Formulating Research Questions: A most important part of research
What You Should Learn From Text and Lecture:

• Why have a strong background in topic
• Describe process of formulating research question
• Characteristics of good research question
• Sources of research ideas
• Process and purpose of literature review
• Importance of clear and precise (a) research and (b) statistical hypotheses
Overview of this section

- Sources of inhibition
- Sources of research ideas
- Types of research questions
- Hypotheses and theories
Fears that Inhibit

- Fear of Geniuses
- Fear of Imitation
- Fear of Apparatus
- Fear of Doing Things By Hand
- Fear of Simplicity
- Fear of Being Imperfect
- Fear of Work
You can observe a lot by watching.
Yogi Berra
Sources of Research Ideas

- Everyday life
- Practical issues
- Past research
- Theory
Source of Ideas: Everyday life

• Why do quarterbacks make so many wrong decision when selecting a receiver?
• Learned what quarterbacks do during pass
  – Complexity of the visual stimuli, very few repetitions with specific scenarios, extreme time pressure, external stressors
• Research on “perceptual” decision making
• Development of training simulator
Source of Ideas: Practical Issues

• Aircraft Accidents
  • Early Problems
    – design of displays, redesign of tasks
    – training
• Three Mile Island
  – How best to represent information
  – How best to train for decision making
Source of Ideas: Past Research

- A characteristic: Research often generates more questions
- Disagreements among studies can lead to worthwhile research
  - Automatic/control processing
  - Search detection and aging
Source of Ideas: Theory

• Theory serves by guiding research
• Theory serves as a source of prediction and hypotheses
Observation

\[ \downarrow \]

Induction

\[ \downarrow \]

Theory

\[ \downarrow \]

Deduction

\[ \downarrow \]

Predicted Observations

\[ \downarrow \]

Experimentation
<table>
<thead>
<tr>
<th>Hours Watching TV (per day)</th>
<th>One</th>
<th>Two</th>
<th>Four</th>
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</thead>
<tbody>
<tr>
<td>Violent TV Type</td>
<td></td>
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<tr>
<td>Non TV Type</td>
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<tr>
<td>Violent</td>
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Characteristics of Good Research Questions

• Should be well grounded in current theoretical and empirical knowledge (know the literature)
• Should be amenable to the formulation of clear hypotheses and operational definitions
• Should be important in terms of theory and application (usually weighted toward one)
Research Questions and Hypotheses

• How do we define research?

• A process of asking a question, or a series of related questions, and then initiating a systematic procedure to obtain valid answers to that question.
Why Worry About Types of Research Questions?

• Understand characteristics of the types of research questions
• Be able to identify the type of question being asked
• Why?
  – Determine if question, hypotheses, and design are compatible
Types of Research Questions

• Existence
• Description and Classification
• Composition
• Relationship
• Descriptive-Comparative
• Causality
• Causality-Comparative
• Causality-Comparative Interaction
Existence Questions

• Does X exist?

• Examples
  – Can neonates perceive color?
  – Is there such a thing as ESP?
  – Do older adults suffer from general slowing?

• Design to systematically rule out rival explanations
Questions of Description and Classification

• What is X like?; Is it variable or invariant?; What are its characteristics?

• Examples
  – What are the characteristics of attention?
  – Is attention uni-dimensional or multi-dimensional?
  – Is attention variable or constant?
Questions of Description and Classification

• Usually call for more than simple description

• Answers tend to require:
  – statements about the generality of the description
  – statements of the uniqueness of the description to the subclass
Questions of Composition

- What are the components that make up X?
- Examples
  - What are the varieties of attention?
  - What are the factors that make up IQ
  - What are the principle components of memory
- Answers call for analysis or breakdown of whole into its component parts
Relationship Questions

• Is there an association between X and Y?
• Examples
  – Is attention related to IQ
  – Is working memory capacity related to GPA
  – IS GRE score related to success in Grad School
• At least one other variable (Y) is introduced
• More complex questions of relationships among several variables can be asked
Descriptive-Comparative Questions

• Is Group X different from Group Y?

• Examples
  – Are women more aggressive than men?
  – Do young have better memory than old adults?
  – Are warning labels with pictographs more effective than labels with words only?

• Expected that researcher will ensure that all is same between groups except issue in question
Causality Questions

• Does X cause, lead to, or prevent changes in Y?
• Examples
  – Does practice lead to skill?
  – Does alcohol intoxication prevent fast RT?
  – Does dividing attention degrade performance?
• Questions can be left open-ended
• Usually not exploratory research
Causality-Comparative Questions

• Does X cause more change in Y than does Z?
• Examples
  – Is aerobic exercise better than problem solving exercises at enhancing cognitive performance of older adult?
• Effects of X are compared with a rival treatment (Z) not simply absence of treatment
Causality-Comparative Interaction Questions

• Does X cause more change in Y than does Z under certain conditions but not under other conditions?

• Examples
  – Does search load affect older adults more in visual search than in memory search?

• Can predict complex interactions in data

• Multiple IVs allow complex interaction questions
Define Your Terms

• Operational definitions precisely specify your terms
• Attention, skill, intelligence defined by operations used to measure terms or constructs
• Make concrete your abstractions
Hypotheses

• Predictive statements about expected outcome of the research.
• Call for a test and embed a prediction
• Dictate the method and design of the research
• Closely linked to the research questions we just reviewed
Hypotheses (continued)

• Research and statistical
• Often omitted in journal articles
• If not explicitly stated then
  – summary of theoretical basis for study
  – overview of the research literature
  – synthesis of the literature
  – statement of the problem
  – reason for the research
• must leave little doubt about predictions
Hypotheses (continued)

• Must be explicit
• “Girls will score higher under distraction condition.”
• What is wrong with this statement as a hypothesis?
Hypotheses and Theory

• Theory is like a large-scale map
  – different areas representing general principles
  – connections between areas being sets of logical rules
• Hypotheses like small “quad” maps
  – small sectional maps
  – focus only on specific areas glossed over by larger map
Stating the Hypothesis

- Generic $Y = fX$
  - $DV\ Y$ is a function of $X$
- Noncausal hypotheses stated in relational terms
- Comparative [Other things being equal], Group A will score higher on $DV$ than Group B
- Cause-effect Group A will be better on $DV$ than control Group B
Linkage of All the Components

• Consistency required among the
  – research question
  – theory
  – hypotheses
  – research design
  – analytic plan
  – conclusions
Summary

• What stops you from getting research ideas
• Where can you get research ideas
• What are the types of research questions
• Hypothesis and theories
Summary (continued)

• Know the literature in your area very well.
• Know historical literature
• Know current literature
• Determine:
  – What is known
  – What is not known
  – What are the controversies
Steps in a Scientific Investigation

Formulate a hypothesis: Age will be correlated with Warning Comprehension

Design the Study: Survey Method, adult life span, representative demographics

Carry out the Study: Administer the survey across Georgia

Analyze the data and draw conclusions

Report the findings: Publish in *Human Factors*
Choice of Participants
Assignment to Groups
Standardized Conditions
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Manipulation of Independent Variable

Sampling bias (unrepresentative sample used)
Experimenter bias (conditions not run as planned)
Confounding of variables (IV varies with extraneous variable)
Measurement Errors (reliability, validity, equipment failure, etc.)
Experimenter Bias dependent variables not measured objectively, mistakes recording data
Experimenter bias (mistakes analyzing data)

Measurement of Dependent Variable

Comparison of Results

Conclusion