Research Methods in Psychology

Review and Prospects

Research Methods: Goals

1. Introduce fundamental skills in psychological research
2. To facilitate your understanding of substantive courses
3. To make you a better consumer of scientific information

Research Methods in Psychology

The hallmark of science is testability of theory; non-testable theories are not science

a) Need to pit theories against each other

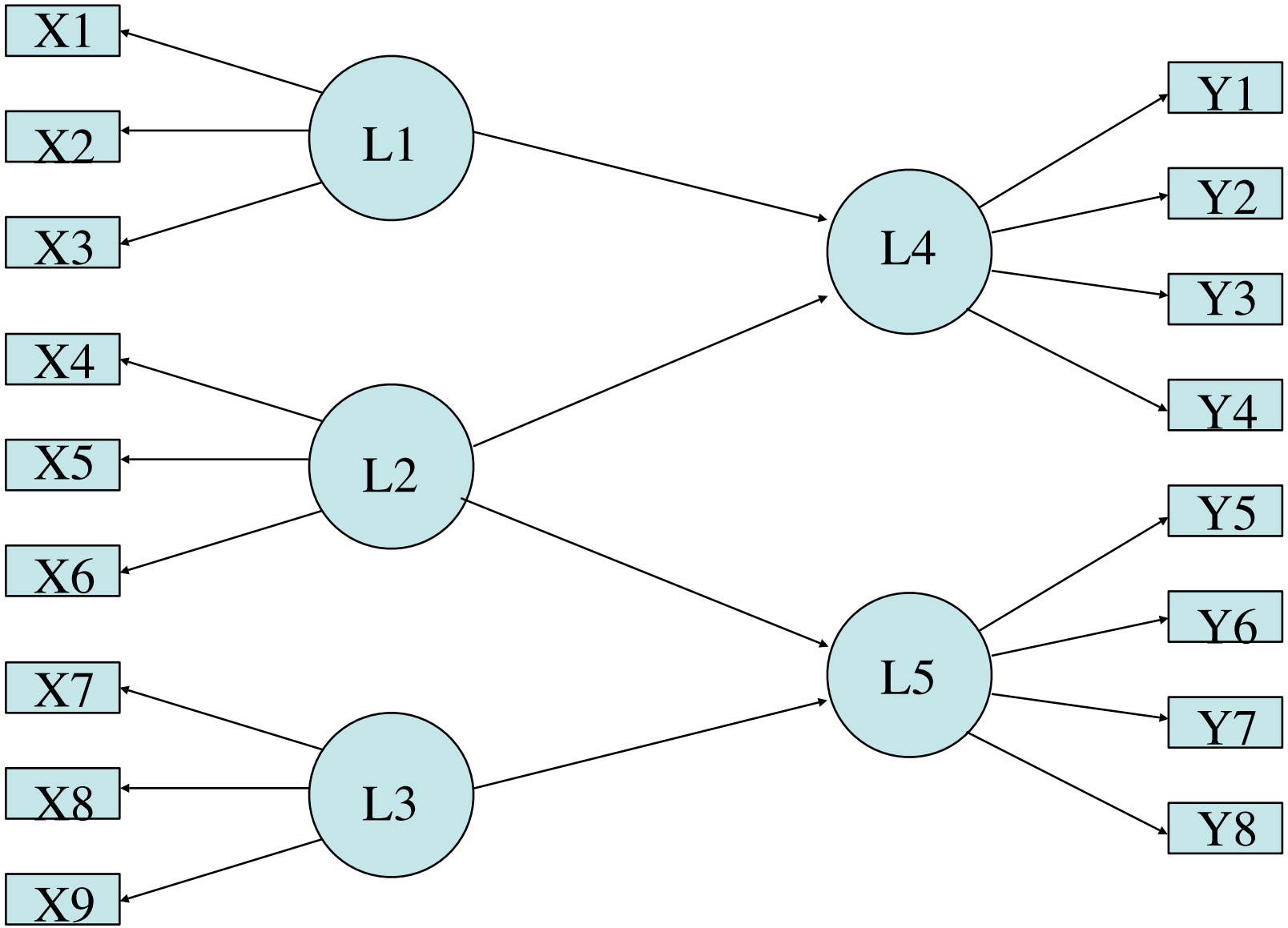
b) Theory testing as a series of pruning alternatives

How do we develop and test theory?

