Intent & Validity
Knowledge & Hypotheses

- Intent "versus" results of our research
- Purpose & Types of validity
- Types of Knowledge
- Types of Research Hypotheses

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Intent of our research efforts ...

The intent of behvioral research is to provide definitive results about causal relationships between behavioral constructs, so that the results can be broadly applied.

2

Let's consider four aspects of this statement...

The intent of behavioral research is to provide definitive results about causal relationships between behavioral constructs, so that the results can be broadly applied.

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"definitive results"

behavioral research is based on "data"...

- we work very hard to be sure that those data are "representative" but they are always incomplete

Our conclusions about the data use statistical analyses ...

- The results from the statistical analysis are probabilistic, rather than exact !!!

- e.g., $p < .05$ properly translates to…

If the null hypothesis were true (that the populations represented by the sample have the same mean DV value), then we would expect to find a statistical value this large or larger less than 5% of the time by chance alone, thus we conclude that it is unlikely that the populations have the same mean DV value.

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"causal relationships"

Evidence needed to say there is a causal relationship between two variables …

- Temporal Precedence (cause comes before effect)
- Statistical relationship between IV and DV
- No alternative causes of the effect (no confounds)

The mainstay for examining causal relationships testing is the "True Experiment" with …

- random assignment of participants to treatment conditions
- manipulation of the treatment by the researcher
- systematic control of potential confounds

However, true experiments can't always be performed…

- Technology -- some "causes" simply can't be manipulated

- Ethics -- some could be manipulated, but is inappropriate to do so (may also limit using random assignment)

- Cost -- the technology exists, and is "allowed", but is too expensive for the researcher

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"behavioral constructs"

Unlike the physical attributes often studied in the "hard sciences" (e.g., mass, velocity, pressure) most of the attributes we study in behavioral sciences are "constructs" (e.g., depression, mental health, memory capacity) -- that is attributes that we have "made up" in order to help organize and explain human behavior.

Scores on these "constructs" are the data we analyze...

- we want our data to be "construct values" but they are limited to "variable scores"
- often our measures aren't direct but depend upon self-report, complex behavioral or content coding schemes, etc.
- the quality of our measures is important (standardization, reliability, validity, interpretation of relative and absolute values)

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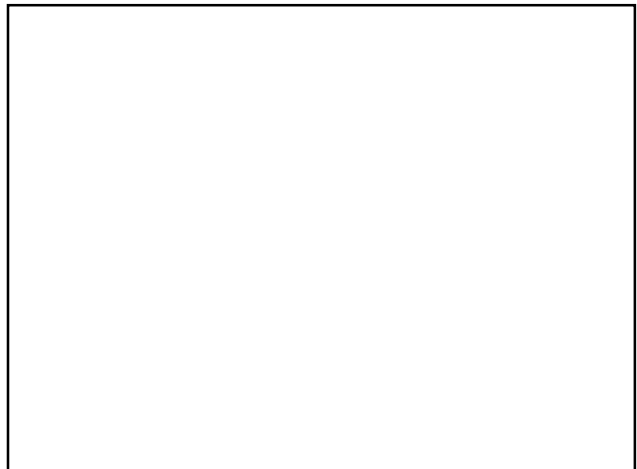
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"results can be broadly applied"

We want our results and conclusions to be "meaningful" and "applicable" -- either to theory or to practice

But in order to conduct our studies -- to get our data -- we make choices that can limit the meaningfulness and applicability of the results from the analysis of those data…

- our sample of participants doesn't represent "all people"
- the locations where we conduct out studies (whether in lab or not) don't represent "all settings"
- the stimuli and tasks we use to collect data are just a subset of all those that might be important to us
- the way we manipulate "causes" isn't the only one possible
- the data we collect don't represent all the "behaviors" we care about

- most importantly, different combinations of samples, locations, tasks, stimuli, manipulations and measures almost certainly produce different patterns of results !!!

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Roughly speaking, each of these "concerns" about what we can expect to get out of a single study relates to one of the basic types of research validity (accuracy or correctness) that we will study extensively this semester…

definitive results   --   statistical conclusion validity

causal relationships   --   internal validity

behavioral constructs   --   measurement validity

results can be broadly applied   --   external validity

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Types of Validity

Measurement Validity
  – do our variables/data accurately represent the behaviors & characteristics we intend to study ?

