

Methods and Statistics for Psychology

Lecture 6

Scales of Measurement

Stevens (1946, 1951)



- Nominal or Categorical
 - Numbers are Labels
- Ordinal
 - Numbers Represent Rank Order
- Interval
 - Identical Intervals are Equivalent Differences
- Ratio
 - Identical Ratios are Equivalent Proportions
 - True Zero

Examples of Psychological Measurement

- Intelligence Tests

- Stanford-Binet Intelligence Scale
- Wechsler Adult Intelligence Scale
- Kaufman Assessment Battery for Children
- Raven's Progressive Matrices

- Personality Inventories

- Minnesota Multiphasic Personality Inventory
- California Psychological Inventory
- Personality Research Form
- NEO Five-Factor Inventory

Types of Statistics

Descriptive

- Central Tendency
 - Mean – Average (M)
 - Median – Midpoint (Mdn)
 - Mode – Most Frequent (Mo)
- Variability (Dispersion)
 - Standard Deviation (SD)
 - Variance (Var)
 - Standard Error of the Mean (SE_M)

Inferential

- t -test (t)
- Correlation Coefficient (r)
- Analysis of Variance (F)
- Multiple Regression (R)

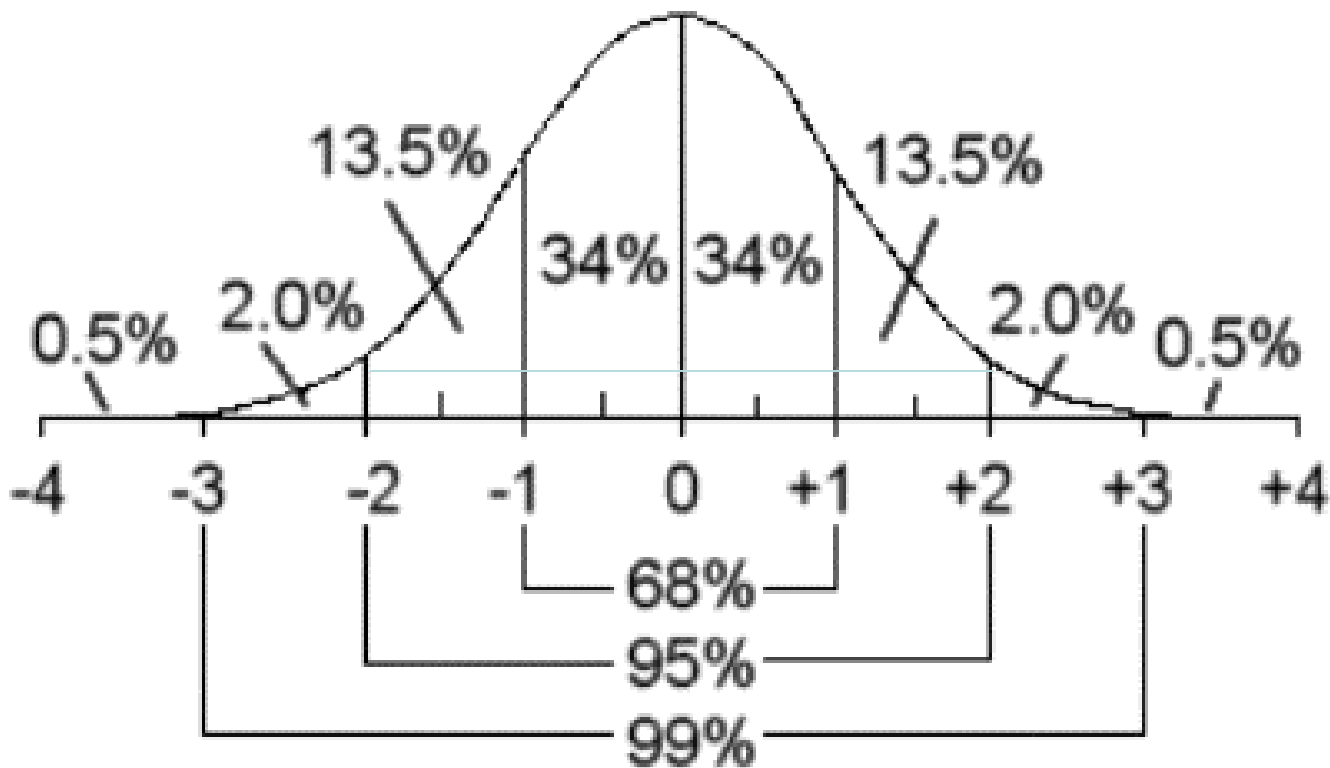
The Normal Distribution

“The Rule of 68, 95, and 99”

95% Confidence Interval

Outliers and “The Rule of 2”