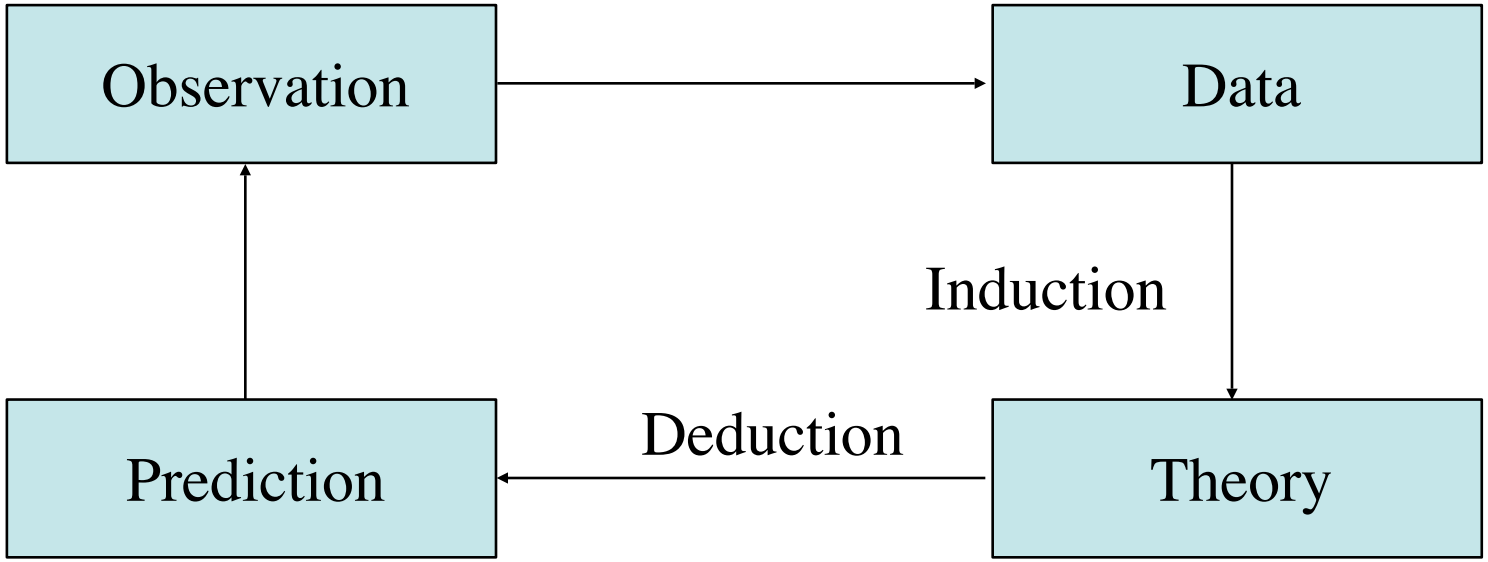
Theory development and testing

- Theories as organizations of observables
- Constructs, latent variables and observables
  - Observables
    - Multiple levels of description and abstraction
    - Multiple levels of inference about observables
    - What is observed or not observed is part of theory
  - Latent Variables
    - Latent variables as the common theme of a set of observables
    - Central tendency across time, space, people, situations
  - Constructs as organizations of latent variables and observed variables

Theory as an organization of observables



Reasoning in Research



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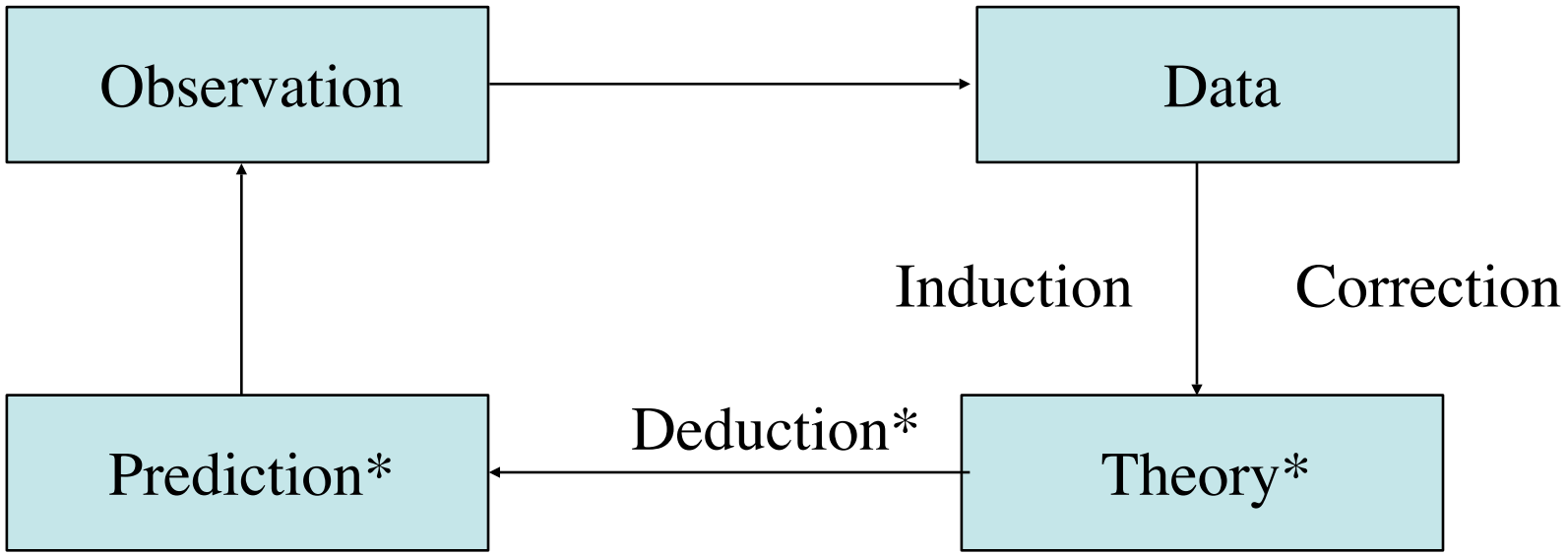


Induction from data and Deduction from theory

1. Data --> Induction --> Theory
2. Theory --> Deduction --> Prediction/confirmation
3. Logical reasoning: Consider theory

If P, then Q

Appropriate Logical deductions

1) P --> Q Affirm the Antecedent

2) Not Q --> Not P Deny the Consequent

Incorrect logical deductions

1) Not P -> Not Q deny the antecedent

2) Q --> P affirming the consequent

J. Platt and Strong Inference

(Science, 1964)