External Validity
  – to what extent can our results can be accurately generalized to other participants, situations, and times ?

Internal Validity
  – is it correct to give a causal interpretation to the relationship we found between the behaviors & characteristics ?
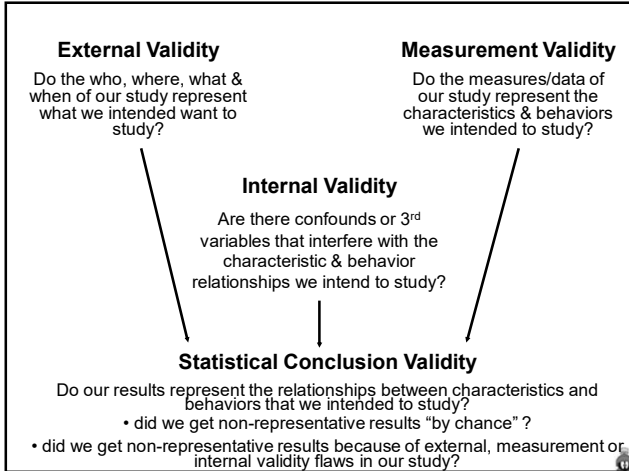
Statistical Conclusion Validity
  – have we reached the correct conclusion about whether or not there is a relationship between the behaviors & characteristics we are studying ?

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External Validity

Do the who, where, what & when of our study represent what we intended want to study?

Measurement Validity

Do the measures/data of our study represent the characteristics & behaviors we intended to study?

Internal Validity

Are there confounds or 3rd variables that interfere with the characteristic & behavior relationships we intend to study?

Statistical Conclusion Validity

Do our results represent the relationships between characteristics and behaviors that we intended to study?
• did we get non-representative results "by chance" ?
• did we get non-representative results because of external, measurement or internal validity flaws in our study?

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This whole course is really about two things …

• How do we acquire new knowledge about behavior?

  • How to be a "producer" of behavioral knowledge -- a researcher

• How do we evaluate the new "knowledge" about behavior that others claim to have found?

  • How to be a "consumer" of that knowledge -- a practitioner

  3 Types of Knowledge about behavior

  • **Descriptive Knowledge**

  • **Predictive Knowledge**

  • **(Causal) Understanding**

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Descriptive Knowledge -- where it all starts !!

• describing behaviors by defining, classifying and/or measuring them

• often means separating, discriminating, or distinguishing between similar behaviors

• Example ..
  – Many of your clients report that they are "socially anxious"
  – Some "get anxious" when they are at a social gathering.
  – Others "get anxious" when they have to speak to a group.
  – Based on this, you hypothesize that there are two different kinds of social anxiety:
    Social behavior anxiety & Public speaking anxiety
  – You can now test this attributive research hypothesis by designing measures (questionnaires or interviews) that provide scores for each and demonstrate that the two can be differentiated (i.e., that there are folks with one, the other, both and with neither type of anxiety)
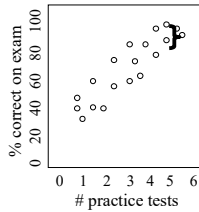
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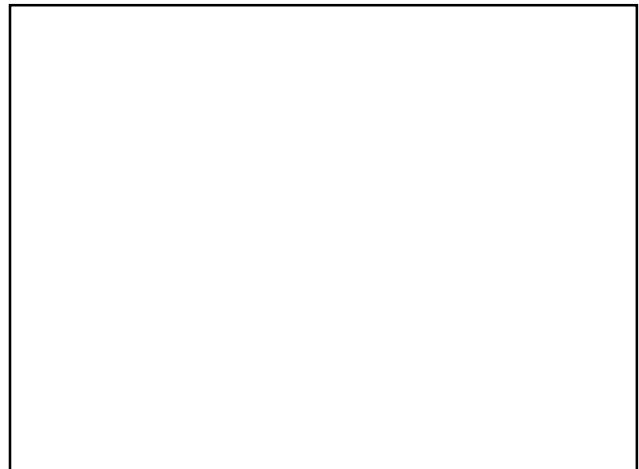
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Predictive Knowledge

- knowing how to use the amount or kind of one behavior to predict the amount or kind of another behavior
- first, we must find the patterns of relationship ...
- Examples ...

