis Over 20 Years in the Framingham Heart Study," British Medical Journal, Vol. 3, January 09.

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Shadish, W. R., T. D. Cook, and D. T. Campbell (2002): Experimental and quasi-experimental designs for generalized causal inference, Wadsworth Cengage learning.

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