4 signs of strong science

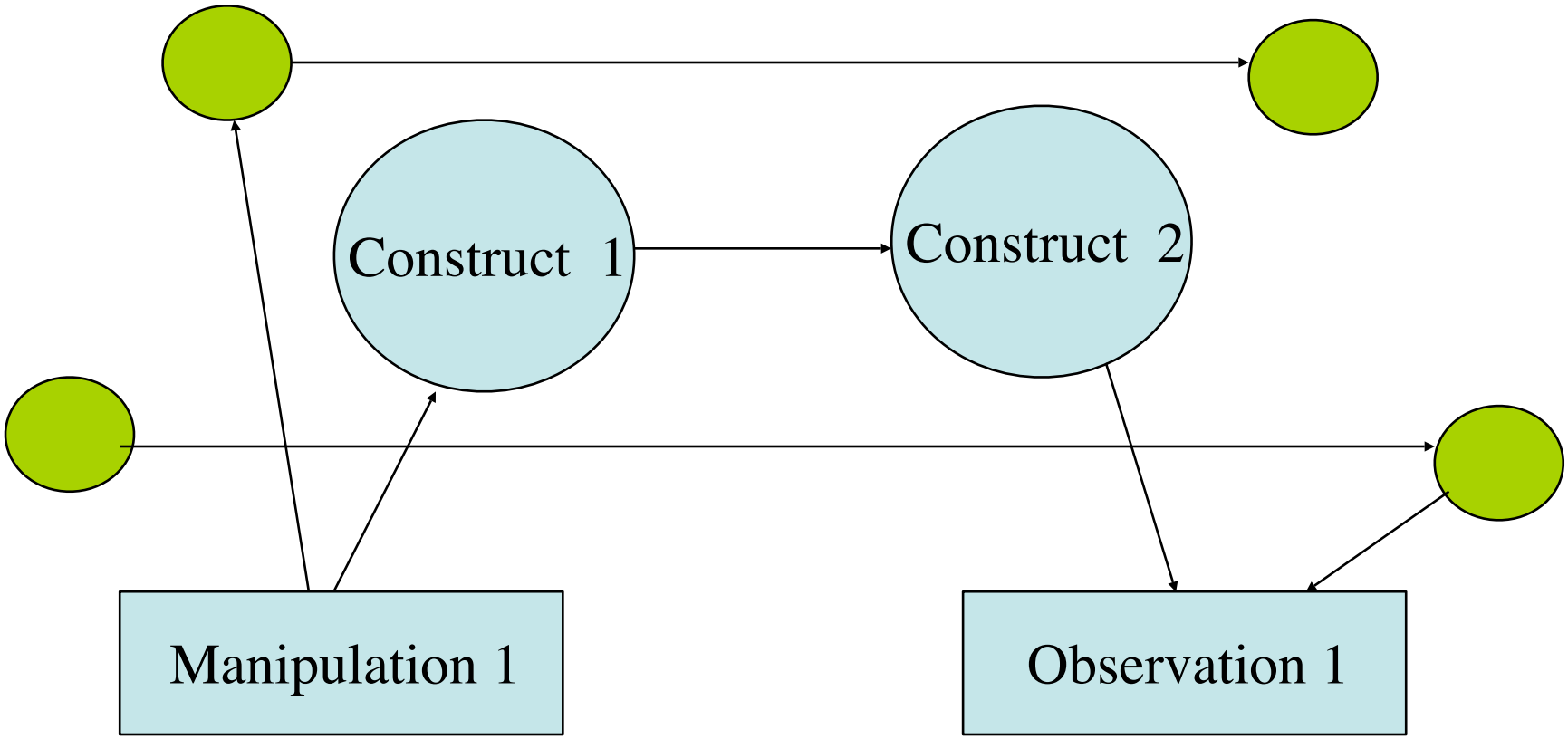
Devising alternative hypotheses

Devising a crucial experiment (or several of them), with alternative possible outcomes, each of which will, as nearly is possible, exclude one or more of the hypotheses

Carrying out the experiment so as to get a clean result

Recycling the procedure, making subhypotheses or sequential hypotheses to refine the possibilities that remain, and so on.

