Developing a Theory

- Step 1: Define the scope (domain)
- Step 2: Know the research literature
- Step 3: Formulate your theory
- Step 4: Test your theory empirically
  - Successful postdiction
  - Successful prediction
# Recasting Theoretical Statements

<table>
<thead>
<tr>
<th>What something seems to be</th>
<th>What it is in reality (or vice versa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Disorganized</td>
<td>• Organized</td>
</tr>
<tr>
<td>• Heterogeneous</td>
<td>• Single element</td>
</tr>
<tr>
<td>• Property of persons</td>
<td>• Property of system</td>
</tr>
<tr>
<td>• Local</td>
<td>• General</td>
</tr>
<tr>
<td>• Stable, unchanging</td>
<td>• Unstable, changing</td>
</tr>
<tr>
<td>• Ineffective</td>
<td>• Effective</td>
</tr>
</tbody>
</table>
Recasting Theoretical Statements

- Bad
- Unrelated
- Coexisting
- Positively correlated
- Similar
- Cause

- Good
- Correlated
- Incompatible
- Negatively correlated
- Opposite
- Effect
Selection of the Research Problem and Design

Operational definitions
Operational Definitions

An *operational definition* is a clearly defined set of procedures for obtaining a measure of the construct of interest.

It would not be possible to use *objective methods* that are essential to scientific inquiry without operational definitions.

In some sciences such as physics, the exact same procedure is agreed upon by all for all experiments involving a particular construct, but in psychology things are not as rigidly defined.

The key to an acceptable operational definition is that the procedure is specified precisely enough to allow replication by others.

*Examples:*

- **quality of memory** -- accuracy of recall in a certain task
- **depression** -- Beck Depression Inventory (survey) score
- **arousal** -- galvanic skin response (conductivity of the surface of the skin)
• **Theoretical Variable** -- This is what we are *really* interested in. The actual thing that we would like to study. Examples: love, depression, memory, aggression.

• It is very important to keep in mind that the *operational definition is NOT the theoretical variable.*

• Instead, an operational definition offers only an imperfect, indirect measure of the theoretical variable of interest.
Operational Definitions: Example

Ethnic Identity

1. Ethnic activities
2. Ethnic friends
3. Language
4. Sense of belongingness

Verbal Statement

Operational Definition (empirical referents)
Selection of the Research Problem and Design

Variable – single measure (e.g., ethnic ID)

Construct – latent variable

Ethnicity

- Ethnic identity
- Acculturation
- Discrimination
Types of Variables

• Manipulated variables - Conditions or instructions (e.g., treatments)

• Participant or individual variables
  – Usually cannot be manipulated (e.g., age)
  – Can ethnicity be experimentally manipulated?
Selection of the Research Problem and Design: True Experiment

- Random assignment
- Maximum control over variables
- Control over sources of bias
- Randomized controlled clinical trials (RCTs)
Empirically Supported Treatments

- **Well-established**
  - 2 RCTs or 10 single-case design expts by at least 2 independent investigators, demonstrating superiority to pill, placebo, or other tx

- **Probably efficacious**
  - 2 expts demonstrating tx > control, 1 RCT, or 4 single-case design

- **Possibly efficacious**
  - 1 study w/out conflicting evidence
Empirically Supported Treatments

- Treatment manual
- Inclusion criteria for sample
- Reliable, valid outcome measures
- Appropriate data analyses
Empirically-Supported Treatments

• Limited evidence that these treatments are efficacious for ethnic minority groups
Selection of the Research Problem and Design: Quasi-Experiments

- All features of an experiment cannot be controlled (e.g., nonrandom assignment)
Selection of the Research Problem and Design: Types of Research

• Case control designs
  – Selection of participants who vary on a characteristic of interest
  – Cross-sectional
Data Analyses

Correlation
Correlational Research
Major Features

• No independent variables are manipulated
• Two or more variables are measured and a relationship established
• Correlational relationships can be used for predictive purposes
  • predictor variables
  • criterion variables
• “Silent” about causality
A coefficient of correlation is a number that indicates the strength and direction of the correlation between two variables. Pearson’s $r$ is a kind of coefficient of correlation. Its values range from -1.00 to +1.00.