Looks like we can partially predict how many times someone practiced based on how well they did on the test

If someone did 5 practice tests ...

... they probably scored between an 85% & a 95%

(graph: y-axis "% correct on exam" 0 20 40 60 80 100; x-axis "# practice tests" 0 1 2 3 4 5 6)

Understanding -- the biggie !

- knowing which behaviors have a causal relationship
- learning what the causal behavior is, so that you can change its value and produce a change in the effect behavior
- Consider each of the predictive examples
  - -- what is the most likely causal "direction"
  - tell which is the most likely "cause" & most likely "effect"
  - Remember → cause comes before effect !

% test score & # practices   Cause   Effect

Amount of therapy & change in depression

GRE quantitative score & # math classes taken

Remember -- just because two behaviors are related doesn't mean they are causally related !!!

Identify each of the types of knowledge involved ...

I want to know if I can anticipate students' scores on Exam 1 from performance on their homework assignments.   — Predictive

I want to construct a score that indicates how well each student prepared for Exam 1.   — Descriptive

I want to know whether I can improve your scores on Exam 1 by increasing the number of homework assignments I give you.   — Understanding
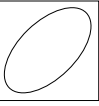
Notice: Which type of knowledge is "univariate" _____

and which types are "bivariate" _____ & _____
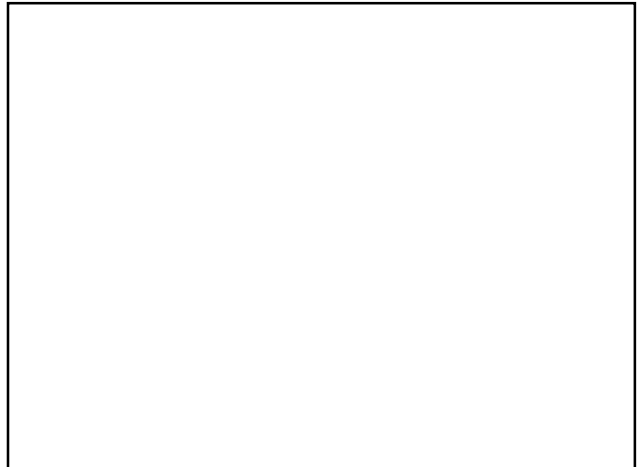
Important thing about "understanding"

- knowing that it really is "that behavior" that's the cause and not "some other behavior"
- just because two behaviors are related -- allowing prediction of one from the other -- doesn't mean that either one is the cause of the other !!
- "association does not ensure causality"
- Famous Example -- There is relationship between ice cream sales and amount of violent crime, but is it causal?
  - Does eating ice cream make you violent ?
  - Does being violent make you crave ice cream ?
  - Maybe both are caused by increases in temperature ?
- Height and weight are strongly related in adults…
  - Would you expect to grow taller if you went out and gained 2 pounds by eating four big bags of M&Ms ???

Violent crimes

Ice cream sales

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Research Hypotheses – start of empirical research

- I'm sure that you already know the central role that research hypotheses play in scientific research !!
- In fact, the whole process revolves around them -- literature reviews to form them, designs to generate data to be analyzed to test them, replication and convergence of them, etc.
- You won't be too surprised to learn that there are 3 types of research hypotheses -- one RH: for each type of "knowledge"
  – Attributive, Associative & Causal Research Hyptheses

Remember, a research hypothesis is a "guess" about what you will find when you complete your research and data analysis.

To be "interesting", a research hypothesis has to be "testable" and it must be "falsifiable" !!!

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"Testable" -- means that there must be some way to way to collect the data to evaluate the RH:

What might limit the testability of a RH: ???