Skew

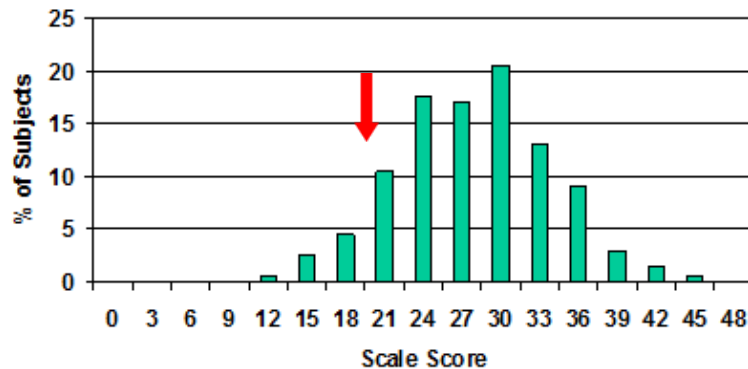


Comparing Scores on Different Tests

Assumption:
A Subject Scores **20** on Both Tests

Distribution of Extraversion

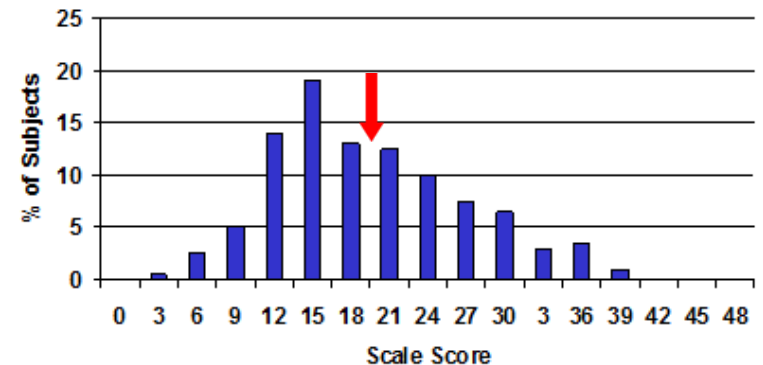
NEO-FFI Standardization Data, N = 983
Costa & McCrae (1989)



- $M = 26.91$
 - $SD = 5.91$
- Median = 27
- Mode = 29

Distribution of Neuroticism

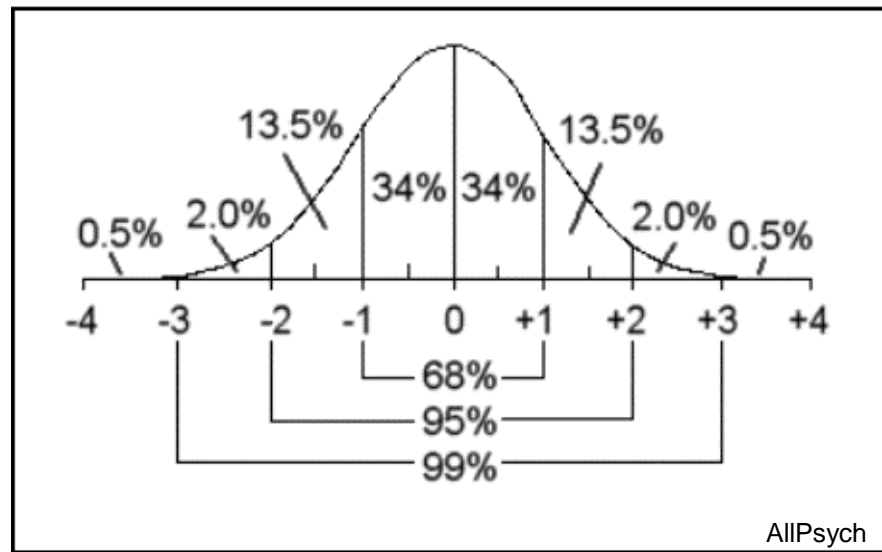
NEO-FFI Standardization Data, N = 983
Costa & McCrae (1989)



- $M = 18.88$
 - $SD = 8.63$
- Median = 17
- Mode = 13

Comparing Means

- Percentiles
- Z-Scores
 - Standard Deviation Units
- T-scores
 - $M = 100$, $SD = 10$

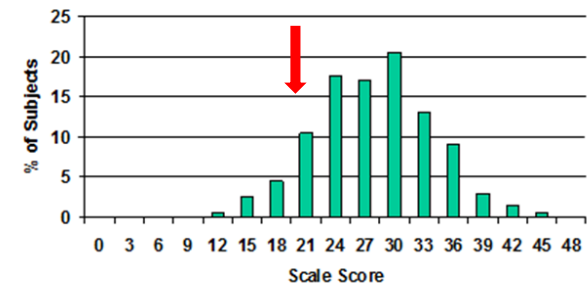


Comparing Scores on Different Tests

- Extraversion Score = 20
 - Percentile Score = 12
 - Z-score = -1.32
 - T-score = 39
- Neuroticism Score = 20
 - Percentile Score = 69
 - Z-score = +.12
 - T-score = 52