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Negative Pearson r values indicate a negative or inverse relationship between the variables.

Positive Pearson r values indicate a positive relationship between the variables.

A Pearson r value of zero indicates that there is no relationship between the variables.

Notice that both positive and negative Pearson r values suggest a predictive relationship between the two variables.
Is there a predictive relationship between arousal level and performance? (Pearson’s $r = 0.0$)

While it is clear that arousal level influences performance, the effect is **nonlinear**. Pearson’s $r$ is only useful for revealing **linear** relationships between variables. In this case, the Pearson’s $r$ value of 0.0 is a poor indicator of whether arousal level and performance are truly related.
The **third variable problem**: A correlation between two variables might be explained by yet another variable that has an effect on both of the observed variables.

**Examples:**

(1) Sales of ice cream and drowning rates are correlated.
(2) The number of crimes and the number of churches in a city are correlated.

In the cases above, a 3rd variable is probably influencing both of the measured variables. The common influence of the 3rd variable might explain why the measured variables seem to move together.
Third Variable Problem

Ice Cream Consumed + Temperature → Number of Drownings
Third Variable Problem

Number of Churches

Size of Population

Number of Crimes
Data Analyses

Mediation and Moderation
Mediation

A ----> C

Ethnic group ----> B ----> Poverty ----> C

Ethnic group ----> A ----> C

Crime
Moderation

A → B

Psychotherapy → Ethnic

C

Ethnic match

C

Ethnic mismatch

minority clients
Data Analyses

Paths to a Particular Outcome
Directionality of Effect Problem

X
Class Attendance

Y
Higher Grades

X
Class Attendance

Y
Higher Grades
The **directionality problem**: If there is a real relationship between two variables, what is the *direction* of the causal relationship?

Example: What is the relationship between (1) a preference for violent T.V. and (2) overt aggressive behavior? (from Eron et al., 1972)

![Diagram showing correlation between preference for violent TV, aggression in third grade, and aggression in 13th grade.]

These data suggest that preference for violent TV might have a real causal effect on later aggression, because 3rd grade TV preference predicts later aggression. However, 3rd grade aggression does *not* predict later TV preferences, suggesting that aggression may *not* have a causal effect on TV preference.
Data Analyses

Subtypes
Subtypes of Depression

- Major Depression, Recurrent
- Dysthymic Disorder
- Major Depression in partial remission
- Major Depression superimposed on Dysthymic Disorder
Subtypes of African American Identity (Sellers et al., 1998)

- Nationalist ideology
  - African heritage
- Oppressed minority ideology
  - Similarities with other minority groups
- Assimilationist ideology
  - Similarities with mainstream Americans
- Humanist ideology
  - Similarities of all human beings
Experimental Research – Group Designs

- Sample should be representative of population
  - How representative must a sample be?
  - How does one recruit a representative sample?
- What is the rationale for the selection of a sample?
- In psychological research, random sampling is not usually invoked (Kazdin, 2003)
- Parsimony – Why should there be individual or group differences?
Population and Sample
Sampling

• “In psychological research…random sampling from a population is not usually invoked.” (Kazdin, p. 150).

• It is parsimonious to assume that lawful relationships from experiments with European Americans will generalize to other groups (p. 151)

• Rationale should be provided for the use of a sample (e.g., European Americans)
Random Assignment

- Decreases likelihood of differences between experimental and control groups
Differential Regression
Toward the Mean

- Random assignment decreases differential risk of regression toward the mean
Random Assignment

• What if random assignment inadvertently results in two groups that are different along some dimension?
  – Increase sample size to >40 per group
  – Statistical control (e.g., ANCOVA)
Randomized Matched Groups Design

Sample

Measure and match.

Group A

Randomly assign one member of each pair to each group.

