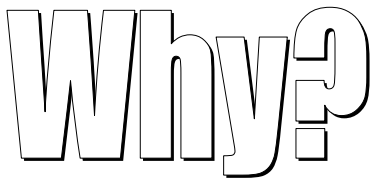
Logic of Causation

- Cause and effect
- Determinism vs. free will
- Explanation:



Causality

Bivariate relationship (2 variables)

X ⟹ Y

(Cause)
Independent variable

(Effect)
Dependent variable

Causality

Multivariate relationship

(3+ variables)

X

Z

Y

(Causes)

Independent variables

(Effect)

Dependent variable

Types of causes (n=2)

- Necessary cause: X must happen for Y to happen

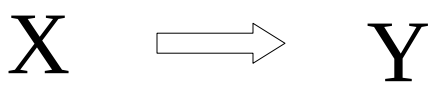
  "Need X to get Y"

- Sufficient cause: Y always happens when X happens

  "Always get Y when you have X"

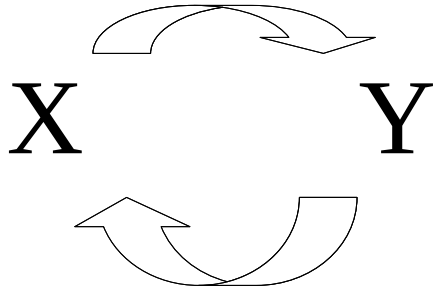
Criteria for Causality (n=3)

1) Cause must precede effect:



Criteria for Causality

2) The two variables must be empirically associated



Criteria for Causality

3) Observed association cannot be explained away by a third variable (test for spuriousness)

X = # firefighters

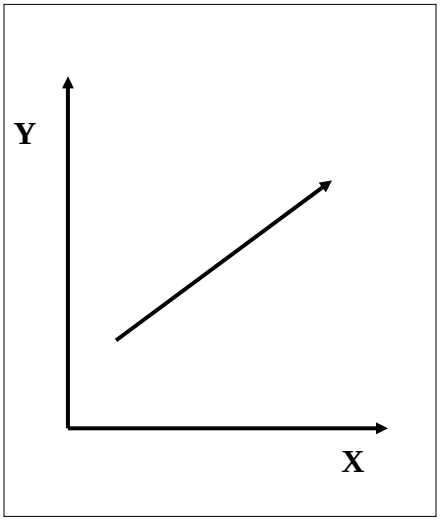
Y = amt. of damage

Criteria for Causality

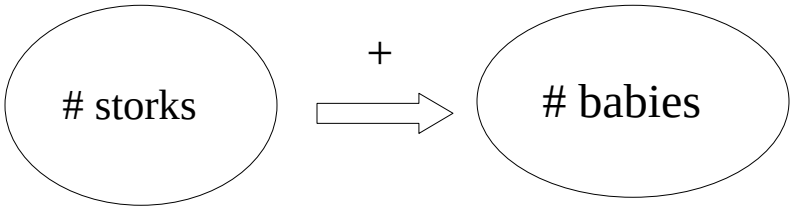
X $\xrightarrow{+}$ **Y**

X= # firefighters

Y= amt. of damage



Spurious relationship?



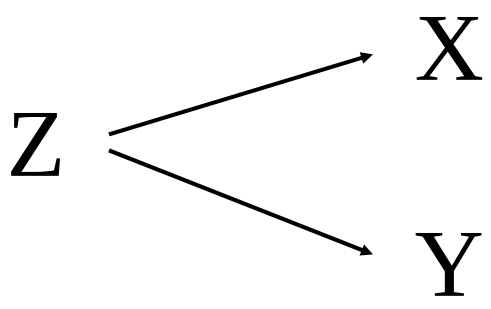
Elaboration Paradigm

- Purpose: to understand nature of observed relationships
- Test: for spuriousness
- Move: from bivariate table to trivariate table
- Evaluate for possible outcomes: replication, explanation, interpretation, specification

Elaboration Paradigm
(Babbie, p. 422)

Partial relationships compared with original	Test variable is:	
	Antecedent	Intervening
Same relationship	Replication	
Less or none	Explanation	Interpretation
Split (one is same or greater, other is less or none)	Specification	

Explanation:



Interpretation:

Rules for creating tables

- ✓Percentage down (in the direction of causality)
- ✓Dependent variable on the side
- ✓Independent variable(s) on the top
- ✓Compare across
- ✓Watch for small Ns in columns
- ✓Collapse on theoretical grounds

