

## An Introduction to the Course

with an emphasis on why, how, and why we learn to conduct research

- Intent of our research efforts
- How we conduct research
- The ubiquity of research
- Types of Knowledge
- Type of Research Hypotheses
- Research Process

## Intent of our research efforts ...

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

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## “definitive results”

Psychological 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.

## “causal relationships”

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

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

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

## “psychological constructs”

Unlike the physical attributes often studied in the “hard sciences” (e.g., mass, velocity, pressure) many of the attributes we study in psychology 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)

“results can be broadly applied”

We want our results and conclusions to be “meaningful” and “applicable” -- either to the theory or the practice of psychology

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 our 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 !!!

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
psychological constructs	--	measurement validity
results can be broadly applied	--	external validity



## How we do Research -- Two contrasting approaches

### Critical Experiment approach (*experimentus crucis*)

- there is one proper way to conduct a study ...
  - one correct sample of participants
  - one correct design
  - one correct manipulation of the causal variable
  - one correct measurement of the effect variable
  - one correct analysis and interpretation of the resulting data
- if you conduct the study that way, you will get the proper answer and that answer will be meaningful and applicable

But the things we have discussed today call us to question this approach, which has been replaced with ...

## Converging Operations approach

multiple studies with different operationalizations (i.e., versions) of the key elements ...

- different samples of participants
- different applicable design
- different manipulations of the causal variable
- different measurements of the effect variable
- different analysis and considering different interpretations of the resulting data

We look carefully to see which combinations produce similar and dissimilar results

- similar results across operationalizations give us greater confidence in the accuracy and applicability of those results across those combinations
- dissimilar results give us confidence in the limits in applicability and helps us recognize the limitations of our current theory (and may suggest how to modify it)



## The Ubiquity of Research

your near future...

- you'll need to produce at least two publication-quality pieces of research to get your Ph.D.
- you'll need to "critically consume" several scores of studies conducted by other folks in order to pass your classes and to do that research

your future beyond graduate school

- whether in academic or applied work, you'll need to "critically consume" several hundred studies conducted by other folks in order to do your work
- you are going to have to "provide evidence" of the effectiveness of you and/or your practices (as research and practice support gets tighter, those with the more convincing evidence will get those limited resources!)

So, don't kid yourself -- no matter what you do or where you do it, you will be intimately involved in research for the rest of your career!!!

This whole course is really about two things ...

• How do we acquire new knowledge about behavior?

- How to be a "producer" of psychological knowledge -- a researcher

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

- How to be a "consumer" of psych knowledge -- a practitioner

3 Types of Knowledge about behavior

- **Descriptive Knowledge**
- **Predictive Knowledge**
- **(Causal) Understanding**

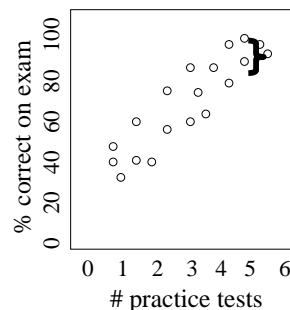


## Descriptive Knowledge -- where it all starts !!

- 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)

## 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%

## 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.

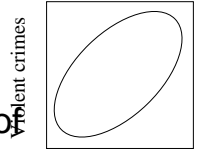
I want to construct a score that indicates how well each student prepared for Exam 1.

I want to know whether I can improve your scores on Exam 1 by increasing the number of homework assignments I give you.

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 ???



Ice cream sales



## 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 Hypotheses

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" !!!

“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 !!!

## 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 !!!

## 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 ?? \_\_\_\_\_

# 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 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 ?? \_\_\_\_\_

Identify each type of research hypothesis below ...

