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Introduction to Cognitive Neuroscience
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Intro to Cognitive Neuroscience

Research - methods, concepts and concerns

Scientific Method

- Form a theory about how the world works

Eating chocolate ice cream makes people smarter.

- Develop a hypothesis.

People who like chocolate ice cream are smarter than people who don't.

- Decide on a way to test that hypothesis.

Ask people what their favorite ice cream flavor is, and what their GPA is.

- Decide whether your results support the original theory

Some things to think about

- How do you choose a hypothesis to test your theory?
- What operational definitions will you use? How will you measure the factors that you're interested in?
- Who will your subjects be?
- How will you analyze your results?
- Where do scientific theories come from?

Testing a hypothesis

- Experiment
 - a systematic research study in which the investigator directly varies some factor (or factors), holds all else constant, and observes the results of the systematic variation.
 - From Woodworth, R. (1938). *Experimental Psychology*.

Testing a hypothesis

- Independent variable - the factor being studied to see how it influences something else.
 - Under the experimenter's control.
 - Has at least two levels.
- Subject variable - like an independent variable, but not assigned by the experimenter, eg gender.
- Control group - to provide a comparison with a baseline level.

Testing a hypothesis

- Dependent variable - the measured outcome of an experiment.
- Operational definition - definition of a concept or variable in terms of precisely described operations, measures, or procedures.

Design an experiment

- What are the independent variables for the following hypotheses? How many levels of the I.V. do you want to use? Identify the levels.
- What are the dependent variables?
- What operational definition will you use for your independent and dependent variables?
 1. Ability to concentrate on a task declines when people are tired.
 2. Animals learn a difficult maze best when they are moderately alert. They do poorly in difficult mazes when their alertness is low or high. When the maze is easy, performance improves steadily from low to moderate to high alertness.

Who will your subjects be?

- Working with humans
 - Studies must be approved by an Institutional Review Board.
 - For any study in which participants are at risk, the IRB must be convinced that the value of the study justifies the risk involved.
 - Informed consent must be given (but subjects can be deceived as to the true purpose of the study if the deception is moderate and the study could not be performed in any other way.
 - Treating participants well includes thoroughly debriefing them after the experiment is over.

Working with animals

- Animal research is a vital source of information about the brain and about behavior.
- Researchers must justify the use of animal subjects by showing that potential significance of the study outweighs the distress of the animals used. (The supervisory body is the Institutional Animal Care and Use Committee.)
- Researchers are obligated to minimize discomfort of animal subjects. After an experiment, alternatives to euthanasia should be considered.
- Researchers must be an expert in caring for the species used, and all others interacting with the animals must be trained in their care.

How will you analyze your results?

- Descriptive statistics summarize the data from your participants.
 - Mean, median, mode
 - Standard deviation

How will you analyze your results?

- Inferential statistics allow you to generalize your results to a broader population.

Measures

- Nominal scale - categories
- Ordinal scale - better
- Interval scale - better still
- Ratio scale - best

Measuring brain function

- In vitro - examining the behavior of cells in a petri dish, test tube, or other lab environment.
- In vivo - examining the behavior of the living brain.

Invasive in vivo methods

- Lesioning - destroying cells in a portion of the brain
- Microinjection - target drug delivery to particular area of the brain

Non-invasive in vivo methods (imaging)

- CAT scan - computerized axial tomography



[Image courtesy of Muffet.](#)

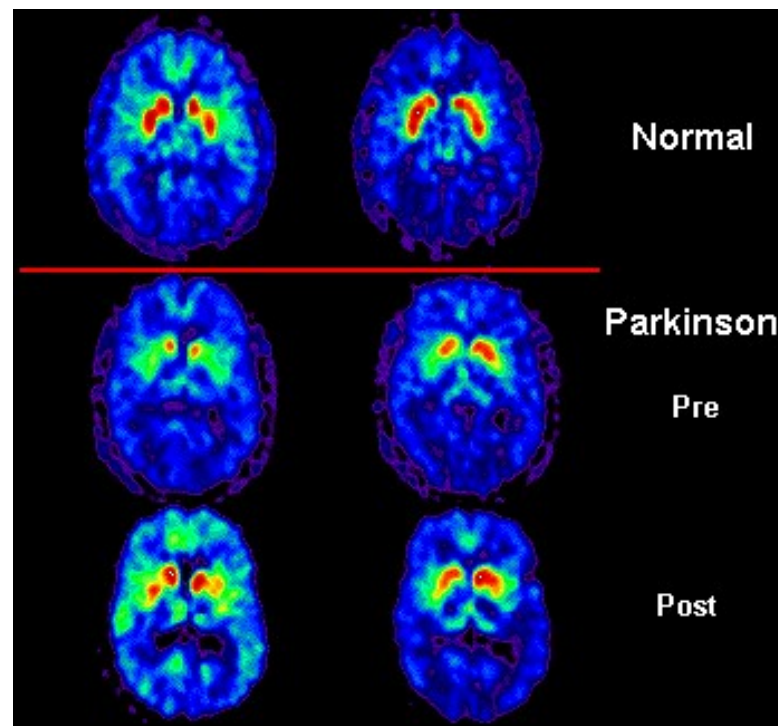
Imaging methods

- MRI - magnetic resonance imaging



[Image courtesy of thomas23](#)

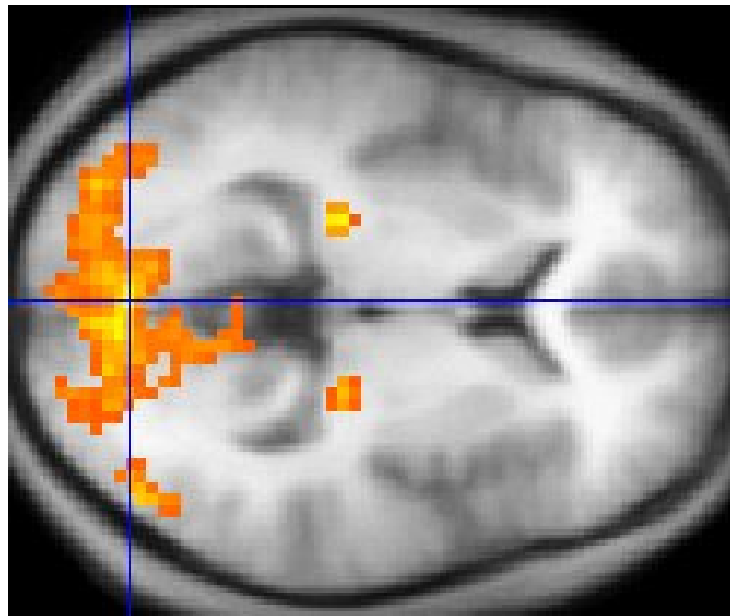
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- PET scan - positron emission tomography



[Image courtesy of NASA.](#)

Imaging methods

- fMRI - functional magnetic resonance imaging



[Image courtesy of Washington Irving](#)