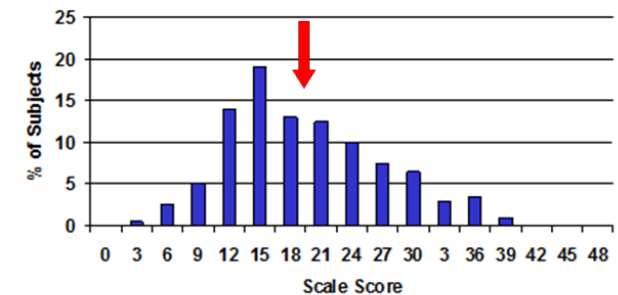
Distribution of Extraversion

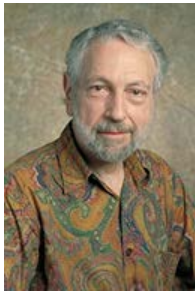
NEO-FFI Standardization Data, N = 983
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Distribution of Neuroticism

NEO-FFI Standardization Data, N = 983
Costa & McCrae (1989)





The Sternberg Experiment

Sternberg (1966)



- Memory-Scanning

- Memorize Study Set

- 1-7 Items

- Probe

C H F M P W

T

- Search Process

- Serial versus Parallel

- Response Latency to Say “Yes”

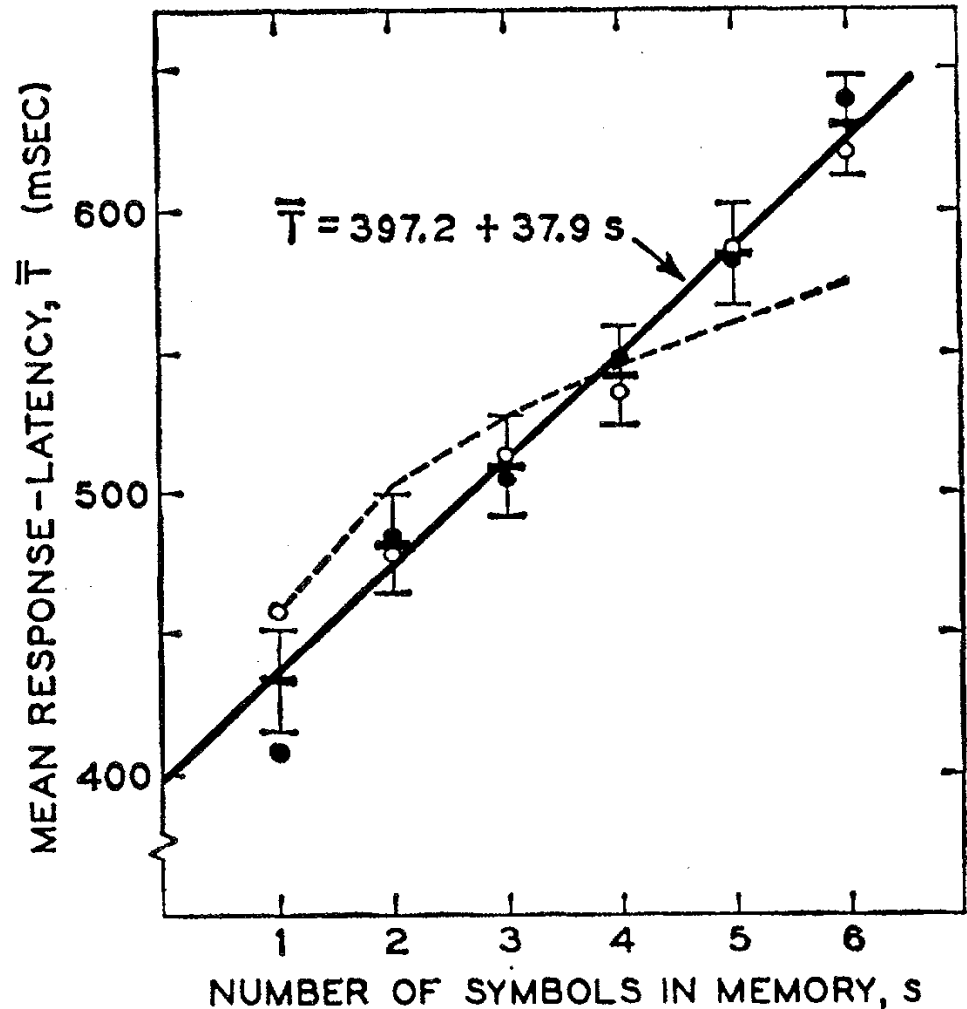
- Function of Set Size

- “Yes” < “No”

Sternberg's Results

Sternberg (1966), Exp. 1

- Independent Variable
 - Set Size
- Dependent Variable
 - Response Latency
 - “Yes”
 - “No”