Theory and Theory Testing
Multiple constructs, multiple Explanations



Reasoning in Research

Observe, Induce, Deduce, Predict, Observe

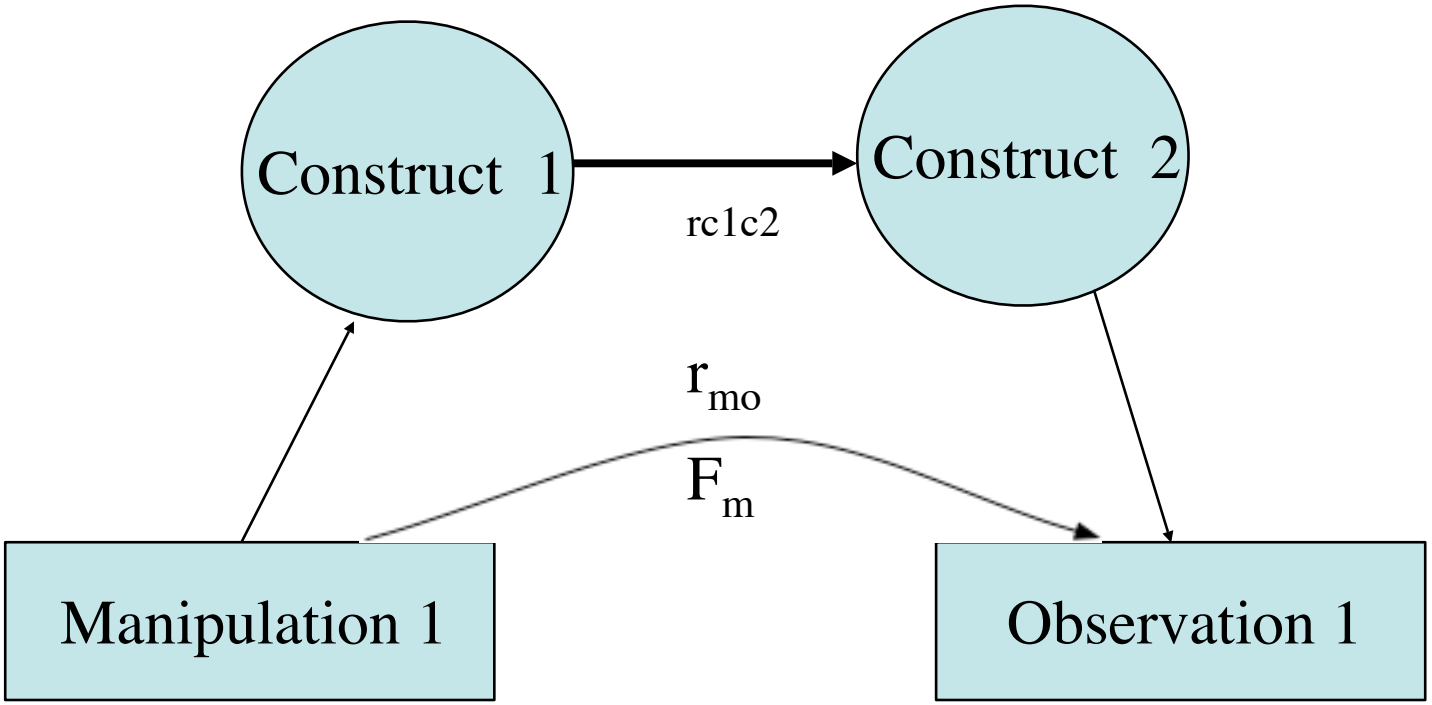
Disconfirm, don't confirm

Prune the tree of alternative explanations

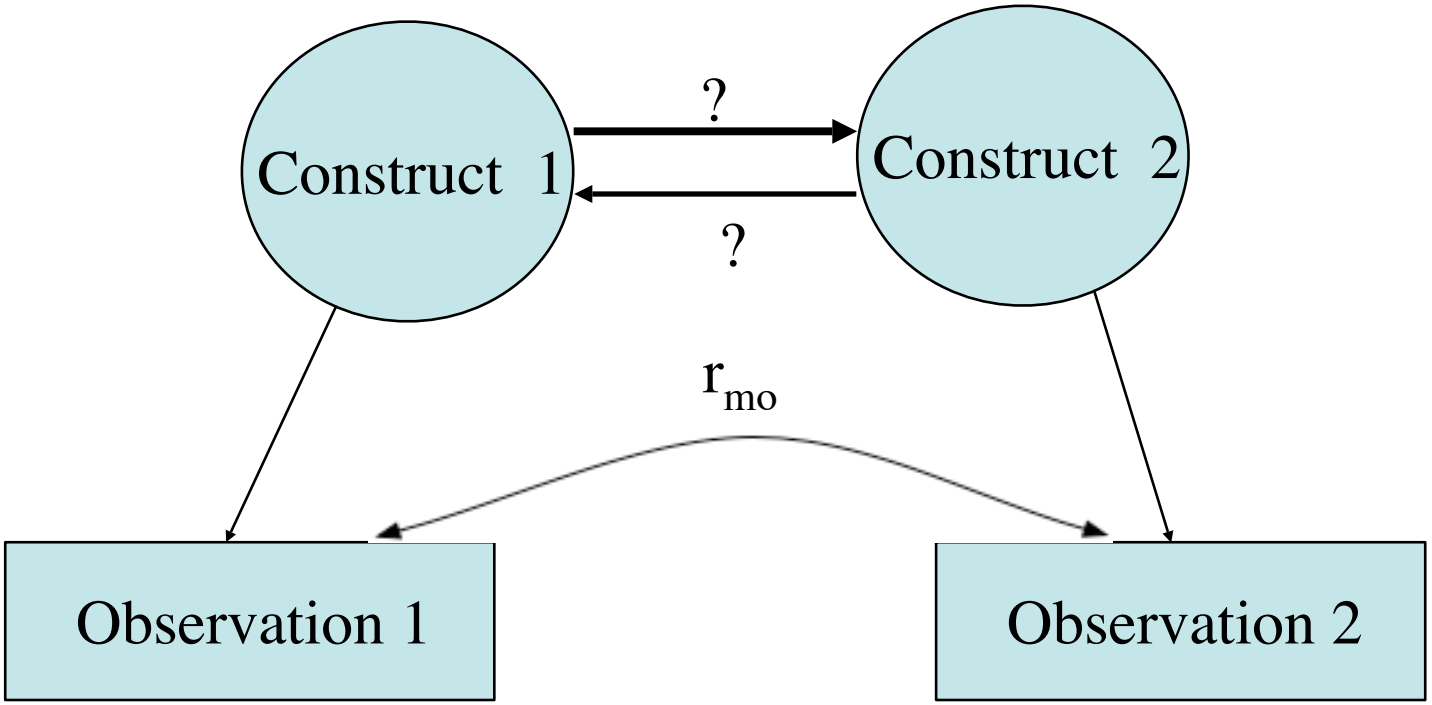
Theory and Theory Testing: Types of Designs

- Experimental
  - Manipulation of at least one variable - Independent Variable (IV)
  - Effect on (at least one) other variable - Dependent Variable (DV)
- Correlational
  - Observation of the relationship between two variables
  - Inability to determine causality
- Quasi experimental -- Field studies
  - Direct relevance
  - Difficult to have appropriate controls

Theory and Theory Testing II: Experimental manipulation



Theory and Theory Testing III: Correlational inference



Overview of the problem

1) Theoretical problem: understanding the relationship between latent variables (constructs)

   a) relationships among latent variables

   b) relationships between latent variables and observed variables

2) Generalization of results and threats to external validity

3) Proper design maximizes internal validity

Types of Measures

- Direct
  - Self report measures of desires, beliefs, knowledge
  - Peer and other ratings of behavior
- Indirect
  - Reaction time as measures of:
    - implicit attitudes
    - cognitive availability
  - Psychophysiological measures of processing
    - EEG, MRI, SPEC, SC, HR, BP, etc.
- Unobtrusive

  Archival

  Observational

Issues of Measurement

- Inferences from observed differences to theoretical differences
  - What is the relationship between latent variable and observed variable?
    - Ratio scales
    - Interval scales
    - Ordinal scales
- Implications of measurement to theoretical inference
  - We are making inferences about unobserved constructs given observed data

Statistical Description and Inference

- Sampling theory: generalizing from a sample to a population
  - Sample estimates have sampling error
  - Need to consider both the sample estimate and the error of the estimate
- Comparisons of group differences reflect real difference and sampling error

- Data = Theory + Error
- Observed Variance = Explained Variance + Error Variance

Generalization of results and threats to external validity-I

- Limitations of generalization for subjects
- Limits of generalization for conditions -interactions with other variables

