

Statistics One

Lecture 1
Introduction

Two segments

- Randomized experiments
- Observational studies

Lecture 1 Segment 1

Randomized experiments

Randomized experiments

- Important concepts
 - Random and representative sampling
 - Independent and dependent variables
 - Double-blind experiments
 - Confounds
 - Causality

Causality!

- The major benefit of randomized experiments is they allow for strong claims about causality
 - Why stuff happens!
 - Predict stuff
 - Prevent bad stuff
 - Promote good stuff

Causality!

- Strong causal claims require:
 - True independent variables
 - Random and representative samples
 - No confounds (impossible, but we try our best)

Examples

- Polio vaccine
- Working memory training

Helpful definitions

- *Population*: the entire collection of cases to which we want to generalize (e.g., all children in the US)
- *Sample*: a subset of the population
- *Parameter*: a numerical measure that describes a characteristic of a population
- *Statistic*: a numerical measure that describes a characteristic of a sample

Helpful definitions

- *Descriptive statistics*: procedures used to summarize, organize, and simplify data
- *Inferential statistics*: techniques that allow for generalizations about population parameters based on sample statistics

Helpful definitions

- *Independent variable*: a variable manipulated by the experimenter
 - aka treatment, e.g., polio vaccine
- *Dependent variable*: a variable that represents the aspect of the world that the experimenter predicts will be affected by the independent variable
 - aka response, e.g., rate of polio

Polio vaccine

- In the first half of the 20th century there were approximately 20,000 cases of polio per year in the USA
- In 1952, there were 58,000 cases

Polio vaccine

- In 1952, the first effective polio vaccine was developed by Dr. Jonas Salk
 - How do we know that it was effective?
 - RANDOMIZED EXPERIMENTS!

Polio vaccine

- Population
 - All children in the USA
- Sample
 - At first
 - 4,000 children from Virginia
 - Eventually
 - 1.8 million children from 44 states

Polio vaccine

- Independent variable
 - Treatment
 - Vaccine
 - Placebo
- Dependent variable
 - Polio diagnosis (measure of an individual child)
 - Rate of polio (measure of a group of children)

Polio vaccine

- Double-blind experiment
 - Experimenter did not know if the treatment was vaccine or placebo
 - Child (and parents) did not know if the treatment was vaccine or placebo

Polio vaccine

- Results
 - Rate (per 100,000)
 - Treatment: 28
 - Control: 71

Polio vaccine

- By 1994 polio had been completely eradicated from all the Americas
 - Prevent bad stuff!

Working memory training

- Is it possible for adults to enhance their intelligence by training their working memory?
 - Promote good stuff!

Working memory training

- Population
 - Healthy adults
- Sample
 - Random selection from the population
 - Representative of the population