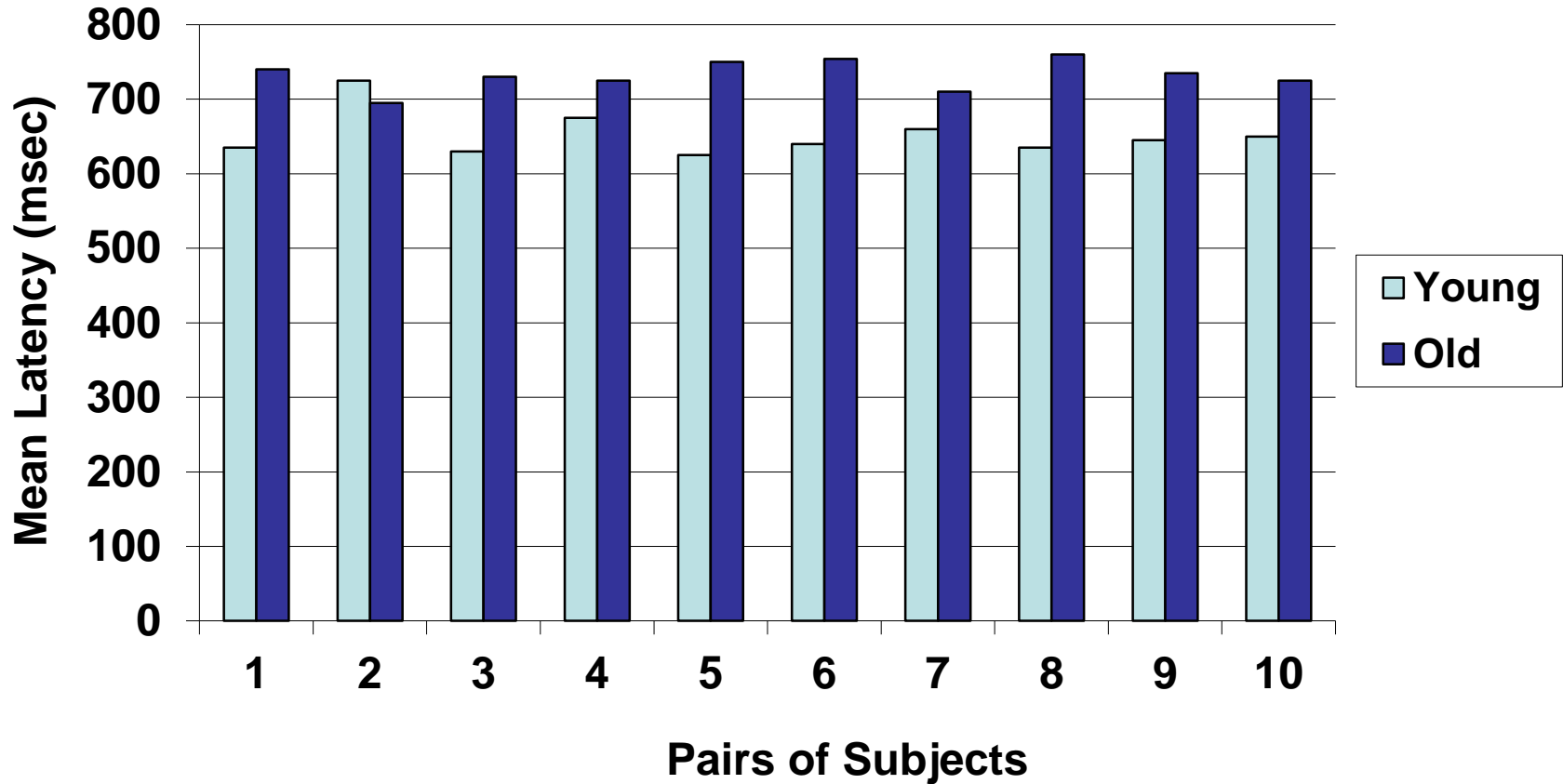
Testing a Hypothesis

Aging Impairs Memory Scanning

- Theory (Aging Slows Mental Processes)
- Hypothesis (Elderly Are Slower on Sternberg Task)
- Population
 - Representative Sample
- Confounding Variables
- Independent Variable
 - Age
- Dependent Variable
 - Response Latency

