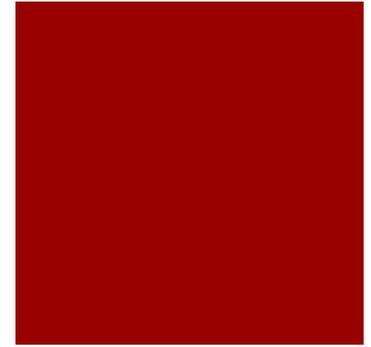


Psy 135
Cognitive
Psychology

Lecture: Research Methods
Gabriela Seropian
August 28, 2013

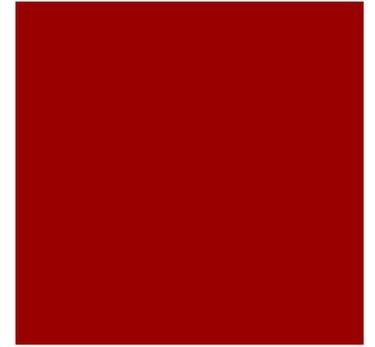
A little bit about me...



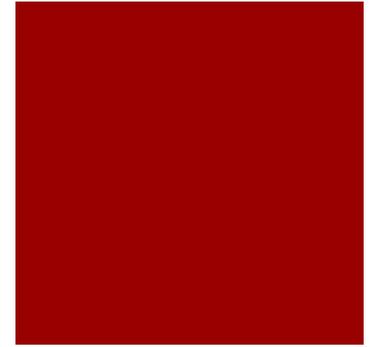
- A.A. Psychology from Las Positas, 2008.
- B.A. Psychology with a minor in Mathematics from San Jose State University, 2011.
- M.S. Human Factors and Ergonomics Engineering from San Jose State University, Expected 2014.
- My Experience:
 - San Jose State Research Foundation, worked with Dr. Van Selst in his Cognitive Psychology Lab on two joint projects with NASA Ames
 - NASA Ames, Human Factors Department, worked with Dr. Liston in his Oculomotor Lab.
 - UC San Diego, Summer Internship, worked with Dr. Aron in his Cognitive Neuroscience lab in Cognitive Control

Today's Agenda

- Early exploration into intelligence
- What is Science?
- The Scientific Method
- Basic research terminology
- Types of Research
- Types of Measures
 - Common measures in Cognitive Psychology
- Examples/showcase of cognitive measures

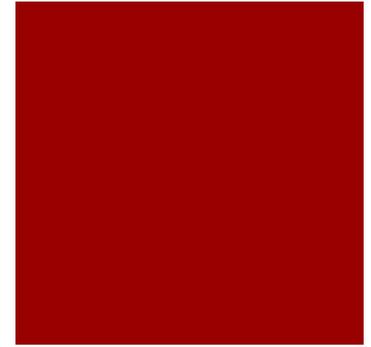


Measuring Heads: Men vs. Women Intelligence



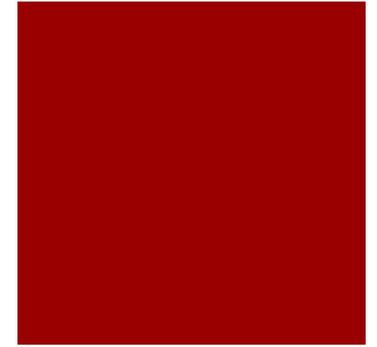
- Paul Broca performed autopsies and compared brain size between males and females.
 - 292 male brains had a mean weight of 1,325 grams, and 140 female brains had a mean weight of 1,144 grams.
 - “We might ask if the small size of the female brain depends exclusively upon the small size of her body...But we must **not forget that women are, on the average, a little less intelligent** than men, a difference which we should not exaggerate but which is, nonetheless, real. We are therefore **permitted to suppose** that the **relatively small size of the female brain depends in part upon her physical inferiority and in part upon her intellectual inferiority** (1861, p. 153)” –Broca , Cited from The Mismeasure of Man by Stephen Jay Gould p. 136

Alfred Binet: Theory of IQ



- Alfred Binet first to study the measurement of intelligence via craniometry.
 - “The relationship between the intelligence of subjects and the volume of their head...is very real and **has been confirmed by all methodical investigators**, without exception...We **conclude** that the preceding proposition [of **correlation between head size and intelligence**] must be considered as **incontestable** (Binet, 1989, p. 294-295).”
(Gould, 176)

Is this scientific research?