Generalization of results and threats to external validity-II

limits of generalization for conditions -- interactions with other variables

(1) problems and benefits of interactions

xy relationship depends upon z

(2) interactions limit generalization

(3) interactions test theoretical limits

Practical problems and threats to internal validity

1 Manipulations affect more than the construct of interest

a) examples:

(1) caffeine induces alertness and motor tremor

(2) failure induces anxiety, depression, anger

(3) practice leads to motivational changes as well as changes in skill

2 Observable variables reflect more than the construct of interest

a) self report of alertness reflects base line differences

b) cognitive performance--ability, motivation, training, practice

c) slowness of responding reflects caution as well as process speed

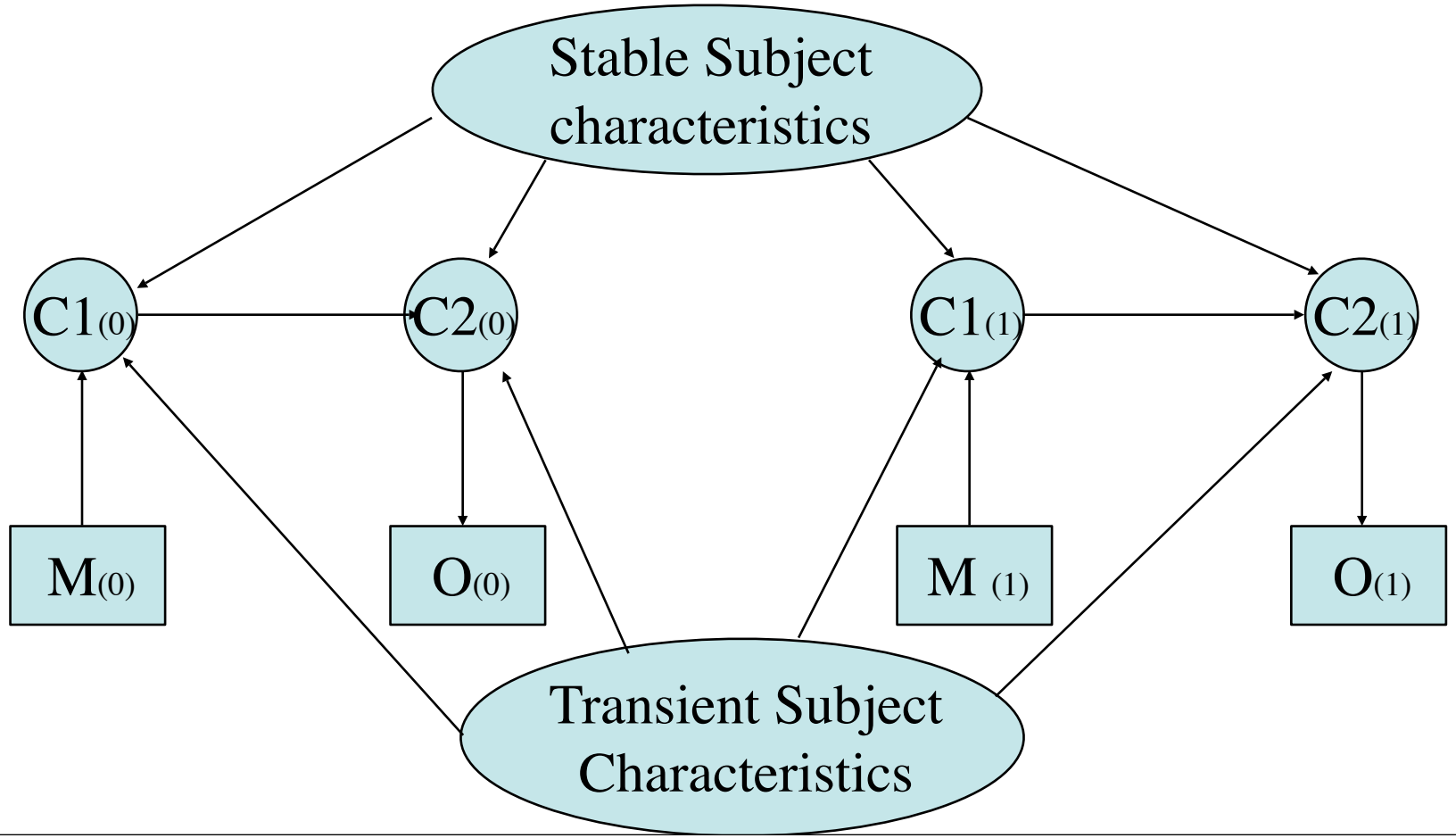
Types of relationships and research designs

- One Factor designs
  - Linear, monotonic, with or without inflection
  - Non-monotonic effects
- Two factor designs
  - Simple additive effects
  - Additive and ordinal interactions
  - Disordinal interactions

Experimental Designs

- Within Subjects
  - Controls for subject variability
  - Sensitive to within subject changes such as fatigue, learning, differential transfer
- Between subjects
  - Controls for within subject changes
  - Sensitive to between subject variability
    - Effects due to subject selection, attrition, randomization
- Mixed designs