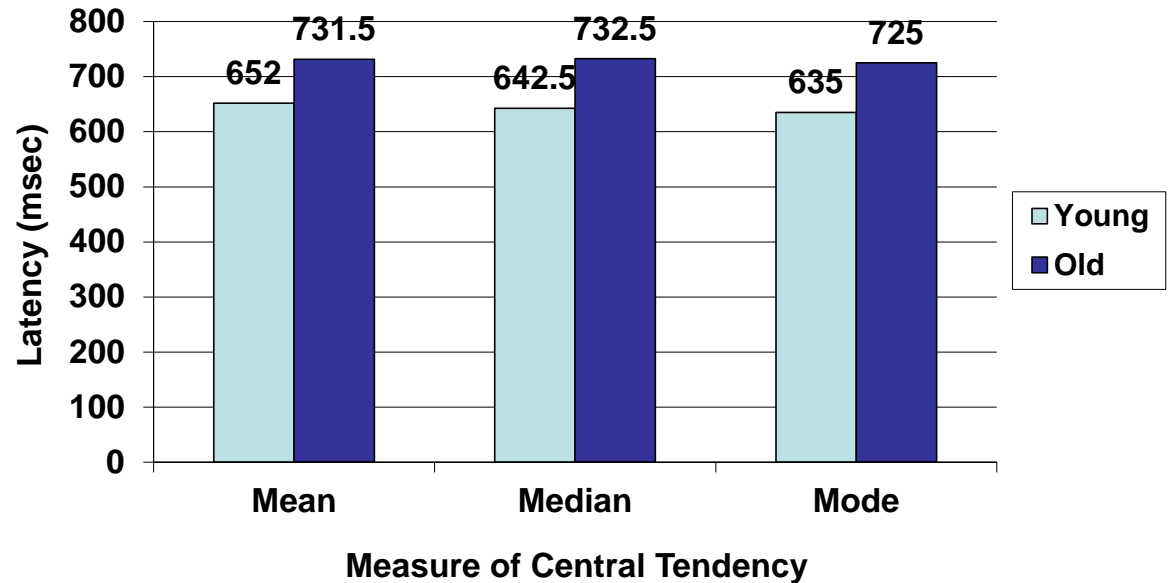
Age and Memory-Scanning Performance

Fabricated Data



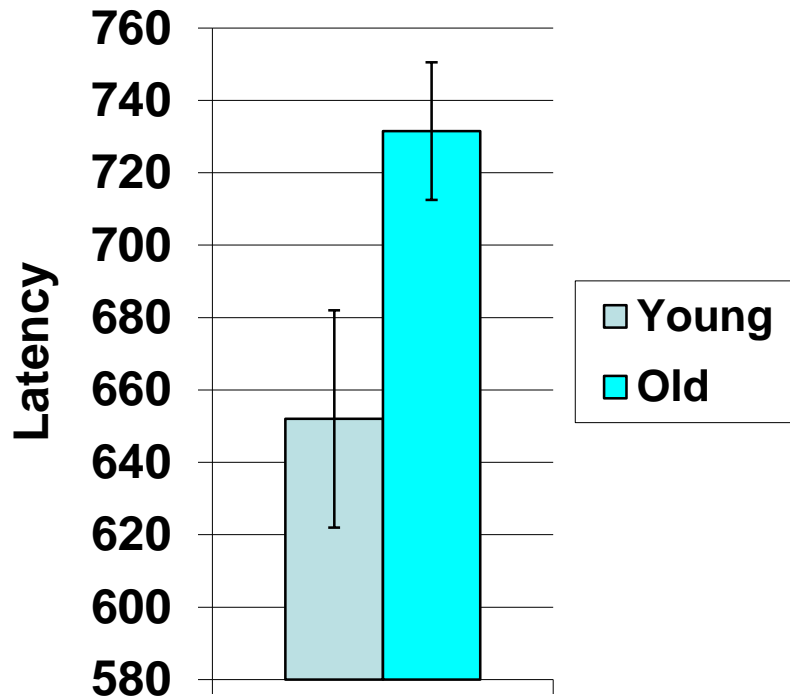
Measures of Central Tendency

- Mean
 - Average
- Median
 - Midpoint
- Mode
 - Most Frequent

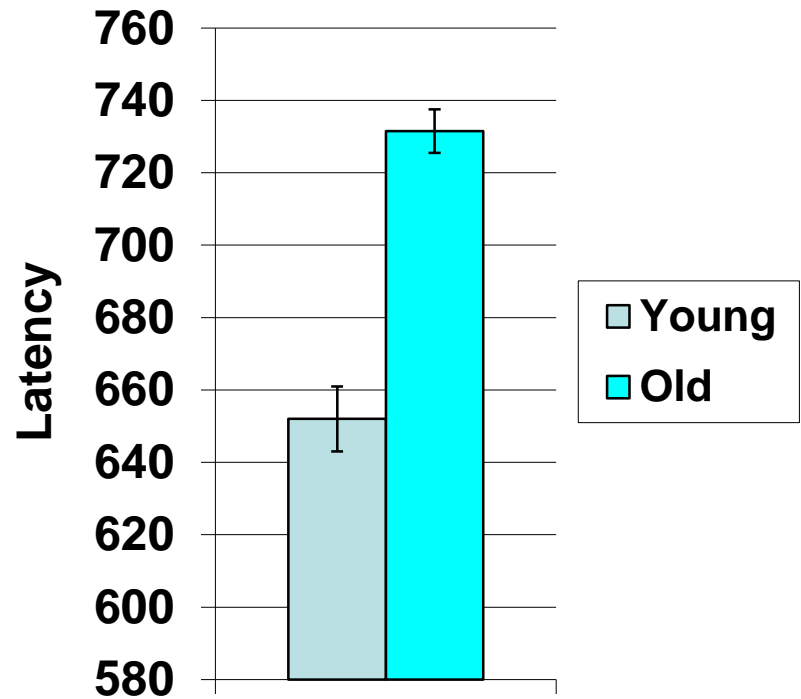


Measures of Variability

Standard Deviation

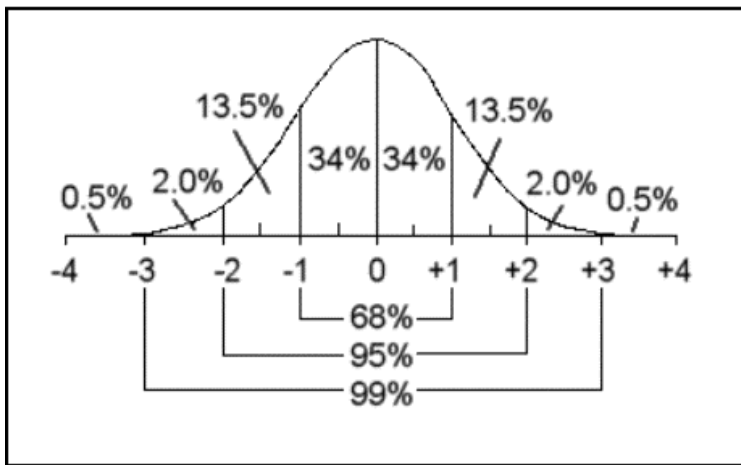


Standard Error

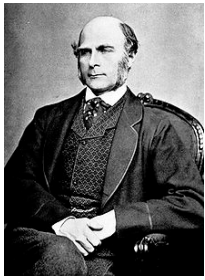


