## Science and the Initiation of Research

**(Bordens & Abbott Chaps. 1-3)**

## I. GENERAL PRINCIPLES
### A. The Nature of Science

- Science is a set of methods for *describing*, *predicting*, and *explaining* phenomena.
  - **Describing**: **Objective** (repeatable) and **reliable** (same results) procedures by which events and their relations are, defined, measured classified, cataloged, and categorized.
  - **Predicting**: Making inferences about phenomina on the basis of other events as informed by a experience, knowledge, or a theory.
  - **Explaining**: A tentative account, often causal, based on objective observation and logic, and subject to empirical test

## I. SCIENCE & INITIATION OF RESEARCH
### B. Scientific Explanations

- Scientific Explanations are distinguished from other forms of explanations.
  - **Commonsense**: Everyday accounts of behavior.
    - We often assume conscious rational control over behavior.
      - Why you came to class today?
      - Answer will appeal to beliefs and desires which can not be objectively measured or tested.
  - **Belief-Based**: Faith that already accepted beliefs are correct.
    - Galileo and the rejection of appeals to Authority.
      - Sometimes appeals to authority leaves contradiction as between appeals to creationism and the Fossil record.

## I. SCIENCE & INITIATION OF RESEARCH
### B. Scientific Explanations

- Scientific Explanations have 7 characteristics
  1. **Empirical**: Evidence can be used to test scientific explanations
  2. **Rational**: Propositions follow logically with no contradictions
  3. **Testable**: Scientific Explanations can be proven false and rejected.
  4. **Parsimonious**: Scientific explanations are the simplest possible for the phenomenon being explained
     - Ockham's Razor – Theory making fewest assumptions is better (Movie: Contact)

## I. SCIENCE & INITIATION OF RESEARCH
### B. Scientific Explanations

- Scientific Explanations have 7 characteristics
  5. **General**: Scientific explanations are broad in the sense of covering all possible related phenomena.
  6. **Tentative**: Scientific explanation can be updated and altered, typically due to being tested and falsified.
  7. **Rigorously Evaluated**: No explanation is fully accepted as it can be tested constantly.

## I. SCIENCE & INITIATION OF RESEARCH
### B. Scientific Explanations

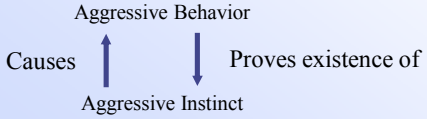
- A Scientific theory has 5 related characteristics
  1. **Account of data**: Scientific theories explain by accounting for data within its domain.
  2. **Explanatory Relevance**: Grounds for believing that conditions specified in the theory could produce the phenomena.
  3. **Testability**: Specify conditions which could be proved false (falsifiability condition).
  4. **Prediction of Novelty**: Theories allow for new (unexpected) phenomena to be identified
  5. **Parsimony**: Minimal number of assumptions.

## I. SCIENCE & INITIATION OF RESEARCH
### B. Scientific Explanations

- Scientific vs. Pseudoscientific Explanations.
  - Some truth claims may not be based on empirical evidence. Such claims are not scientific ones.
  - But other truth claims appeal to evidence but not in a scientific manner – that is **Pseudoscience**.
    - Explanations not based on falsifiable theories.
    - Explanations have not been rigorously tested
      - Based exclusively on **confirmation** (evidence for predictions) not **disconfirmation** (evidence against predictions) strategies.
    - Evidence is anecdotal (case studies or testimonials).
    - Explanation published in non-reputable journals
    - No building on or convergence with previous research.

## I. SCIENCE & INITIATION OF RESEARCH
### B. Scientific Explanations

- If scientific explanations are so good, why do they sometime fail?
  - Faulty Inference: Unjustified assumptions leading to faulty inferences (phrenology).
  - Pseudo-explanations: Circular Explanations: Explanation takes meaning from the phenomena explained.



## I. SCIENCE & INITIATION OF RESEARCH
### C. Scientific vs. other knowledge

- Science provides rules and techniques to arrive at knowledge
  - **Method of Authority**
    - Involves acquiring knowledge by an appeal to experts or authorities.
    - People may be endowed with expert status for reasons other than knowing scientific truth.
  - **Rational Method**
    - Involves acquiring knowledge by deduction from first principles (e.g., logic, geometry or mathematics)
      - If all As are a B, and this thing is an A, Therefore it is a B.
    - The truth of claims deduced from premises depend on the truth of the premises.

## I. SCIENCE & INITIATION OF RESEARCH
### C. Scientific vs. other knowledge

- **Scientific Method**
  - The scientific method involves steps.
    - **Observing a phenomenon**: See something of interest and watch all relevant ***variables***
    - **Formulate a tentative explanation**: Identify variables which might explain phenomenon (***hypothesis***).
    - **Research based on explanation**: Design research to orderly and systematically examine variables of interest and their hypothesized relationship to each other.
    - **Refine and retest explanations**: The consequence of the initial observations and explanations may lead to altering the hypothesis or the characteristics if the experimentation.