- Insufficient technology -- some things we "just can't do" !
  - determine a person's skin color and "racial appearance"
- Ethics -- some things we "just shouldn't do" !
  - assign new-born children to their parents
- Resources -- tech. exists and is acceptable, but you "just can't afford it" (especially common for students)
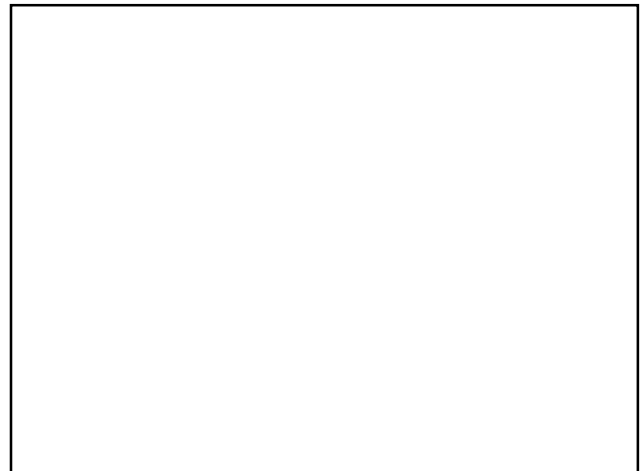
"Falsifiable" -- means that the RH: must possibly be wrong!

Remember, we are going to "test" the RH: !!!

A research hypothesis predicts a specific outcome…

- "Practice improves performance." is a RH: that could be right, or could be wrong!
- "Practice either improves performance; or it doesn't." isn't a falsifiable RH: -- this statement is going to be correct !!!

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Attributive Research Hypothesis

- states that a behavior exists, can be measured, and can be distinguished from similar other behaviors
- univariate hypothesis (one variable)
- Evidence to support ...
  - need to demonstrate a technique that allows properly trained researchers to reliably record and score the behavior
- with what type of "knowledge about behavior" does this correspond ?? _____

As we describe the types of RH:, be sure to notice that there is the same hierarchical arrangement among the types of RH: as there are among the types of knowledge !!!

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Associative Research Hypothesis

- states that a relationship exists between two behaviors -- that knowing the amount or kind of one behavior helps you to predict the amount of kind of the other behavior
- bivariate hypothesis (two variables)
- Evidence to support …
  - show that there is a reliable statistical relationship between the two variables

- with what type of "knowledge about behavior" does this type of RH correspond ?? _____

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Causal Research Hypothesis

- states that differences in the amount or kind of one behavior causes/produces/creates/changes/etc. differences in amount or kind of the other behavior
- bivariate hypothesis -- "causal behavior"
                               & "effect behavior"
- Evidence needed to support a causal hypothesis...
  - temporal precedence ("cause proceeds effect")
  - demonstrate a reliable statistical relationship
  - elimination of alternative explanations (no other viable causes/explanations of the effect)

- With what type of "knowledge about behavior" does this type of RH correspond ?? _____

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Slide 29
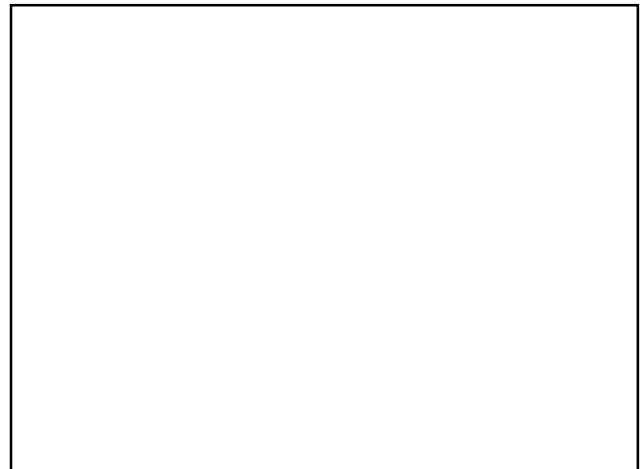
Identify each type of research hypothesis below ...

I want to know if I can predict scores on Exam 1 from performance on homework assignments. — Associative

I want to construct a score that reflects how well you did on the computational parts of your homework assignments. — Attributive