Confidence Intervals

<u>Group</u>	<u>Mean</u>	<u>SD</u>	<u>95% CI</u>
Young	652	30	592 - 712
Old	731.5	19	713 – 751



Everyone else is an *outlier!*



Inferential Statistics for Hypothesis-Testing

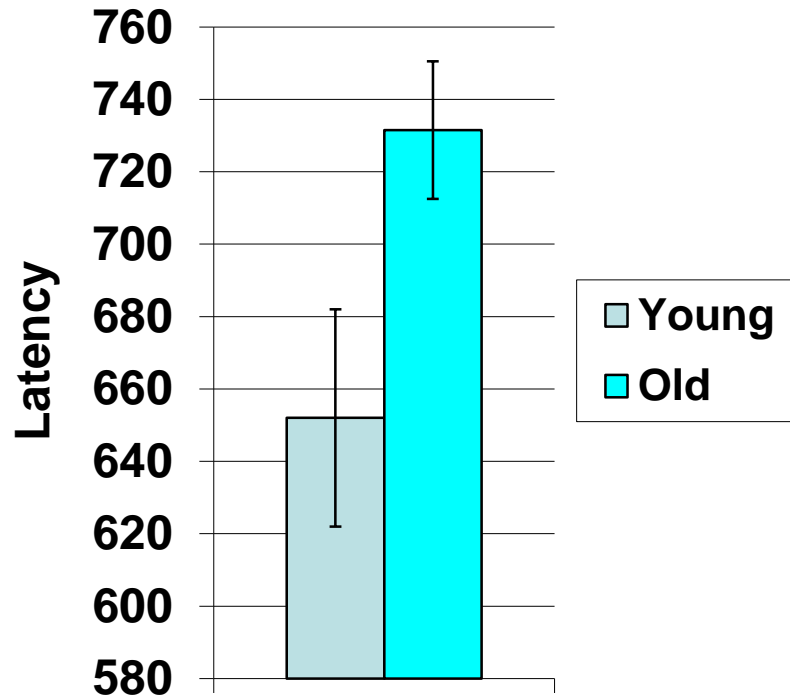


- Two Groups or Variables
 - (Student's) t -Test (t)
 - Correlation Coefficient (r)
- More than Two Groups or Variables
 - Analysis of Variance (F)
 - Multiple regression (R)