What is Science?

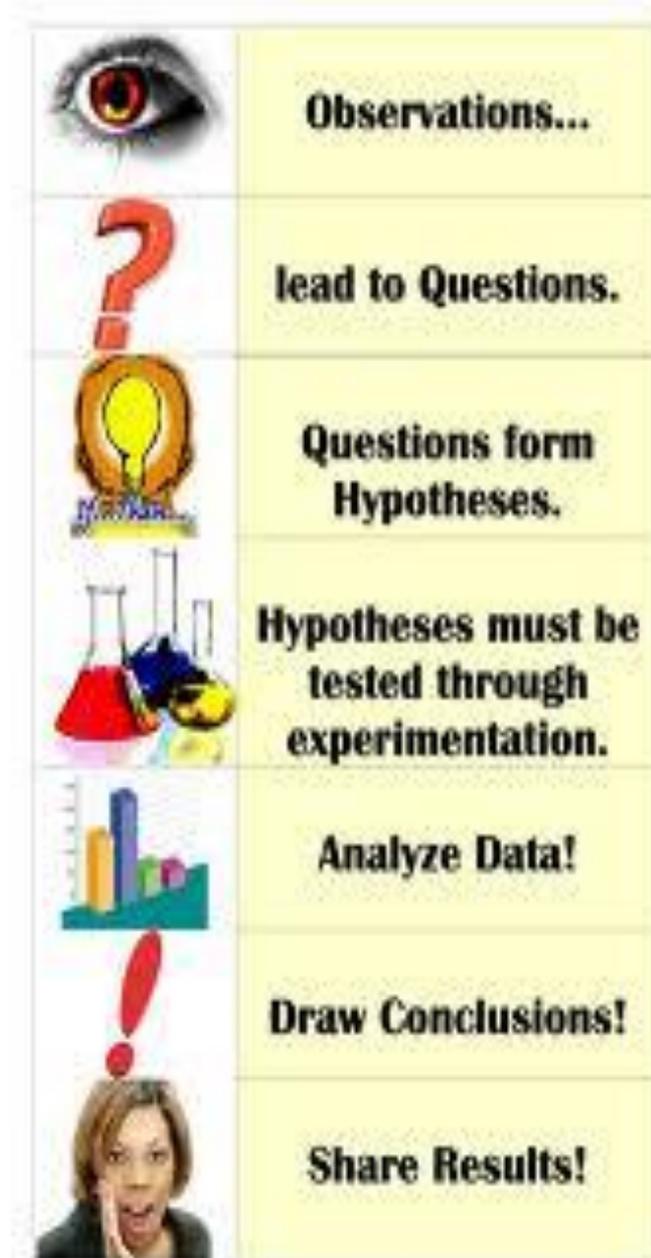
- Cumulative
- A process
- Objective
- Open Skepticism
- Intellectual Honesty

Pseudoscience (What Science Is Not?)

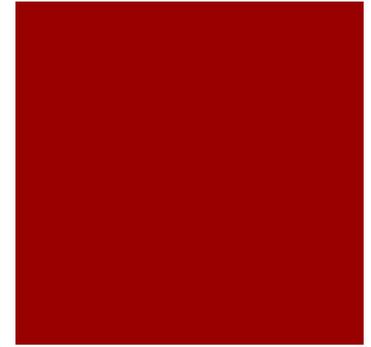
- Lack cumulative progress
- Uses loose and distorted logic
- Lack internal skepticism
- Disregards real-world observations and established facts/results and contradicts what is already known

The Scientific Method

- Theory (an organized set of principles that describes, predicts, and explains some phenomenon).
- Hypothesis (a specific testable prediction, often derived from a theory)
 - Predicted relationship of variables
- Collect data → Methodological sound plan
 - Control
 - Confounds
 - Double-blind experiments, etc.
 - Reliability, validity, and replicability
- Analyze data with inferential statistics
- Interpret [generalizability?]
 - Sample/limitation



Two Types of Research: Basic and Applied



- **Basic Research:** Research conducted to seek new knowledge rather for its practical applications. Fundamental questions about psychological processes.
 - **Goal:** to explore and understand the fundamental mechanisms that underlie behavior; establish theories, explanations, concepts and principles.
- **Applied Research:** Research conducted to solve specific problems.
 - **Goal:** to bring about direct benefits to society by addressing specific problems (e.g. depression) and develop solution.
 - **Alfred Binet:** developed the worlds first modern intelligence test to help school identify children needing special attention.

