

# Knowing, Research Hypotheses & Programmatic Research

- Types of knowledge
- Sources of Knowledge and Sources of Research Hypotheses
- Research Hypotheses
  - Properties of a Useful Research Hypothesis
  - Types of Research Hypotheses
  - Interrelationships Among the Types of Research Hypotheses
  - Research Loop and Programmatic Research

This whole course is really about two things ...

- How do we acquire new knowledge about behavior & characteristics ?
  - How to be a “producer” of psyc knowledge -- a researcher
- How do we evaluate the new knowledge about behavior & characteristics that others claim to have found?
  - How to be a “consumer” of psyc knowledge -- a practitioner

3 Types of Knowledge about behavior & characteristics

∞ **Descriptive Knowledge**

∞ **Predictive Knowledge**

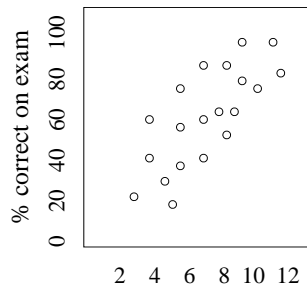
∞ **Causal Knowledge (Understanding)**

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

- ∞ describing behaviors & characteristics by defining, classifying and/or measuring them
- ∞ separating, discriminating, or distinguishing between similar behaviors & characteristics
- ∞ 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 folx with one, the other, both and with neither type of anxiety)

## Predictive Knowledge

- ∞ knowing how to use the amount or kind of one behavior or characteristic to predict the amount or kind of another behavior or characteristic
- ∞ first, we must find the patterns of relationship ...
- ∞ Example...
- ∞ Recorded the number of practice problems each student completed before taking the exam and exam score and



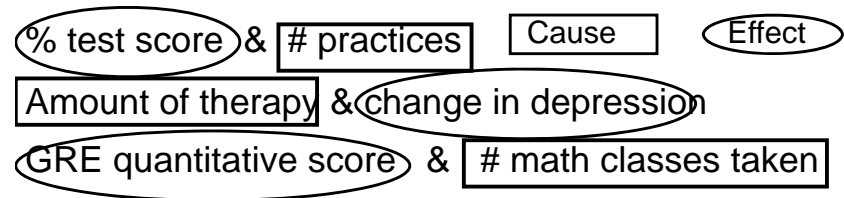
Looks like we can predict how well someone did on the test based on how many practice problems they completed.

Notice the while the prediction isn't perfect, it does give us some useful information.

# practice problems competed

## Understanding -- the biggie !

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



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

### Identify each of the types of knowledge involved ...

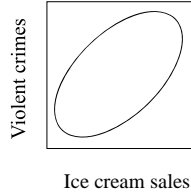
I want to know if I can anticipate students' scores on Exam 1 from performance on their homework assignments. Predictive

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

## Important thing about “understanding”

- ∞ knowing that it really is “that behavior or characteristic” that’s the cause and not “some other”
- ∞ just because two things 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 a 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 ???



## “Sources” of New Knowledge about Behavior & Characteristics

### Intuition

- ∞ Knowledge about behavior & characteristics based on opinion, faith, belief or feelings
- ∞ Sometimes without conscious attention or reasoning that can be described to others
- ∞ Defended by claims of “special knowledge” or “common sense”
- ∞ Commonly accepted way of acquiring “everyday” knowledge

## “Sources” of New Knowledge about Behavior & Characteristics

### Authority

- ∞ Knowledge about behavior or characteristics is acquired from a “trustworthy” source
- ∞ Defended by claims of prior accuracy of the authority
- ∞ Commonly accepted way of acquiring “everyday” knowledge



### **Argumentum ad Verecundiam**

*Declaring an argument to be true without any supporting evidence, merely because of the authority, knowledge or position of the person asserting it.*

## Rational-Inductive Argument

- ∞ Learn whatever is already known about a specific behavior or characteristic and related behaviors & characteristics
- ∞ Logically combine known information into new knowledge -- usually starting with an “axiom” or “fact” with which all agree
- ∞ The description of the “combination” leaves a “trail” that others can follow -- agreeing or disagreeing with your “facts,” “axioms” and your “logic”
- ∞ Defended on the basis of the quality of the facts and their combination into new knowledge
- ∞ Commonly accepted way of acquiring “everyday” knowledge
- ∞ Traditional means of gathering knowledge in math, history, philosophy & literature