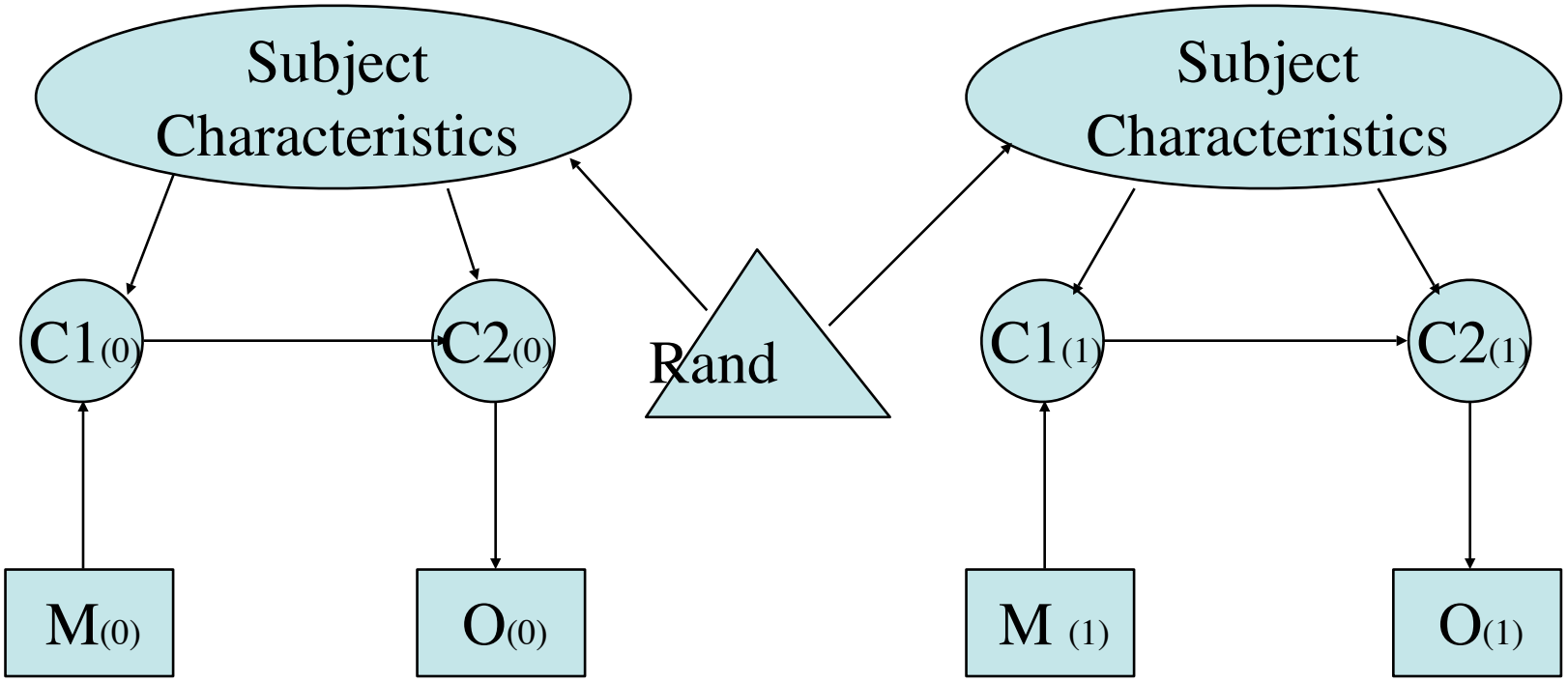
Theory and Theory Testing II: Experimental manipulation- Within Subjects



Between Subject designs

- Subject variables as threat to external validity
- Confounded effects that can lead to subject variability
- Randomization as a control
  - but does not guarantee control in any one study, just guarantees that the confounded variables have zero correlation in the long run

Theory and Theory Testing II: Experimental manipulation- Between Subjects



Randomization breaks the link confounding subjects and conditions

Between Subject designs

- Subject variables as threat to external validity
  - Ability
  - Practice
  - Motivation
  - Interest
  - Gender
  - Age
  - Culture

Between Subject designs

- Confounded effects that can lead to subject variability
  - Time of day
    - Naturally occurring rhythms of alertness
    - Classroom effects
    - Fatigue
  - Time of week, month, season, year
    - Class schedules
      - Mid terms
      - Papers
    - Weather
  - Volunteer effects
  - Experimenter-Subject interactions

Randomization as a control

- Only the expected values of groups are equal --not the observed values
  - In any particular experiment, groups are not equivalent
  - Expected value of the (signed) group difference=0
  - Randomization does not introduce systematic bias