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

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

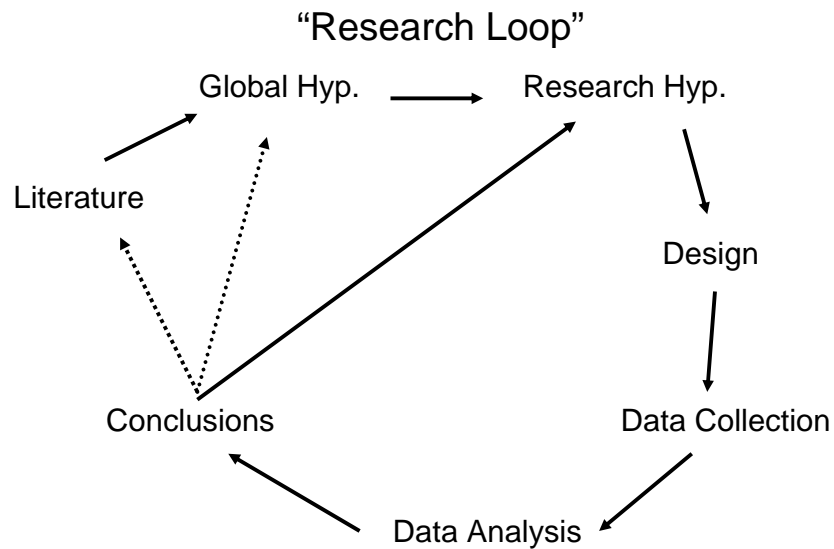
I want to know whether I can improve your scores on Exam 1 by grading and returning your homework assignments the next class period.

Again, please notice the correspondence between the types of “knowledge about behavior” and types of Research Hypotheses !!!

## 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”





## Applications of “the Loop”

### Original Research

- first “test” of a bivariate relationship

### Replication

- demonstrates reliability of the finding/effect
- doing the study again using the same design & procedures

### Converging Operations

- demonstrates generalizability/specificity of the relationship
- examining different “versions” of the relationship
  - different variable operationalizations (measurement)
  - different populations
  - different situations//settings
  - different confound control technique
  - including additional variables

Different folks use different words or terms, but ...

### Programmatic Research = Converging Operations

“the use of multiple interrelated studies to test the existence, replicability and generality/specificity of a “global hypothesis” and the “specific research hypotheses” logically derived from it”

What are the most common outcomes of this process?

- Failure to support the initial research hypothesis
- Failure to replicate the initially supported research hypothesis
- Convergent research reveals support for research hypothesis only under “uninteresting” populations/settings/controls
- Convergent research reveals complexity of IV-DV relationship

**Literature** -- based on a knowledge of “what’s been done,”  
develop your own ideas

you should also learn...

- what samples have been used to represent what populations
- how IVs have been manipulated
- how DVs have been measured
- what confounds are of concern and how they are controlled
- how the data have been analyzed
- how specific findings have been “tied into” the literature

**Global Hypothesis** -- a “general rule” of the  
relationship between the IV and  
DV constructs

also called ...

- Universal Hypothesis .. Theory .. Model, etc.

**Research Hypothesis** -- a “specific prediction” based  
on the global hypothesis

also called ...

- Existential Hypothesis .. Instantial Hypothesis, etc.

**Design** -- all the specifics about how to test your RH  
you must specify...

- the sample used to represent the population of interest
- how the IV will be manipulated
- the task the participants will complete (to produce DV)
- how the DV will be measured to evaluate the effect of the IV
- the design you will use (e.g., between vs. within-groups)
- how you will control confounds (e.g., random assignment of subjects, use of the same materials and instruments)

These should be specified with sufficient precision that  
someone could replicate your study without your help.

## Data Collection -- record of “running” participants

more than “just the data” is important ...

- informed consent
- instructions and determination of their understanding
- collection of the “data as intended”
- notes about “protocol violations” -- very important when identifying “outliers” and “influential data points”
- debriefing and feedback from participant

## Data Analysis -- describing the data and comparing it to the research hypothesis

we will be emphasizing t-tests, ANOVA, Pearson’s Correlation and Multiple Regression ...

- statistical models are chosen based on the types of data and the expression of the research hypothesis
- these models are the most commonly used techniques in Psychological research, and are the basis for most of the more sophisticated models
- there is more to data analysis than null hypothesis testing, including confidence intervals, effect size estimates, power analysis and various forms of qualitative data analysis (we won’t be covering this last one in this class)

## Conclusions -- considering “what the results mean”

how the results related to other parts of “the loop”...

- provide direct information about the research hypothesis -- either complete support, partial support, or no support
- provide useful information about the global hypothesis -- shows an “instance” for which it applies, or shows that the global hypothesis isn’t global (since it didn’t apply to this specific set of design conditions/procedures)
- become part of the literature, potentially influencing the global and research hypotheses that will be drawn from that literature by others