Research Methodology

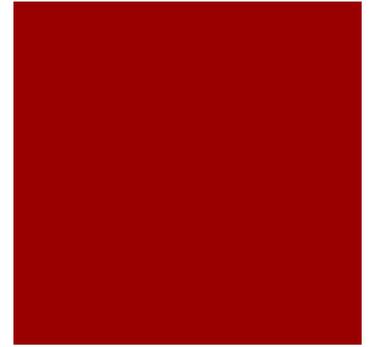
Basics



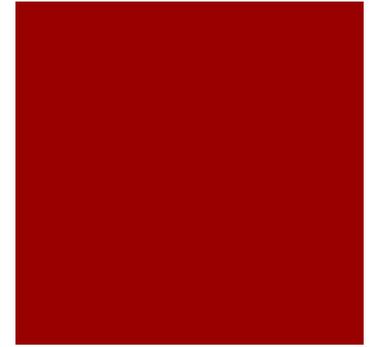
- **Constructs:** hypothetical attributes or mechanisms that help explain and predict behavior in a theory. E.g. Intelligence, motivation, aggression...
- **Operational Definition:** a procedure for measuring and defining construct.
- **Variables:** Characteristics or conditions that change or have different values for different individuals.
- **Independent Variable:** Variables manipulated by the researcher.
- **Dependent Variable:** the variable that is observed for changes to assess the effects of manipulating the IV.
- **Validity:** the degree to which the measurement process measures the variable that it claims to measure.
- **Reliability:** the consistency of the measurement. E.g. IQ test
- **External Validity/Generalizability:** The extent to which we can generalize the results of a research study to people, settings, times, measures, and characteristics other than those used in that study.

Types of Research

- Descriptive
- Correlational
- Experimental



Descriptive Research



- Research designs in which the research defines a problem and variable of interest but makes no predictions and does not control or manipulate anything.
- Types:
 - **Case Study**
 - E.g. Broca and Mr. Tan
 - Disadvantage: Individual Differences
 - **Naturalistic Observation**
 - E.g. Jane Goodall observed chimpanzee's in Tazmania
 - Advantage: Real world behavior
 - Disadvantage: time-consuming, potential for observer influence, potential for subjective interpretation.

Descriptive Research

■ Systematic Observation

- E.g. Usability Testing
- Advantage: Don't have to wait for behavior to occur.
- Disadvantage: less natural



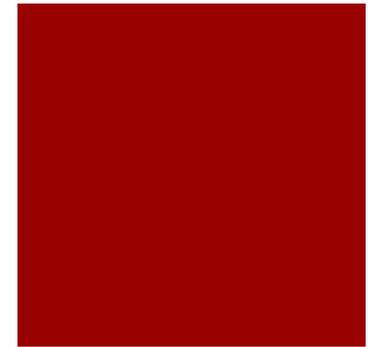
■ Survey

- Collects information about attitudes, opinions, preferences, and behaviors.
- Advantage: flexible, obtain a wide variety of information/variables, easy and efficient.
- Disadvantage: Low response rate, non response bias, difficult to analyze, self-report (trustworthy?).

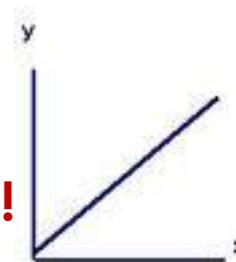


■ Interview

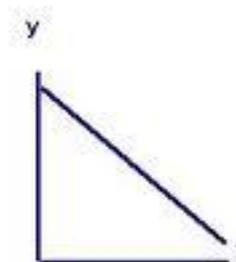
Correlational Research



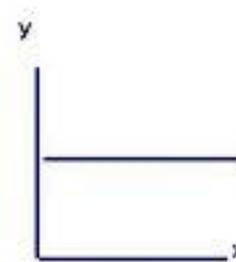
- Examines relationship between 2 or more variables, no manipulations or treatments.
 - E.g. GPA and Wake-up time
 - May be used for prediction
- Strengths:
 - good starting point that can lead to experimental research
 - allows researchers to investigate variables that would be impossible or unethical to manipulate (e.g. exposure to pollution)
 - high external validity.
- Limitations:
 - **Correlation does not mean causation!**
 - The third-variable problem



Positive
Correlation
+1.00



Inverse
Correlation
-1.00



No
Correlation
0.00

Experimental Research

- Experimental Research attempts to answer cause-and-effect questions about the relationship between variables by controlling and manipulating variables.

