

Logic of Causation

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

Why?

Causality

Bivariate relationship (2 variables)

X → Y

(Cause)

Independent
variable

(Effect)

Dependent
variable

Causality

Multivariate relationship
(3+ variables)

X

Y

Z

(Causes)

(Effect)

Independent
variables

Dependent
variable

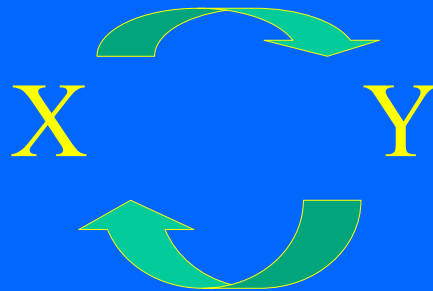
Criteria for Causality (n=3)

1) Cause must precede effect:

X → Y

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)

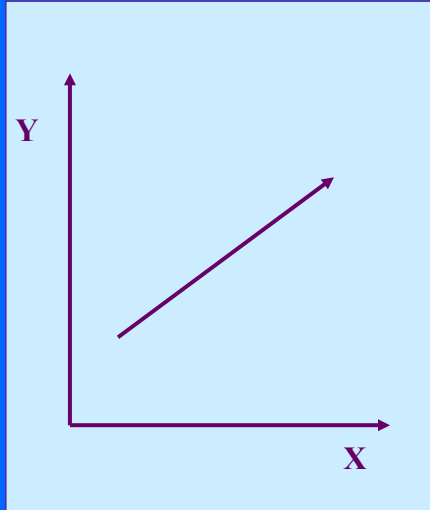
X = # firefighters

Y = amt. of damage

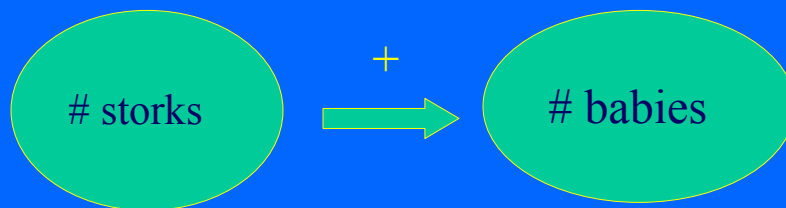
Criteria for Causality

$X \xrightarrow{+} Y$

$X = \# \text{ firefighters}$
 $Y = \text{amt. of damage}$



Spurious relationship?



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”

Elaboration Paradigm

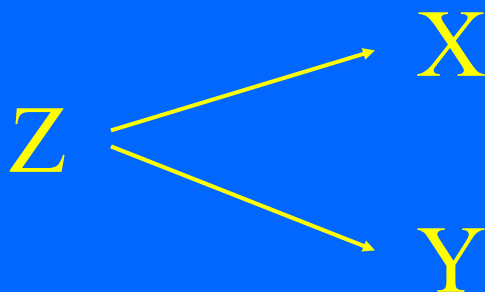
- Purpose: to understand nature of observed relationships
- Test: for spuriousness
- Move: from bivariate table to trivariate table
- Evaluate for possible outcomes: replication, explanation, interpretation, specification

Elaboration Paradigm

(Babbie, p. 422)

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

Explanation:



Interpretation:



Elaboration Paradigm

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

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)		
	<u>Got married in grad school</u>	
<u>Got Ph.D.</u>	<u>Yes</u>	<u>No</u>
Yes	65.0	80.0
N	(200)	(200)

Succinct table reduces redundancy

Elaboration Paradigm

Percentage receiving Ph.D. by getting married by sex (hypothetical)

	<u>Sex</u>			
	<u>Men</u>		<u>Women</u>	
<u>Got Ph.D.</u>	<u>Married</u>	<u>Didn't marry</u>	<u>Married</u>	<u>Didn't marry</u>
Yes	80.0	80.0	50.0	80.0
No	<u>20.0</u>	<u>20.0</u>	<u>50.0</u>	<u>20.0</u>
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)