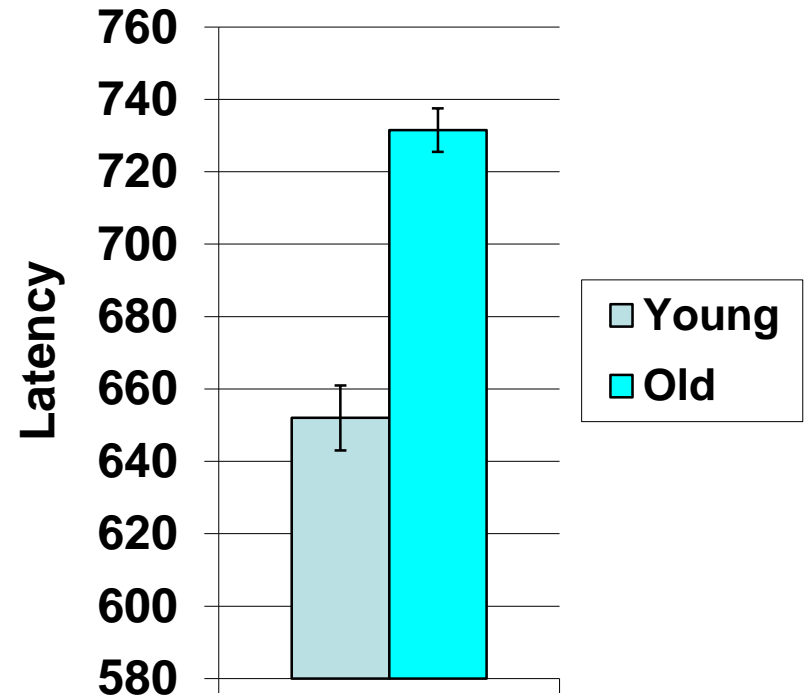
Testing the Difference Between Means

$$t = 7.12 (p < .001)$$

Standard Deviation



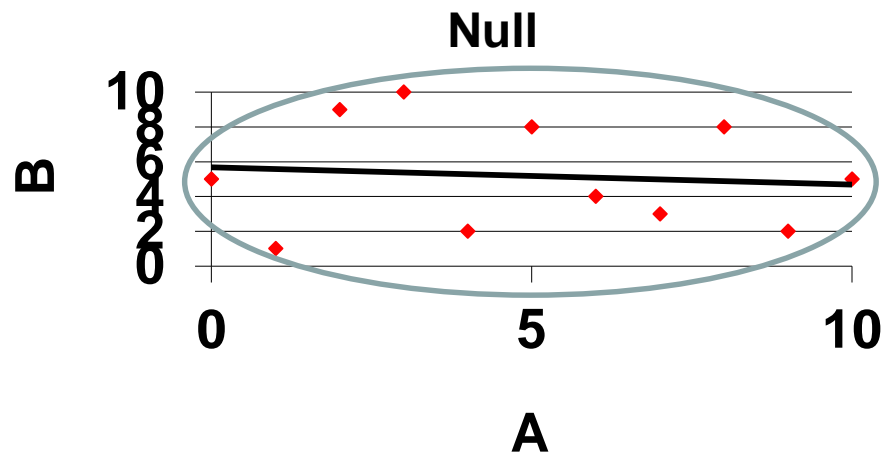
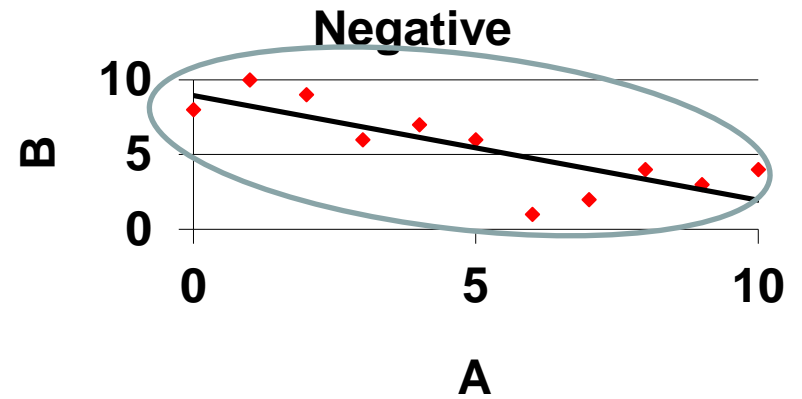
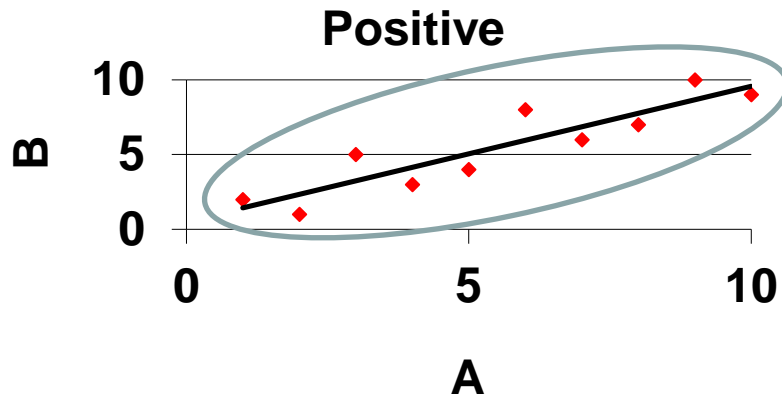
Standard Error



Experimental and Correlational Methods

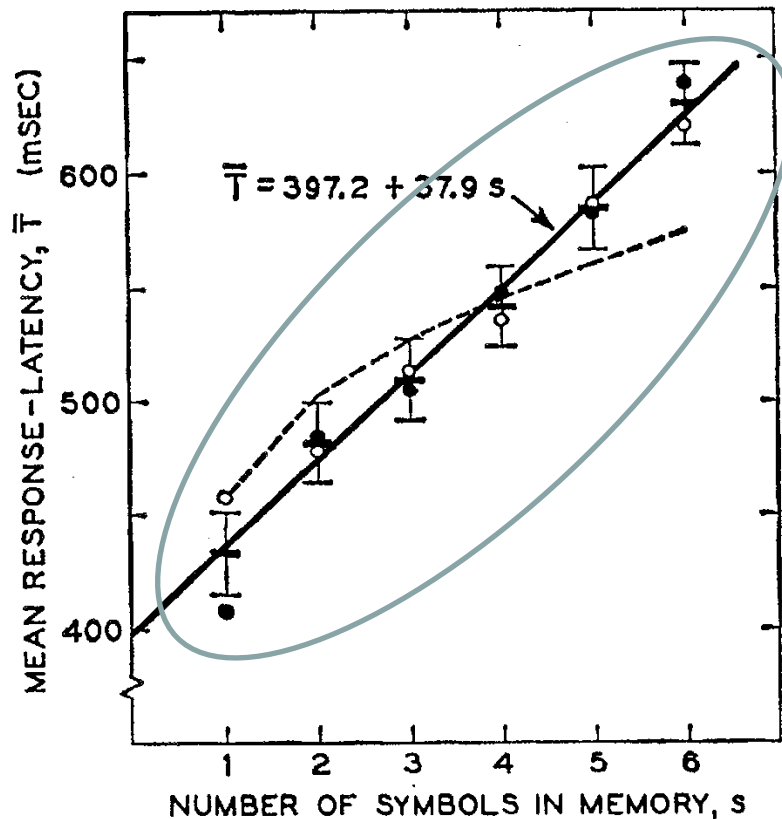
- Experimental
 - Experimental Manipulation
 - Independent vs. Dependent Variables
 - Quasi-Experiments
 - Within-Subjects vs. Between-Groups Designs
- Correlational
 - Natural Variation
 - Predictor vs. Criterion Variables
 - Association Between Variables
 - Direction, Strength