Logic:

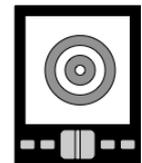
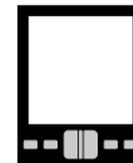
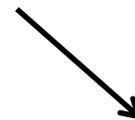
1. Manipulate IV
2. Measure DV
3. Control Nuisance variables (e.g., randomization)
4. Compare values of the DV across the IV



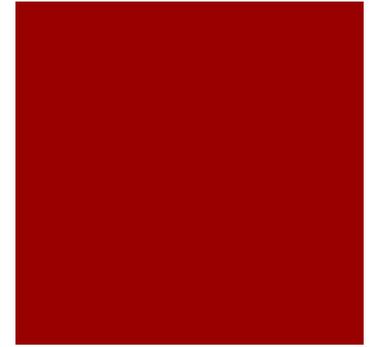
Experimental Study Basics

- Random Assignment
- Experimental Group
- Control Group
- Placebo
- Single-blind Studies
- Double-Blind Studies
- Experimenter expectancy effects

Example:
Van Selst M., Seropian, G. (2010)
Dose-Dependent Cognitive Effects
of Alcohol.



Quasi-Experimental Research



- Similar to experimental, however, it makes use of naturally occurring groups rather than randomly assigning subjects to group.
 - Males and Females
 - Ethnicity

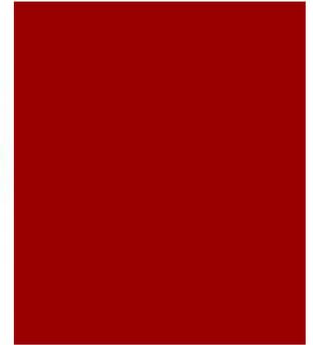


Types of Measures

- **Self-Report Measures:** written or oral accounts of a person's thoughts, feelings, or actions.
 - Survey/Questionnaires
 - Interview
 - Limitations:
 - Social desirability bias
 - Lack of clear insight into one's own behavior
- **Behavioral Measures:** *Objective* observations of action in either natural or lab settings.
 - Limitations:
 - Requires times to train coders and conduct coding
 - Participants may modify their behavior

Types of Measures

- Physiological Measures:
 - Blood Pressure
 - Heart rate
 - Sweating
 - Respirations
 - Pupil Dilation/Eye tracking
 - Electroencephalograms (EEG)
 - Positron Emission Tomography (PET)
 - Images of brain activity via metabolic activity
 - Magnetic Resonance Imaging (fMRI)
 - Measures oxygen concentration in the blood flow in the brain.



Types of Measures

- **Multiple Measurements:** Several measures combined to acquire data on one aspect of behavior to offset any limitations of any single measurement.
 - Limitation:
 - Expensive and time consuming
- Seropian, G., Van Selst, M. (2010). Assessing the Cognitive Effects of Sleep Deprivation