## Scientific Empiricism

- ∞ Learn whatever is already known about a target behavior or characteristics and related behaviors and characteristics
- ∞ Generate a “guess” or “hypothesis” about that target or about how it is related to some other behavior or characteristic
- ∞ Determine what would be evidence of the new knowledge you hypothesize
- ∞ Collect data to provide this evidence in a systematic, objective and controlled manner
- ∞ Evaluate data to test the hypothesis
- ∞ Defend on basis of the quality of data and appropriateness of their evaluation

Identify the knowledge source for each of the following:

- My mom says that kissing toads will give you warts!      Authority
- Toads have warts; warts may be produced by infections; infections can be passed by touching, so it makes sense that kissing toads will give you warts.      Rational-Inductive
- I had two of my four brothers kiss toads, and they were the only two who got warts.      Empiricism
- I believe that kissing toads will give you warts!      Intuition

**The point is that not all sources of information are equally good !!**

What is the **accepted role** of each of these sources of knowledge in modern scientific psychological research ?

∞ **All four** are accepted “**sources of hypotheses**”

- Intuition is often considered a reasonable source of research hypotheses -- especially when it is the intuition of a well-know researcher or theoretician who “knows what is known” (i.e., Intuition by an Authority with a history of good intuition)
- Rational Induction is often used to form “new hypotheses” by logically combining the empirical findings from separate areas of research
- Prior empirical research findings are perhaps the most common source of new research hypotheses, especially when carefully combined using rational induction

∞ Only **scientific empiricism** is an accepted “**source of scientific psychological knowledge**”

We must be careful about what we claim to “find” using scientific empiricism.

∞ We don't find “Proof” !!!

- Proof comes only from proper application of the rational inductive processes (remember “proofs” from Geometry?)
- Proof requires a starting “axiom” that is definitely true
- However, there are no axioms about behavior – so we have no place to start the rational inductive process!

∞ We find “probabilistic evidence” !!!!

- “evidence” because no one study is ever conclusive
- “probabilistic” because we may or may not have gotten the correct answer
  - Sampling and assignment procedures work “on average” or “probably”
  - Statistical analyses tell us the “probability” that certain findings are accurate (rather than prove they are)

So, if we're limited to “probabilistic evidence, how do we convince our selves that we've got it right – that the new knowledge we've gained via the scientific method is correct?

That's the focus of the rest of this unit ... to anticipate...

∞ We use good research methods -- methods that have been used successfully in previous research (which means we have to know what those procedures are and why they work)

∞ We repeat our research – since no one finding is ever convincing, we need to show that a set of results is replicable

∞ We complete differing versions of our research (called programmatic research) looking for converging evidence about when we get similar and different findings



## Research Hypotheses -- getting empirical research started

- ∞ 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 also 3 types of research hypotheses -- one RH: for each type of "knowledge"

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

"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 "can't study" !
- Ethics - some things we've decided "shouldn't study" !
- Resources -- tech. exists to perform the study and it is "allowed," but you "just can't afford it" (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 !!!

## Research Hypotheses

### ∞ General Definition

- a tentative explanation or a guess about the target behavior or characteristic
- MUST BE TESTABLE & FALSIFIABLE !!!

### 3 Different Kinds

#### ∞ Attributive

#### ∞ Associative

#### ∞ Causal

# Attributive Research Hypothesis

∞ states that a behavior or characteristic exists, can be measured, and can be distinguished from similar others

∞ 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” does this correspond ??  
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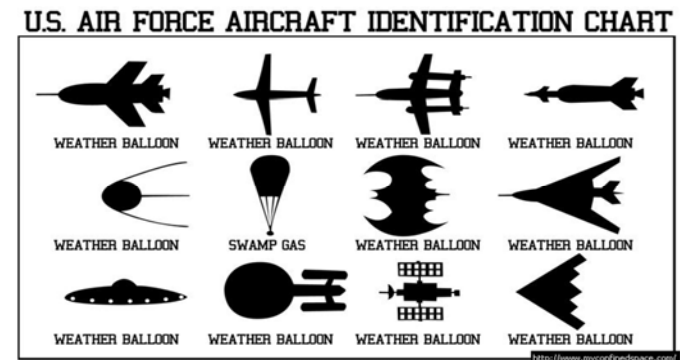
**As we describe the types of RH:, be sure to notice that there is the same hierarchical arrangement among the types of RH: as there is among the types of knowledge !!!**

Attributive Hypothesis: Flying Saucers have been seen in our skies.