	<u>Sex</u>			
	<u>Men</u>		<u>Women</u>	
<u>Got Ph.D.</u>	<u>Married</u>	<u>Didn't marry</u>	<u>Married</u>	<u>Didn't marry</u>
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

	<u>Suitability of supervision</u>	
	<u>Suitable</u>	<u>Unsuitable</u>
<u>% Delinquent</u>	30.3	83.7
<u>N</u>	(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

	<u>Housewife</u>		<u>Occasionally Employed</u>		<u>Regularly employed</u>	
	<u>Suitable</u>	<u>Un-suitable</u>	<u>Suitable</u>	<u>Un-Suitable</u>	<u>Suitable</u>	<u>Un-Suitable</u>
% 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

	<u>Housewife</u>	<u>Occasionally employed</u>	<u>Regularly employed</u>
% 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

	<u>Housewife</u>		<u>Occasionally Employed</u>		<u>Regularly employed</u>	
	<u>Suitable</u>	<u>Un-suitable</u>	<u>Suitable</u>	<u>Un-Suitable</u>	<u>Suitable</u>	<u>Un-Suitable</u>
% Delinquent	31.9	84.6	31.5	88.8	19.5	77.3
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Elaboration Paradigm

Percent delinquent by church attendance (hypothetical)

	<u>Church attendance</u>	
	<u>Regular/often</u>	<u>Seldom/never</u>
% Delinquent	44.0	56.0
N	(150)	(150)

Elaboration Paradigm

Percent delinquent by church attendance by age

	<u><=14 years</u>		<u>>=15 years</u>	
	<u>Regular/ often</u>	<u>Seldom/ never</u>	<u>Regular/ often</u>	<u>Seldom/ never</u>
% Delinquent	33.0	33.0	67.0	67.0
N	(100)	(100)	(50)	(100)

Testing hypotheses

Raw data: predicting traffic accidents

<u>Sex</u>	<u>Miles driven</u>	<u>Traffic accidents</u>	<u>N</u>
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

Original bivariate relationship

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

Trivariate relationship

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

Elaboration Paradigm

Hypothesis:

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

Elaboration Paradigm

Review rules:

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

Original relationship

<u>1996 Vote</u>	<u>Sex</u>	
	<u>Men</u>	<u>Women</u>
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

Trivariate table

Percentage Voting for Clinton by Current Work Status by Sex				
	<u>Sex</u>			
	<u>Men</u>		<u>Women</u>	
<u>1996 Vote</u>	<u>Currently Working</u>	<u>Not curr. working</u>	<u>Currently Working</u>	<u>Not curr. working</u>
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

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

<u>Percentage believing abortion should be available by education and religion</u>								
	<u>Education</u>							
	<u><=8 yrs.</u>		<u>9-11 yrs.</u>		<u>H.S. grad</u>		<u>College+</u>	
<u>Abortion belief</u>	<u>Cath.</u>	<u>Prot.</u>	<u>Cath.</u>	<u>Prot.</u>	<u>Cath.</u>	<u>Prot.</u>	<u>Cath.</u>	<u>Prot.</u>
Should Be available	31.0	29.0	33.0	36.0	33.0	43.0	31.0	51.0
N	(90)	(287)	(96)	(250)	(89)	(256)	(75)	(225)

3-D table: statistical interaction

Percent believing abortion should be available by education and religion

	<u>Education</u>			
<u>Religion</u>	<u><=8 yrs.</u>	<u>9-11 yrs</u>	<u>H.S. grad</u>	<u>College+</u>
Catholic	31.0 (90)	33.0 (96)	33.0 (89)	31.0 (75)
Protestant	29.0 (287)	36.0 (250)	43.0 (256)	51.0 (225)

Additive relationship (hypothetical)

	<u>Education</u>			
<u>Religion</u>	<u><=8 yrs.</u>	<u>9-11</u>	<u>H.S. grad</u>	<u>College+</u>
Catholic	30.0	35.0	45.0	65.0
Protestants	40.0	45.0	55.0	75.0

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?”