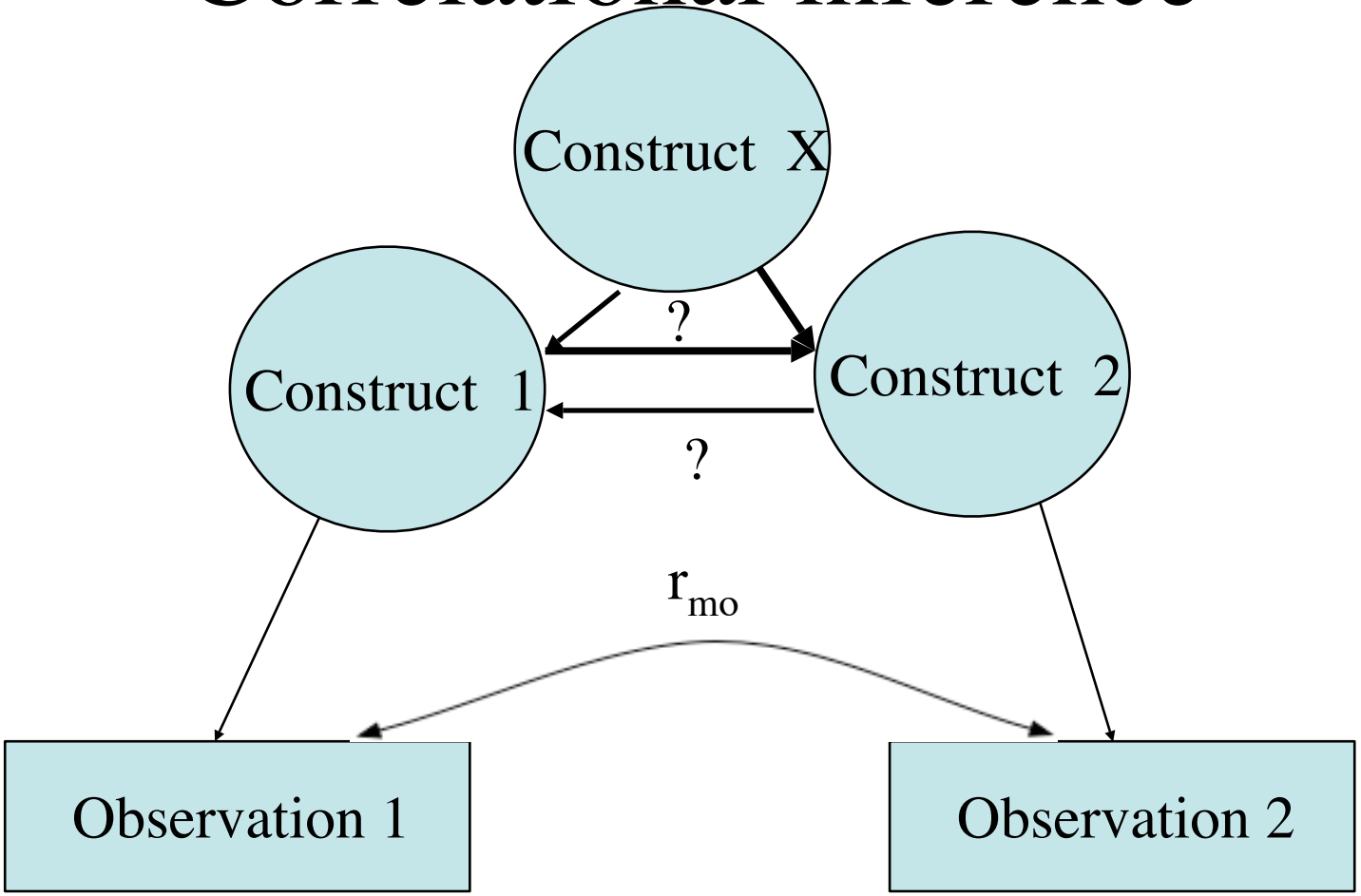
Types of Randomization

- Subjects matched on variable of interest and then assigned to condition
- Blocking to control for order effects
  - Ignores stable subject effects
  - Eliminates subject effects associated with time of appearance
- Complete randomization
  - "failures" of randomization
  - Problems at the end of the experiment
    - Power is maximized with equal cell sizes
    - Randomization will tend not to produce equal size groups

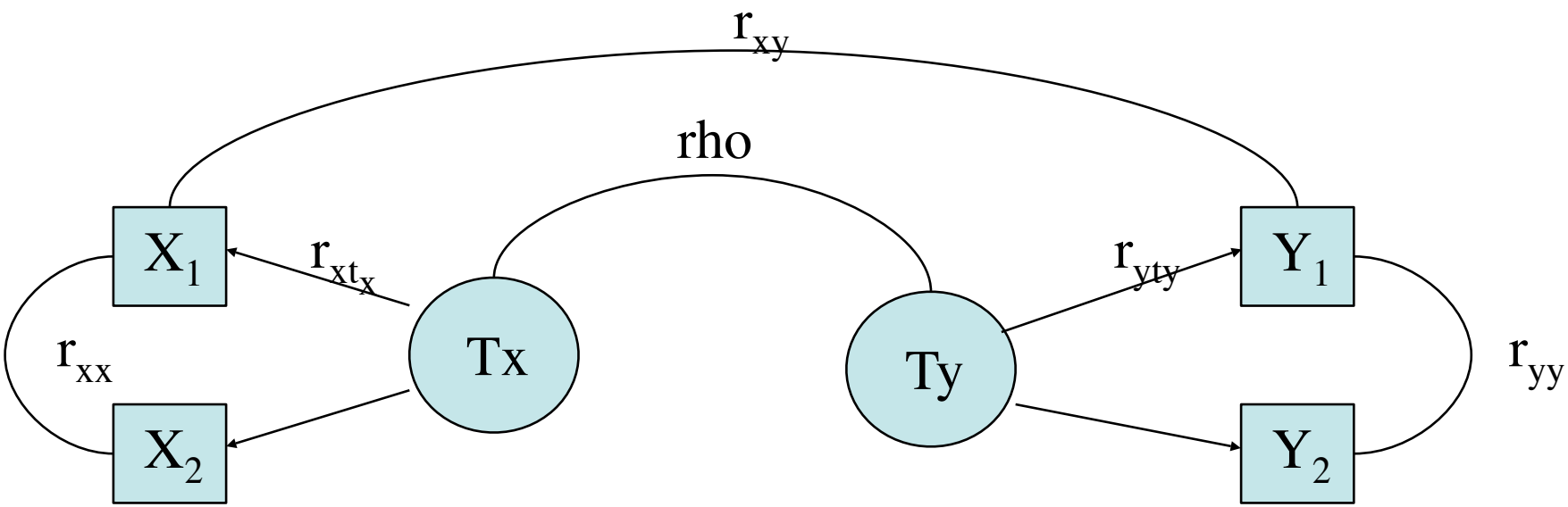
Steps in correlational inference

- Estimate the reliability of the variables
  - Magnitude of correlation is influenced by the reliability of the correlation
  - Varieties of reliability
    - (can you measure the same thing twice?)
- Estimate the construct validity of the measures
    - (Are you measuring what you think you are measuring?)
  - Convergent, Discriminant, Incremental validity
- Consider alternative explanatory variables