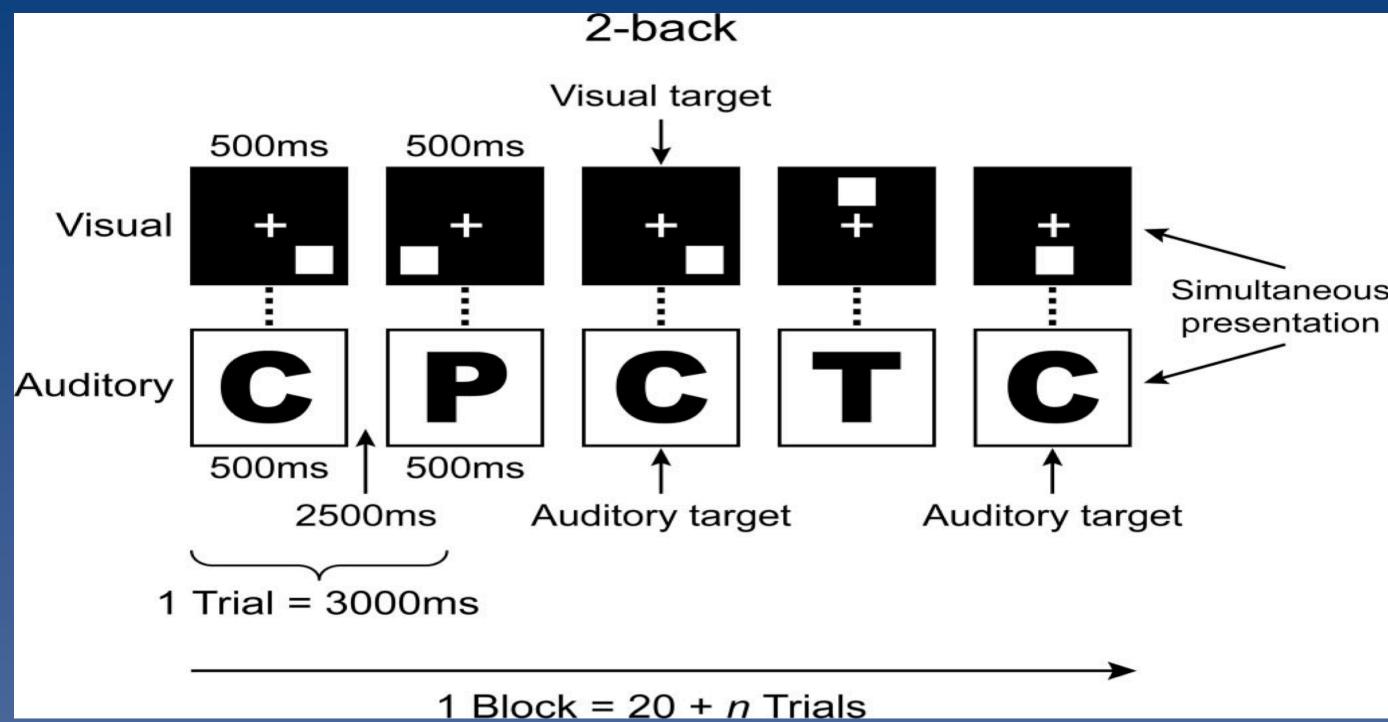
Working memory training

- Independent variable
 - Training
 - Memory training
 - No training
- Dependent variable
 - Change in score on an intelligence test
 - IQ change