Elaboration Paradigm

Percentage receiving Ph.D. by marriage in grad school (hypothetical)		
	Got married in grad school	
Got Ph.D.	Yes	No
Yes	65.0	80.0
No	35.0	20.0
Total	100.0	100.0
N	(200)	(200)

Elaboration Paradigm

Percentage receiving Ph.D. by marriage in grad school (hypothetical)		
	Got married in grad school	
Got Ph.D.	Yes	No
Yes	65.0	80.0
N	(200)	(200)

Succinct table reduces redundancy

Elaboration Paradigm

Percentage receiving Ph.D. by getting married by sex (hypothetical)				
	Sex			
	Men		Women	
Got Ph.D.	Married	Didn't marry	Married	Didn't marry
Yes	80.0	80.0	50.0	80.0
No	20.0	20.0	50.0	20.0
Total	100.0	100.0	100.0	100.0
N	(100)	(100)	(100)	(100)

Elaboration Paradigm

Percentage receiving Ph.D. by getting married by sex (hypothetical)				
	Sex			
	Men		Women	
Got Ph.D.	Married	Didn't marry	Married	Didn't marry
Yes	80.0	80.0	50.0	80.0
N	(100)	(100)	(100)	(100)

Make it succinct!

Elaboration Paradigm

What happens to the original relationship within categories of the test variable?

Elaboration Paradigm

Percent delinquent by suitability of supervision		
	Suitability of supervision	
	Suitable	Unsuitable
% Delinquent	30.3	83.7
N	(628)	(375)

Source: Eleanor Maccoby 1960 data (reprinted in Travis Hirschi and Hanan Selvin, 1967, Delinquency Research: An Appraisal of Analytic Methods, New York: Free Press, p. 240)

Elaboration Paradigm

Percent delinquent by suitability of supervision by mother's employment						
	Housewife		Occasionally Employed		Regularly employed	
	Suitable	Un-suitable	Suitable	Un-Suitable	Suitable	Un-Suitable
% Delinquent	31.9	84.6	31.5	88.8	19.5	77.3
N	(457)	(149)	(89)	(116)	(82)	(110)

Source: Eleanor Maccoby 1960 data (reprinted in Travis Hirschi and Hanan Selvin, 1967, Delinquency Research: An Appraisal of Analytic Methods, New York: Free Press, p. 240)

Elaboration Paradigm

Percentage delinquent by mother's employment			
	Housewife	Occasionally employed	Regularly employed
% Delinquent	44.9	63.9	52.6
N	(606)	(205)	(192)

Source: Eleanor Maccoby 1960 data (reprinted in Travis Hirschi and Hanan Selvin, 1967, Delinquency Research: An Appraisal of Analytic Methods, New York: Free Press, p. 240)

Elaboration Paradigm

Percent delinquent by suitability of supervision by mother's employment						
	Housewife		Occasionally Employed		Regularly employed	
	Suitable	Un-suitable	Suitable	Un-Suitable	Suitable	Un-Suitable
% Delinquent	31.9	84.6	31.5	88.8	19.5	77.3
N	(457)	(149)	(89)	(116)	(82)	(110)

Source: Eleanor Maccoby 1960 data (reprinted in Travis Hirschi and Hanan Selvin, 1967, Delinquency Research: An Appraisal of Analytic Methods, New York: Free Press, p. 240)

Elaboration Paradigm

Percent delinquent by church attendance (hypothetical)		
	Church attendance	
	Regular/often	Seldom/never
% Delinquent	44.0	56.0
N	(150)	(150)

Elaboration Paradigm

Percent delinquent by church attendance by age				
	<=14 years		>=15 years	
	Regular/ often	Seldom/ never	Regular/ often	Seldom/ never
% Delinquent	33.0	33.0	67.0	67.0
N	(100)	(50)	(50)	(100)

Testing hypotheses

Raw data: predicting traffic accidents			
Sex	Miles driven	Traffic accidents	N
Women	Few	Many	20
Women	Few	Few	180
Women	Many	Many	80
Women	Many	Few	20
Men	Few	Many	5
Men	Few	Few	45
Men	Many	Many	160
Men	Many	Few	40

Testing hypotheses

Hypothesis:

"Men are more accident prone than women"

X = ?

Y = ?