Theory and Theory Testing IV: Correlational inference



Reliability- Correction for attenuation



$r_{xt_x} = \text{sqrt}(r_{xx})$

$r_{yty} = \text{sqrt}(r_{yy})$

$\text{rho} = \text{rxy}/\text{sqrt}(r_{xx} * r_{yy})$

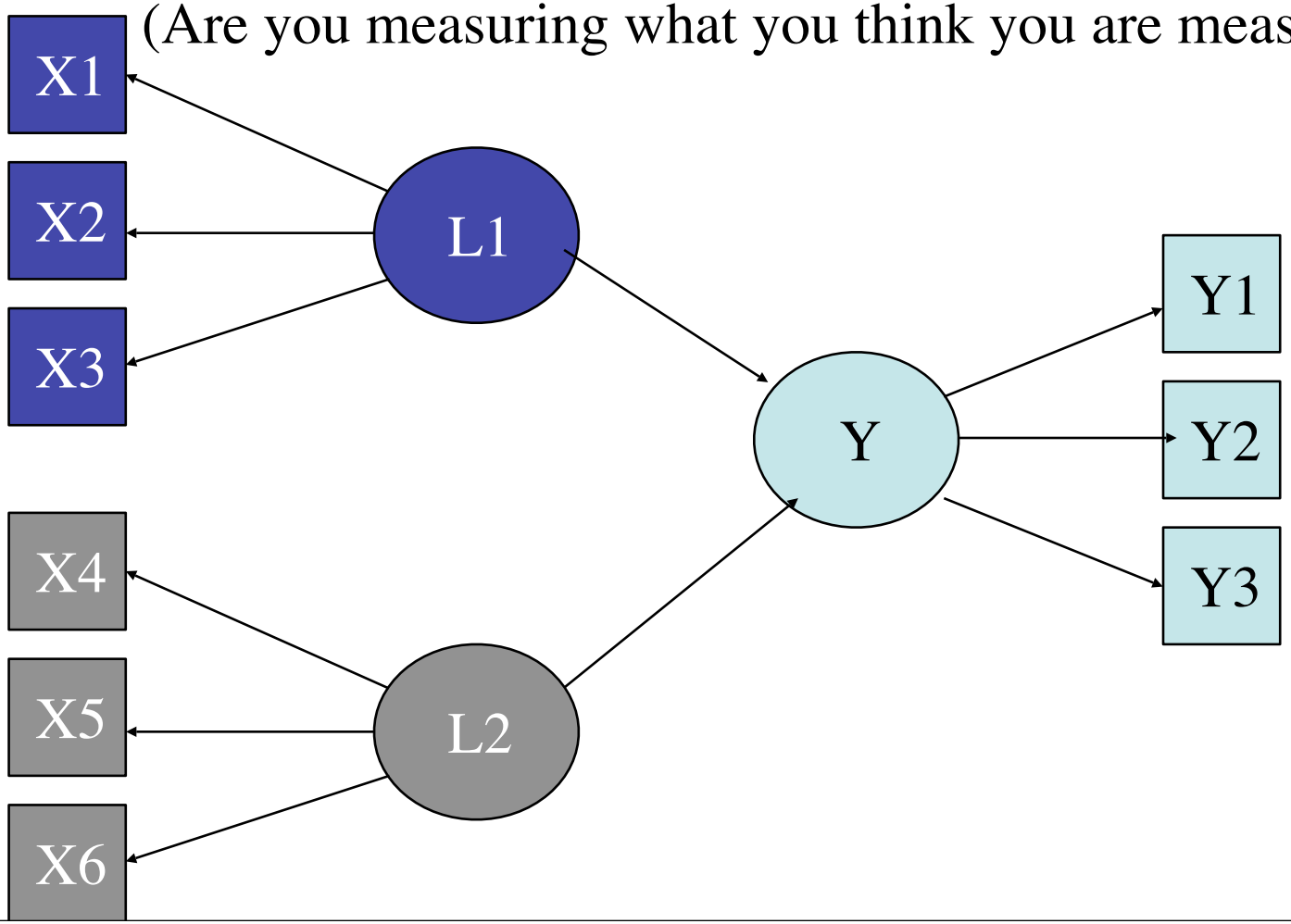
Varieties of reliability coefficients

(can you measure the same thing twice)

Generalize across	Type of reliability
Items	Internal consistency
	split half
	alpha
Forms	Alternate forms
Time	Test-retest
Raters	Interrater reliability

Construct Validity: Convergent, Discriminant, Incremental

(Are you measuring what you think you are measuring)



Alternatives to Experiments

- Real Experiments
  - Within subjects
  - Between subjects (random assignment)
- Quasi Experiments
  - Field studies, lack of subject assignment
- Correlational/Observational

Quasi Experimental Designs

- Post Test Only
- Post Test only with non-equivalent groups
- One Group - Pre Test- Post Test
- Untreated control group pretest-posttest
- Multiple Levels pretest - post test

Pitfalls in Research

- Investigator Effects
  - Investigator Paradigm effect
  - Investigator design effects
  - Investigator loose procedures effects
  - Investigator analysis effects
  - Investigator fraud effects

Pitfalls in Research

- Experimenter Effects
  - Experimenter characteristics effects
  - Experimenter procedural effects
  - Experimenter data recording effects
  - Experimenter expectancy effects
  - Experimenter fraud effects
- Recommendations
  - Tighten theory, design, execution
  - Consider statistical interpretation

Type 1 and Type 2 errors

	State of World Groups are from	
	Same population	Different population
Scientist says		
Same population	Correct failure to reject H_0	Incorrect failure to reject H_0 Type 2 error
Different population	Incorrect rejection of H_0 Type 1 error	Correct rejection of H_0

Science and error

- Type 1 errors can happen to you (or me)!
  - Experiment wide error rate is a function of the number of tests run = 1- (1-alpha)^n
  - Bonferoni correction sets experiment wide error rate by using a correction for the number of tests = alpha/n
  - This is somewhat conservative but better than pretending that type 1 errors don't happen
- Type 2 errors happen due to lack of power
  - If the study is too small, important effects will probably not be detected

Ethical principles

- Basic summary
  - Do no harm
  - Be honest
  - Be fair
- Specific guidelines
  - American Psychological Association
  - National Academy of Sciences
  - Institutional Review Boards

Researching the literature

- What has gone before - Science as an accumulation of knowledge
- Original publications in peer reviewed journals
  - Produce new results based upon prior theory
  - Include references to prior work
- Literature searching with database tools
  - Psych Info, SSCI,

Writing a scientific paper

- Purpose is to add to the accumulated knowledge base
- Reviews prior work
- Methods are clearly stated so that others can replicate if they choose
- Results are appropriately analyzed so that someone else would reach similar conclusions
- Discussion links results to prior work and suggests future directions

Final Project

- Conceptualize an interesting problem
- Design a study to test a hypothesis concerning this problem
- Execute the study following the design
- Analyze appropriately
- Report in a scientific manner

The Psychology Major at NU