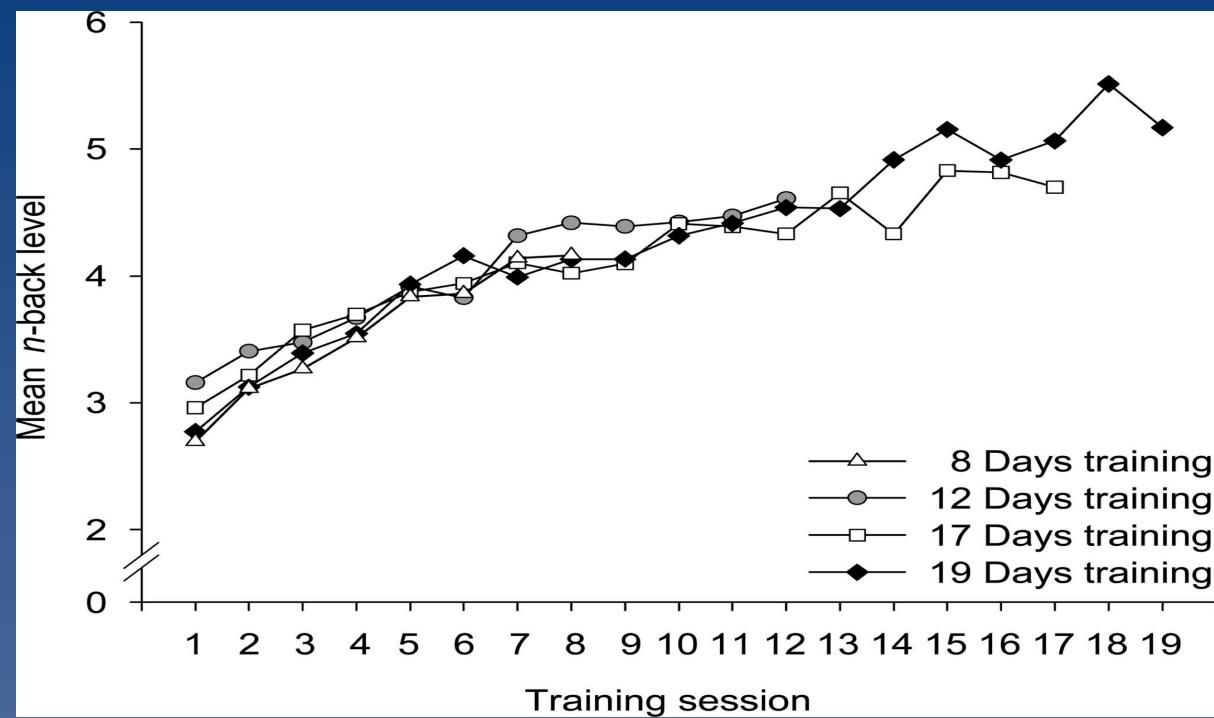
Working memory training

- Procedure
 - Treatment group engaged in memory training for a half hour every day for weeks
 - See next slide
 - IQ change
 - All subjects completed a test of intelligence before and after training

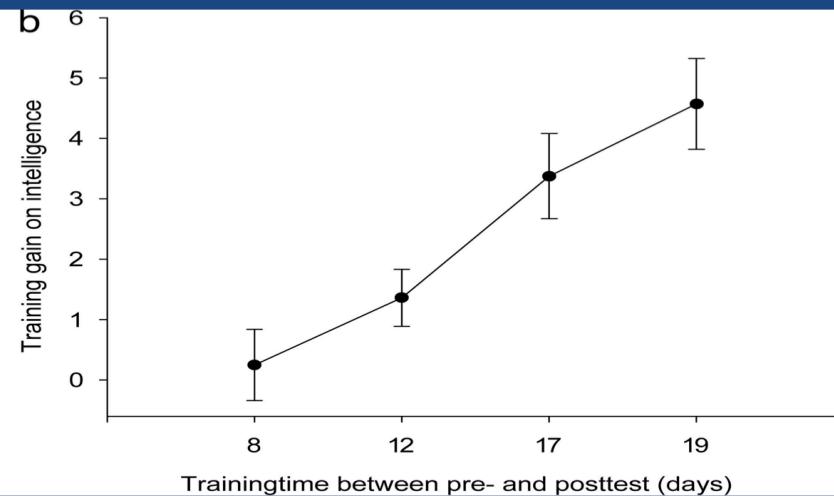
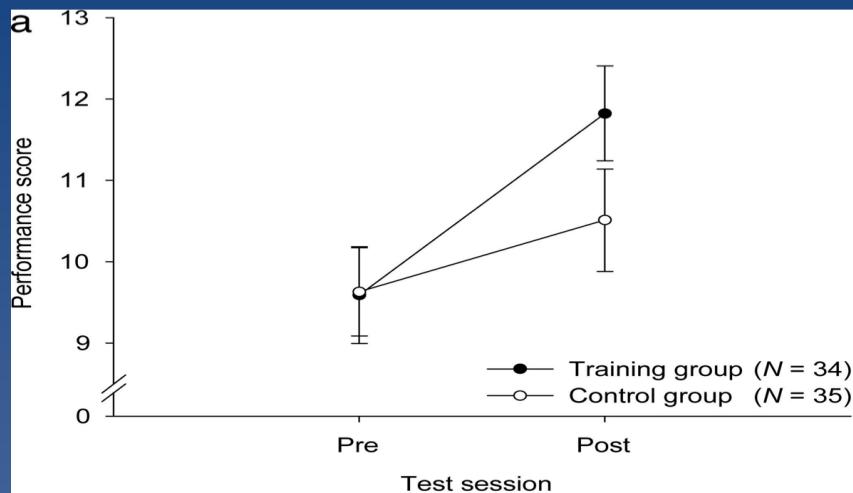
Jaeggi et al. (2008)



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Jaeggi et al. (2008)



Working memory training

- Discuss
 - Potential confounds?
 - Double-blind?

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Randomized experiments

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 - Random and representative sampling
 - Independent and dependent variables
 - Double-blind experiments
 - Confounds
 - Causality

Images in slides 8 - 11 are from Jaeggi, S. M., Buschkuhl, M., Jonides, J., & Perrig, W. J. (2008). Improving fluid intelligence with training on working memory. *Proceedings of the National Academy of Sciences*, 105(19), 6829-6833.

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