Original bivariate relationship

Percentage of traffic accidents by sex (hypothetical)		
Accidents	Men	Women
Few	34.0	66.7
Many	66.0	33.3
Total	100.0	100.0
N	(250)	(300)

Trivariate relationship

Percentage of traffic accidents by miles driven by sex (hypothetical)				
	Sex			
	Men		Women	
Accidents	Few	Many	Few	Many
Few	90.0	20.0	90.0	20.0
Many	10.0	80.0	10.0	80.0
Total	100.0	100.0	100.0	100.0
N	(50)	(200)	(200)	(100)

Elaboration Paradigm: using GSS

Hypothesis:

Women were more likely than men to vote for Bill Clinton in 1996

Elaboration paradigm

X = ?

Y = ?

Z = ?

Elaboration Paradigm

Review rules:

- ✓Percentage down (in direction of causality)
- ✓Compare across
- ✓Check N in columns

Original relationship

Percentage Voting for Clinton in 1996 by Sex		
	Sex	
1996 Vote	Men	Women
Clinton	55.4	65.1
Dole	44.6	34.9
Total	100.0	100.0
N	(634)	(877)

Source: General Social Survey, 1998

Original relationship

Rules for interpretation:

- ✓General statement about relationship (modeled on the hypothesis)
- ✓Compare specific percentages
- ✓GEE! (generalization, example, exception) (Miller, 2005)

Trivariate table

Percentage Voting for Clinton by Current Work Status by Sex				
	Sex			
	Men		Women	
1996 Vote	Currently Working	Not curr. working	Currently Working	Not curr. working
Clinton	52.7	63.0	67.7	60.8
Dole	47.3	37.0	32.3	39.2
Total	100.0	100.0	100.0	100.0
N	(469)	(165)	(548)	(329)

Source: General Social Survey 1998

Trivariate table

Percentage Voting for Clinton by Sex by Current Work Status				
	Current work status			
	Currently working		Not currently working	
1996 Vote	Men	Women	Men	Women
Clinton	52.7	67.7	63.0	60.8
Dole	47.3	32.3	37.0	39.2
Total	100.0	100.0	100.0	100.0
N	(469)	(548)	(165)	(329)

Source: General Social Survey 1998

Interpreting trivariate tables

Trivariate mantra:

What happens to the original relationship within categories of the test variable?

Refinements to elaboration paradigm: suppressor and distorter variables

- Suppressor variable (relationship emerges):
  bivariate = no relationship
  trivariate = positive or negative relationship
- Distorter variable (relationship switches):
  bivariate = positive relationship
  trivariate = negative relationship
  (or negative to positive)

3 dimensional tables: basic table

Percentage believing abortion should be available by educational degree and religion, 1977-78

	Educational degree							
	LT HS		HS grad/Jr. coll.		BA degree		Grad degree	
Abortion belief	Prot.	Cath.	Prot.	Cath.	Prot.	Cath.	Prot.	Cath.
Should Be available	22.8	30.2	35.4	28.1	49.4	27.5	55.0	34.8
N	(666)	(232)	(1008)	(409)	(160)	(69)	(80)	(23)
Chi-square	p=.03		p=.01		p=.00		p=.09	

General Social Survey, 1977-78

3-D table: statistical interaction

Percent believing abortion should be available by educational degree and religion, 1977-78

	Educational degree			
Religion	LT HS	HS grad/Jr. coll	BA degree	Grad degree
Protestant	22.8* (666)	35.4* (1008)	49.4* (160)	55.0 (80)
Catholic	30.2 (232)	28.1 (409)	27.5 (69)	34.8 (23)

General Social Survey, 1977-78
Note: *=Chi square for religion, p=<.05

3-D table:
statistical interaction

Percent believing abortion should be available by educational degree and religion, 2000-04				
	Educational degree			
Religion	LT HS	HS grad/Jr. coll	BA degree	Grad degree
Protestant	23.4 (291)	34.7 (1140)	40.2 (264)	50.4 (135)
Catholic	26.2 (119)	34.2 (535)	37.0 (136)	44.8 (63)

General Social Survey, 2000-04
Note: Chi square (no p values for religion less than .05)

Additive relationship
(hypothetical)

	Educational degree			
Religion	LT HS	HS grad/Jr. coll.	BA degree	Grad degree
Protestants	40.0	45.0	55.0	75.0
Catholic	30.0	35.0	45.0	65.0

Statistical interaction

Question to ask:

"Does the effect of one variable (X) on another (Y) remain the same for all groups of the third (Z) variable?"