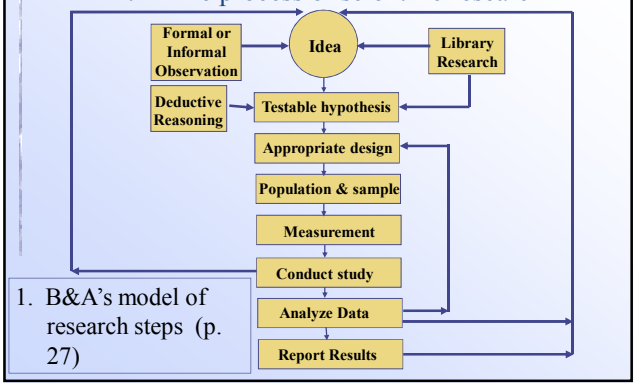
## I. SCIENCE & INITIATION OF RESEARCH
### C. Scientific vs. other knowledge

- 1. Scientific Attitude
  - Science depends as much on an attitude as it does on a procedure.
  - Missing in the other approaches to knowledge acquisition is a **skeptical attitude.**
  - Also, there is a good deal of preparatory intellectual activity to doing science
    - Defining parameters objectively and reliably.
    - Seeking out relevant information.
    - Rigorous testing.
  - But not all problems allow such preparatory activity, making them non-scientific problems.

## I. SCIENCE & INITIATION OF RESEARCH
### D. The process of scientific research

- The scientific method is tailored depending on the type of research being performed:
  - **Basic research:** Test hypothesis with less of a regard to real world applications. Typically do not worry about sample.
    - How do students acquire psychological literacy?
  - **Applied Research:** Investigate a real world problem. Solutions apply to real world conditions of the phenomenon. Sample may be relevant to the problem.
    - Can WSU introductory psychology classes be improved to promote greater psychological literacy?

## I. SCIENCE & INITIATION OF RESEARCH
### D. The process of scientific research

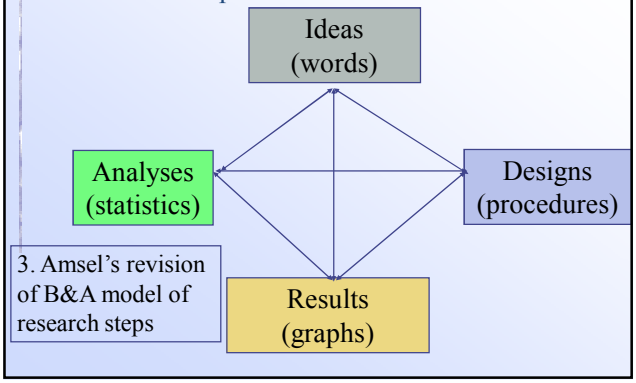



1. B&A's model of research steps (p. 27)

## I. SCIENCE & INITIATION OF RESEARCH
### D. The process of scientific research

- 2. Problems
  - The model is a deeply flawed account of how scientists do research.
  - The steps are ***not*** sequential because any decision simultaneously has implications for all others
    - Measurement decisions affect not only how the study is conducted and data are analyzed, but also how an idea is made into a testable hypothesis, which design is best used to test it, and the sample on whom to run the study.
  - A major goal of this course is for you to see the **connections between ideas, designs, analyses, and results** and to translate between them

## I. SCIENCE & INITIATION OF RESEARCH
### D. The process of scientific research




3. Amsel's revision of B&A model of research steps

## I. SCIENCE & INITIATION OF RESEARCH
### E. Sources of Research Hypotheses

- Sources of Research Hypotheses
  - **Unsystematic observations**: Ideas may come from phenomena you don't understand or are curious about.
  - **Systematic observations**: Ideas may build out of more careful study of phenomena.
  - **Theory**: Ideas may come from theoretical principles or from multiple conflicting theories.
  - **Practical problems**: Hypotheses may come from problems which need to be solved.

## I. SCIENCE & INITIATION OF RESEARCH
### F. Good Research Questions

- A good research idea has 3 characteristics.
  - **Testable**: A good research idea is placed in the form of a question which can be posed and answered empirically.
    - A hypothesis should be in the form of a prediction of a relation (causal vs. correlational) between two variables.
  - **Significant**: A hypothesis could move the field ahead in its understanding of a phenomenon.
    - Clarify, Falsify, Novelty, Practical Applications, Theoretically Confirmed or Theoretically Disconfirmed
  - **Operationally Defined**: Variables defined in terms of operations needed to measure them.

## I. SCIENCE & INITIATION OF RESEARCH
### G. Literature Review

- **Literature reviews**: Retrieving archival information and analyzing it to connect it to but move it beyond previous research.
  - Primary sources (full research report) is always better then secondary ones (summarized primary reports) because of the availability of details of the procedures and results.
    - **Books**: Sometimes the source of primary research. Not refereed.
    - **Journals**: Refereed vs. not referred.
    - **Conference Reports**: Low referred, work in progress
    - **Personal communications**: Worst of all for details

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### G. Literature Review

- Literature reviews usually involve working with **PsychInfo**
  - A library-based computer access to all abstracts (short summary or research papers) of all psychology-related journals
  - Conducting a keyword search on all with Boolean Operators (and, or etc.)
    - Search by topic, author journal etc.
  - Access by computer on-campus or off campus.

## I. SCIENCE & INITIATION OF RESEARCH
### G. Literature Review

- **Reading Literature Critically**
  - Remain skeptical
    - Do not collaborate with the authors by assuming YOU misunderstand something. Maybe it makes no sense!
  - Imagine you are a participant (down and dirty)
    - How do you react? What strategies do you adopt? Can you figure out the hypothesis? Are you doing what they expect? CRITIQUE THE DETAILS
  - Generate alternative accounts (big and broad)
    - Challenge the authors' account of the data by coming up with a perfectly parallel account based on imagining you are a participant or other theories or knowledge. CHALLENGE THE BIG PICTURE