Group B
Group Designs
Posttest Only Design

Group 1  Treatment  Posttest

Group 2  Posttest
<table>
<thead>
<tr>
<th>Group 1</th>
<th>Pretest</th>
<th>Treatment</th>
<th>Posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 2</td>
<td>Pretest</td>
<td></td>
<td>Posttest</td>
</tr>
</tbody>
</table>
## Solomon Four-Group Design

<table>
<thead>
<tr>
<th>Group 1</th>
<th>Pretest</th>
<th>Treatment</th>
<th>Posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 2</td>
<td>Pretest</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 3</td>
<td></td>
<td>Treatment</td>
<td></td>
</tr>
<tr>
<td>Group 4</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Between Subjects Designs

Different Subjects in Each Treatment Condition
Within Subjects Designs

Treatment Condition

\[ A_1 \]
\[ S_1 \]
\[ S_2 \]
\[ S_3 \]
\[ S_4 \]
\[ S_n \]

\[ A_2 \]
\[ S_1 \]
\[ S_2 \]
\[ S_3 \]
\[ S_4 \]
\[ S_n \]

\[ A_3 \]
\[ S_1 \]
\[ S_2 \]
\[ S_3 \]
\[ S_4 \]
\[ S_n \]

Same Subjects Across Treatment Conditions
When to Use a Within-Subjects Design

- Participant variables make it difficult to create a comparable control group
- It is important to economize on number of participants
- When you want to assess the effects of increasing exposure on behavior
Disadvantages of Within-Subject Designs

- You cannot assume the person is exactly the same after exposure to the first treatment
  - Carryover effects occur when a previous treatment alters the observed behavior in a subsequent treatment
Order Effects

BDI

Treatment A
Treatment B

Pretest Posttest 1 Posttest 2
Sequence Effects

![Graph showing sequence effects with BDI scores across pretest, posttest 1, and posttest 2 for Drug + CBT and CBT + Drug conditions.](image)
Sources of Carryover

• **Learning**
  – Learning a task in the first treatment may affect performance in the second

• **Fatigue**
  – Fatigue from earlier treatments may affect performance in later treatments

• **Habituation**
  – Repeated exposure to a stimulus may lead to unresponsiveness to that stimulus
Sources of Carryover

- **Sensitization**
  - Exposure to a stimulus may make a subject respond more strongly to another

- **Contrast**
  - Subjects may compare treatments, which may affect behavior

- **Adaptation**
  - If a subject undergoes adaptation (e.g., becomes accustomed to depression), then earlier results may differ from later ones
Dealing with Carryover Effects

• Counterbalancing
  - The various treatments are presented in a different order for different subjects (complete or partial)
Floor Effects: Low Base Rates

- A California Study of cognitive-behavioral interventions for sexual offenders selected men with one arrest only
- Risk for reoffense is likely to be low
Ceiling Effects

Global Assessment Scale

Pretest

Posttest
Ceiling Effects: High Base Rates

- Is a treatment that yields a 40% rate of violent recidivism significant?
- Is this reduction likely to be viewed as important by the public?
Factorial Designs

• 2 or more variables
• Why examine 2 or more variables at once?
  – Interactions between variables and potential moderators or mediators can be examined
  – e.g., gender x ethnic group
• Selection of variables should be guided by theory
Factorial Designs

- Complex interactions are difficult to interpret
- Effects of gender, anxiety, and stress on depression

<table>
<thead>
<tr>
<th>Gender</th>
<th>Anxiety</th>
<th>Stress</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>Hi</td>
<td>Hi</td>
</tr>
<tr>
<td>M</td>
<td>Hi</td>
<td>Lo</td>
</tr>
<tr>
<td>M</td>
<td>Lo</td>
<td>Hi</td>
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<td>M</td>
<td>Lo</td>
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<tr>
<td>F</td>
<td>Hi</td>
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<td>Hi</td>
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<tr>
<td>F</td>
<td>Lo</td>
<td>Lo</td>
</tr>
</tbody>
</table>
Factorial Design: Between and Within Model

Between Subjects Independent Variable

A₁

B₁

S₁
S₂
S₃
S₄

A₂

S₁
S₂
S₃
S₄

A₃

S₁
S₂
S₃
S₄

Within-Subjects Independent Variable

B₂

S₅
S₆
S₇
S₈

S₅
S₆
S₇
S₈