The Sleep Log

Fill this part of the form out **first thing in the morning.**

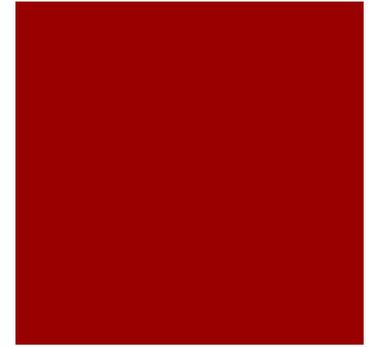
Went to bed last night at _____

Woke up this morning at _____

Are you feeling sick today? yes no

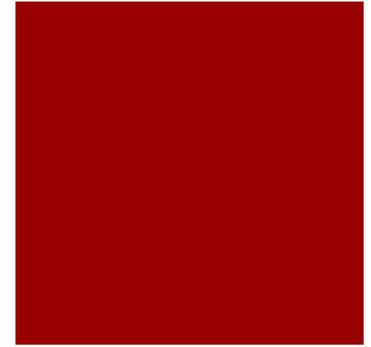
Are you feeling pain today? yes no

Common Dependent Variables in Cognitive Research



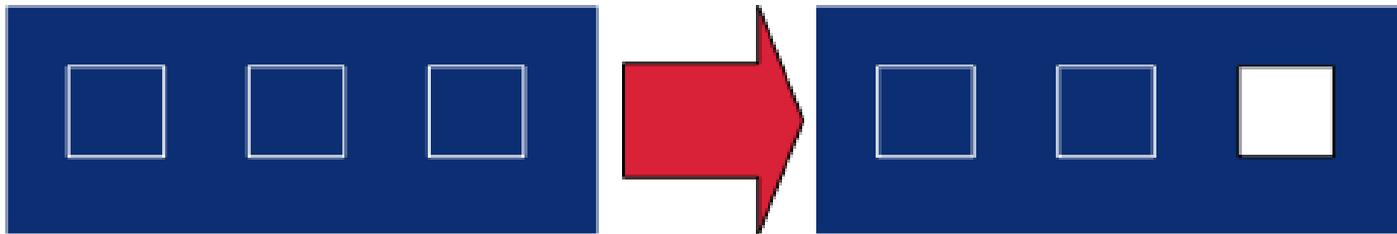
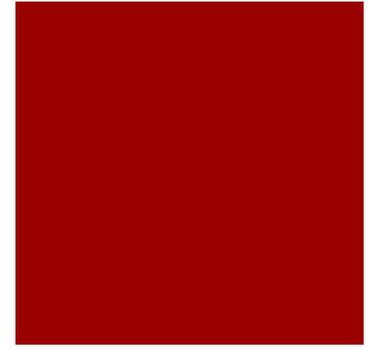
- **Reaction Time (RT):** Time to perform a task. Measures speed.
- **Accuracy:** Number of correct items.
 - **Speed/Accuracy Tradeoff:** Relationship in which speed on a task is almost always inversely related to accuracy on the task.
- **Verbal Protocol:** People think aloud while carrying out a task, revealing conscious processing.
 - Involves introspection and creates subjective data.
 - Good for reasoning, problem solving, and writing tasks.
 - Limitation:
 - With certain tests/tasks people tend to perform better because they are more consciously aware, thus prone to less mistakes.
 - Lose RT data

Examples of Dependent Variables: Reaction Time & Accuracy



- DELTA Cognitive Battery Test has been used to study the effects of environmental and chemical stressors on human performance.
 - (Surrogate Measures) NASA Ames and Army Research laboratory
- Tests include
 - Box Selection/3-choice reaction time
 - Code Substitution
 - Math
 - Mental Rotation
 - Pattern Comparison
 - Alternating Finger Tapping
 - dominant and non-dominant hand

DELTA: Box Selection/3-Choice Reaction Time



“Press the numeric key that corresponds to the box that has changed”

- Presentation of a visual stimulus and measured response latency to the stimulus.

DELTA: Pattern Comparison

- The task was to determine whether the patterns were the same or different.
 - This test measures integrative spatial function and has been compared to the ability to recognize changes in the radar screen or map display.