I want to know whether I can improve your scores on Exam 1 by grading and returning your homework assignments the next class period. — Causal
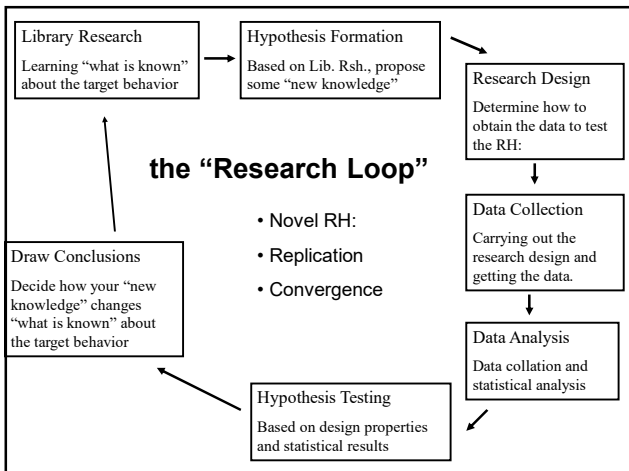
Again, please notice the correspondence between the types of "knowledge about behavior" and types of Research Hypotheses !!!

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Slide 30

Relationships among types of Research Hypotheses

- There is a "**hierarchical arrangement**" among the types of research hypotheses
- Attributive hypotheses are the foundation of all data-based behavioral research
  - if we can't agree how to define and measure things, then we can't collect data to test associative and causal hypotheses
- Causal hypotheses presuppose associative hypotheses, because...
  - "If two behaviors are not related, then they can't be causally related."
- **but also remember...**
  - "Association does not ensure causation." … or …
  - "Just because two behaviors are related doesn't mean that one causes the other"

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Slide 31

Library Research

Learning "what is known" about the target behavior

→ Hypothesis Formation

Based on Lib. Rsh., propose some "new knowledge"

Research Design

Determine how to obtain the data to test the RH:

the "Research Loop"

- Novel RH:
- Replication
- Convergence

Data Collection

Carrying out the research design and getting the data.

Draw Conclusions

Decide how your "new knowledge" changes "what is known" about the target behavior

Data Analysis

Data collation and statistical analysis

Hypothesis Testing

Based on design properties and statistical results

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Slide 32

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Applying the Research Loop

The "research loop" is applied over and over, in three ways…

- Initial RH: test
  - The first test of a research hypothesis -- using the "best" design you can
- Replication
  - being sure your conclusions about a particular RH: are correct by repeating exactly the same research design
  - the main purpose of replication is to acquire confidence in our methods, data and resulting conclusions
- Convergent Research
  - using "variations" of the research design (varying population, setting, task, measures and sometimes the data analyses)
  - the main purpose of convergence is to test the limits of the "generalizability" of our results, asking "What design/analysis changes lead to different results?"

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"Critical Experiment" vs. "Converging Operations"

You might be asking yourself, "How can we sure we 'got the study right'?" How can we be sure that we..

- … have a sample that represents the target population?
- … have the best research design?
- … have good measures, tasks and a good setting?
- … did the right analyses and make the correct interpretations?

Said differently – How can we be sure we're running the right study in the right way ???

This question assumes the "*critical experiment*" approach to empirical research – that there is "one correct way to run the one correct study" and the answer to that study will be "proof".

For both philosophical and pragmatic reasons (that will become apparent as we go along) scientific psychologists have abandoned this approach and adopted "*converging operations*" – the process of running multiple different versions of each study and looking for consistency & determining the source of inconsistencies
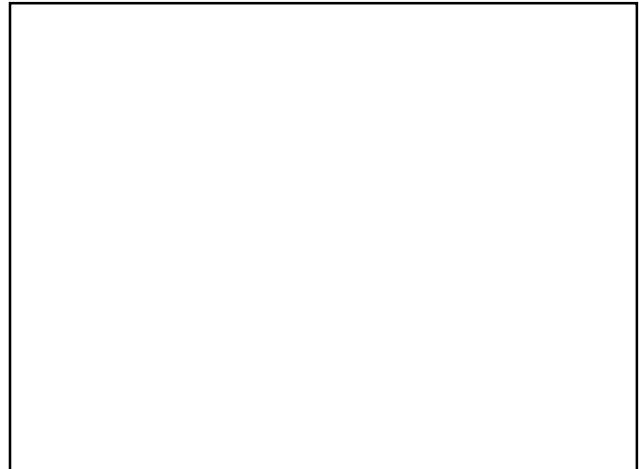
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We've known all this stuff since we were kids!!

Here's a story…

So… We'll add some jargon and tighten some definitions, but this is the same basic "Scientific Method" we've known since about 4th grade!!