Supporting evidence would be: Flying/floating things have been seen with unidentifiable shapes

Contrary Evidence would be: All flying/floating things have recognizable shapes.

Some Data:



# Associative Research Hypothesis

∞ states that a relationship exists between two behaviors or characteristics -- that knowing the amount or kind of one helps you to predict the amount or kind of the other

∞ bivariate hypothesis (two variables)

∞ Evidence to support ...

- show that there is a reliable statistical relationship between the two

∞ with what type of “knowledge” does this type of RH correspond ??  
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# Causal Research Hypothesis

∩ states that differences in the amount or kind of one behavior or characteristic cause/produce/change/etc. differences in amount or kind of the other

∩ bivariate hypothesis -- “causal behavior” & “effect behavior”

∩ Evidence needed to support a causal hypothesis...

- temporal precedence (“cause precedes effect”)
- demonstrate a statistical relationship
- elimination of alternative explanations (no other viable causes/explanations of the effect)

∩ With what type of “knowledge about” 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 Pink Things. 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 increasing the number of Pink Things that are required. Causal

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 characteristics & behaviors, then we can’t collect data to test associative and causal hypotheses

∩ Causal hypotheses presuppose associative hypotheses, because...

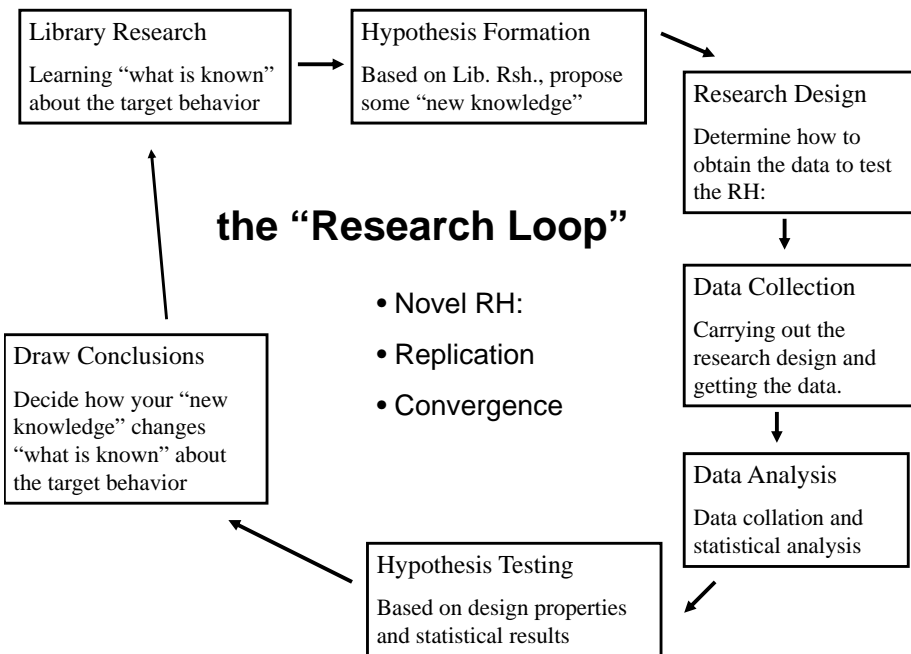
- “If two behaviors or characteristics are not related, then they can’t be causally related.”

∩ **but also remember...**

- “Association does not ensure causation.” ... or ...
- “Just because two things are related doesn’t mean that one causes the other”







## 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?”

## “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

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 4<sup>th</sup> grade!!

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



**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

**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)

## Research Design -- proposing how to get new knowledge

- ∞ Based on a thorough 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!!

## 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 !!!

## 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

## 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.

## 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