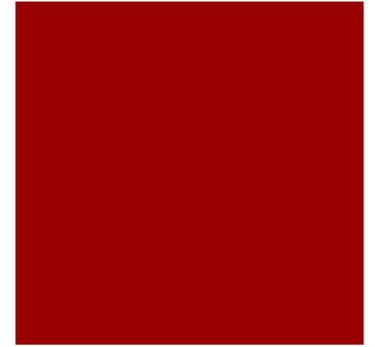
Pattern Comparison



***** *

***** *

DELTA: Rapid Tapping



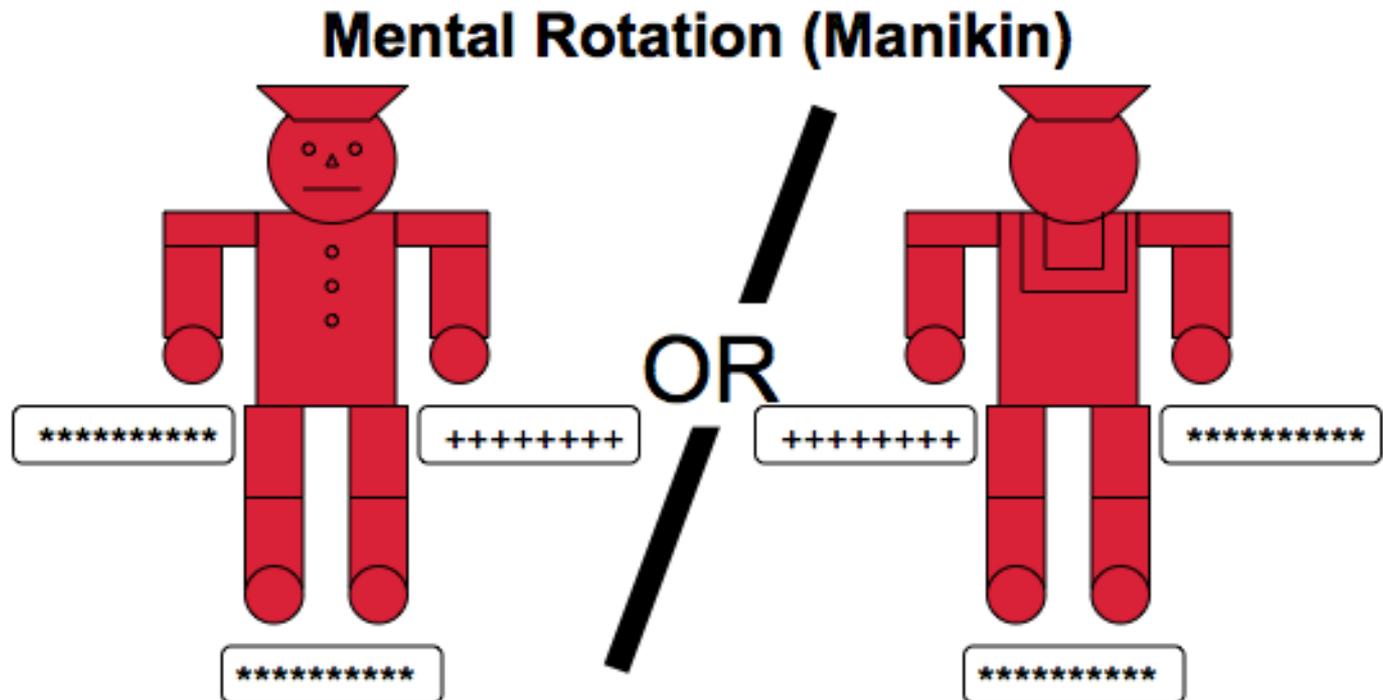
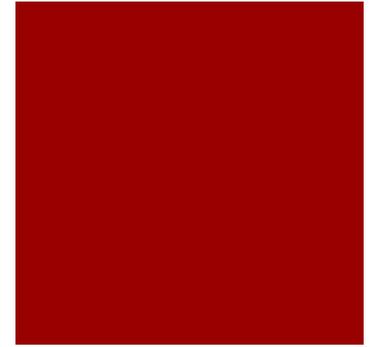
Rapid Tapping



- Task asked participants to alternate between two fingers as fast as possible.
- Test measures manual motor skills and coordination.

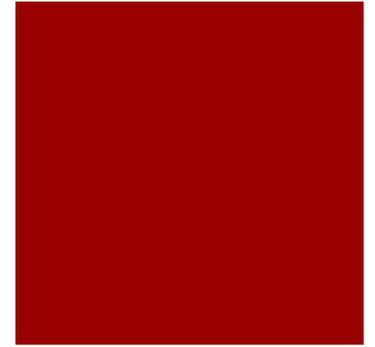
DELTA: Spatial Transformation

- Task asked participants to identify which hand matches the object that appears in the box upon which the sailor is standing.
- This test measures ability to spatially transform mental images (mental rotation) and determine the orientation of a given stimulus.



Take Away

- Science is a process and ongoing.
- It is important to understand research methodology so you are able to make your own decisions about what the conclusions are.
 - Remember, science is open to skepticism
- The scientific method involves observation, prediction, testing, integration, and communication.
- Correlational research does not demonstrate casualty, only demonstrates a relationship, whereas, experimental research demonstrates cause-and-effect (if well planned and controlled).
- Many techniques exist to measure cognitive functions.
 - Verbal protocol, RT, and Accuracy
 - Physiological Measures such as ERP, PET, and fMRI reveals brain activity.



References

- Gould, S.J. (1996) Mismeasure of Man.
- Gravetter, F.J., Forzano, L.B. (2012) Research Methods for the Behavior Sciences. 4th Edition.
- Jones, E. (2007) Brain, Mind and Behavior: An Introduction to Biopsychology. 3rd Edition.
- Seropian, G., Van Selst, M. (2010) Assessing the Cognitive Effects of Sleep Deprivation.
- Van Selst, M., Seropian, G., Prendez, J. (2010) Dose Dependent Cognitive Effects of Alcohol.