So…. Relax, do your Pink Things & ask for help when you need me (cgarbin@unl.edu) !!!

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Library Research -- few like it, but you have to be good at it!
- Must have a correct picture of the current "knowledge" about the behavior you want to study
- Must know the hypotheses that have been tested
- Must know the research designs that have been used to test those hypotheses
- Must know the statistical analyses that were done
- Must understand how these were combined into the conclusions that make up the current "knowledge"

Doing this well requires the ability …   (will be often practiced in lab)

• … to identify the relevant portions of the literature -- lit search skills

• … read that literature critically & properly evaluate it -- research
           methods and statistics skills

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Hypothesis Formation -- proposing new knowledge
- Based on a thorough understanding of what is known and how it was learned, you identify some "guess" about what "new knowledge" (descriptive, predictive or understanding) you propose to identify with your research
- You must be able to "trace" how you combined "current knowledge" to form your proposal

Doing this well requires the ability … (which will be practiced in lab)

• … to break what's known down into its relevant components (analysis)

• … and "reassemble" the components from multiple pieces of research into
           "possible new knowledge" (synthesis)

• … judge whether or not this "new knowledge" will be a worthwhile
   addition to "what's already known" (evaluation)

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Research Design -- proposing how to get new knowledge
- Based on a through understanding of how what is known has been studied, you identify how you will test your hypothesis
- You must be able to explain how your methods provide a proper test your research hypothesis

- Elements of the design you must specify include…
  – The target population and how you will sample it
  – The setting in which the data will be collected
  – The task the participants will complete to yield data
  – How/when you will treat participants differently from each other (called "manipulations")
  – How/when you will collect the data

Doing this properly depends upon a complete knowledge of the designs and methodologies used in the lit you review!!

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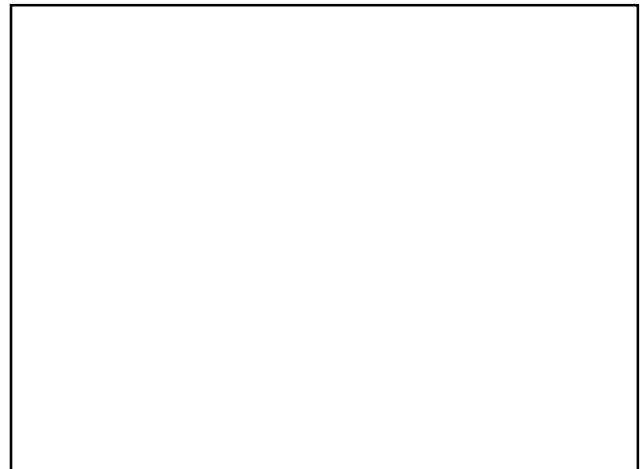
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Data Collection -- actually "doing" the study

- Each participant …
  - is "selected" to be in the study
  - may be "assigned" to a "condition" or a "manipulation" or a "treatment"
  - completes a specific "task" in a specific "setting" under particular "conditions", resulting in data

By considering what happens with/to each participant, we can focus on whether our research procedures are appropriate to test our hypotheses !!

Any discrepancy between the intended design and the actual data collection procedures hinders the interpretability of the data to test our research hypotheses !!!

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Data Analysis -- statistical treatment of the data

- Data must often be scored, collated, aggregated and otherwise prepared for statistical analysis
- Statistical analyses must be chosen to match the nature of the data, the research design and the specifics of the research hypothesis

Performing statistical analyses is (with practice) a relatively simple and straightforward task. It is more difficult to evaluate the statistical analyses and conclusions that have been done by others

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Hypothesis testing -- well, were you right about the RH: ??

Requires combining …

- … the results of the statistical analysis ...
- … the specifics of the design and data collection ...
- … bases for supporting the specific type of RH: …

… to decide whether or not you can claim you have
    supported your research hypothesis

While this is a challenging task, it is even more challenging to evaluate the research conducted by others and assess the accuracy of the conclusions they have reached.

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Draw Conclusions -- finishing up and starting over...

Involves …

- combining the "knowledge" you got from the literature review, with the "new knowledge" from your study to decide with you know now that you didn't know before

- working with all this, decide what is the next RH: you want to test

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