The Correlation Coefficient



The Sternberg Experiment Redux

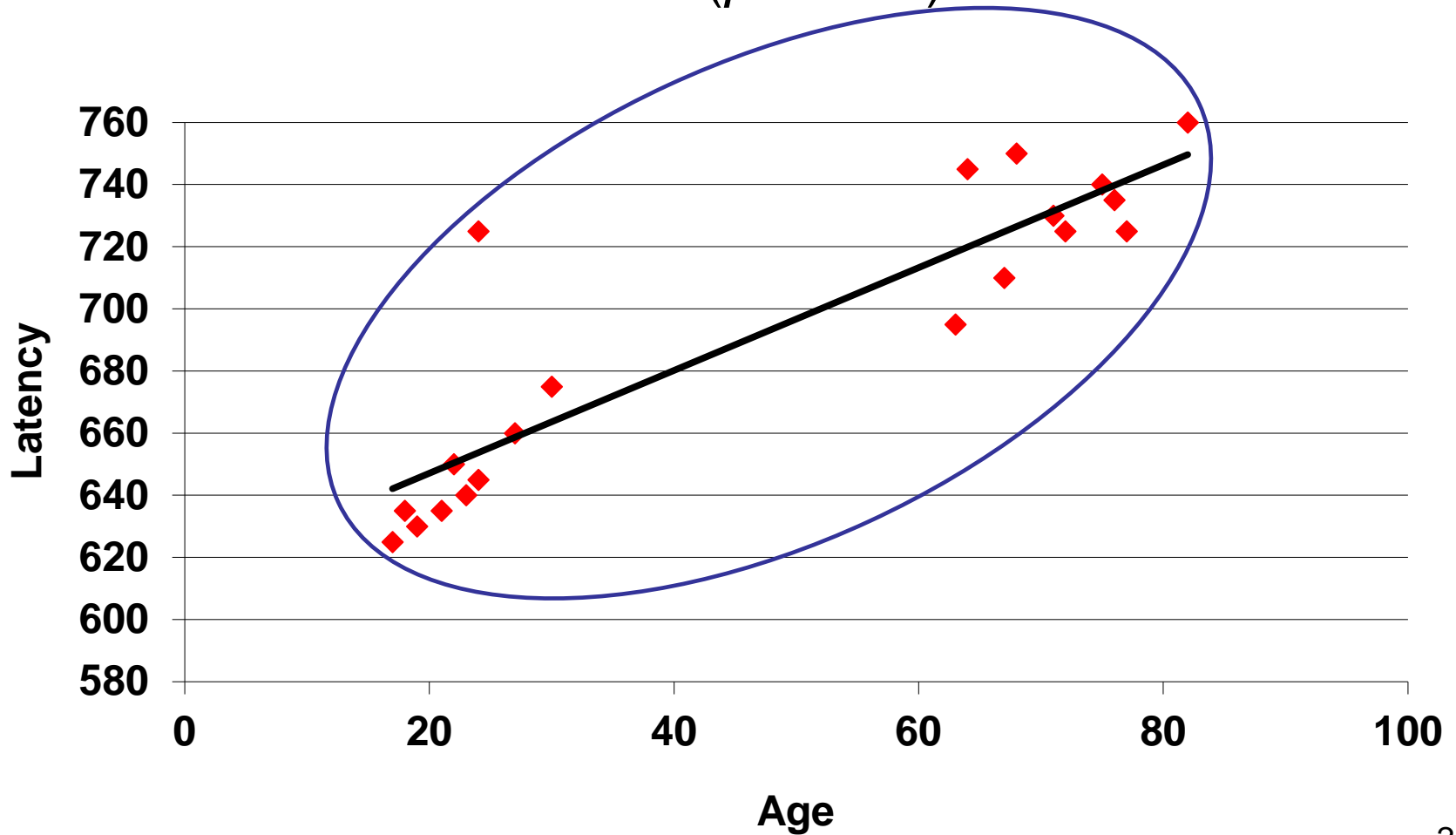
Sternberg, 1966



- Set Size
 - Independent Variable
 - Predictor Variable
- Response Latency
 - Dependent Variable
 - Criterion Variable

Correlation of Age with Response Latency

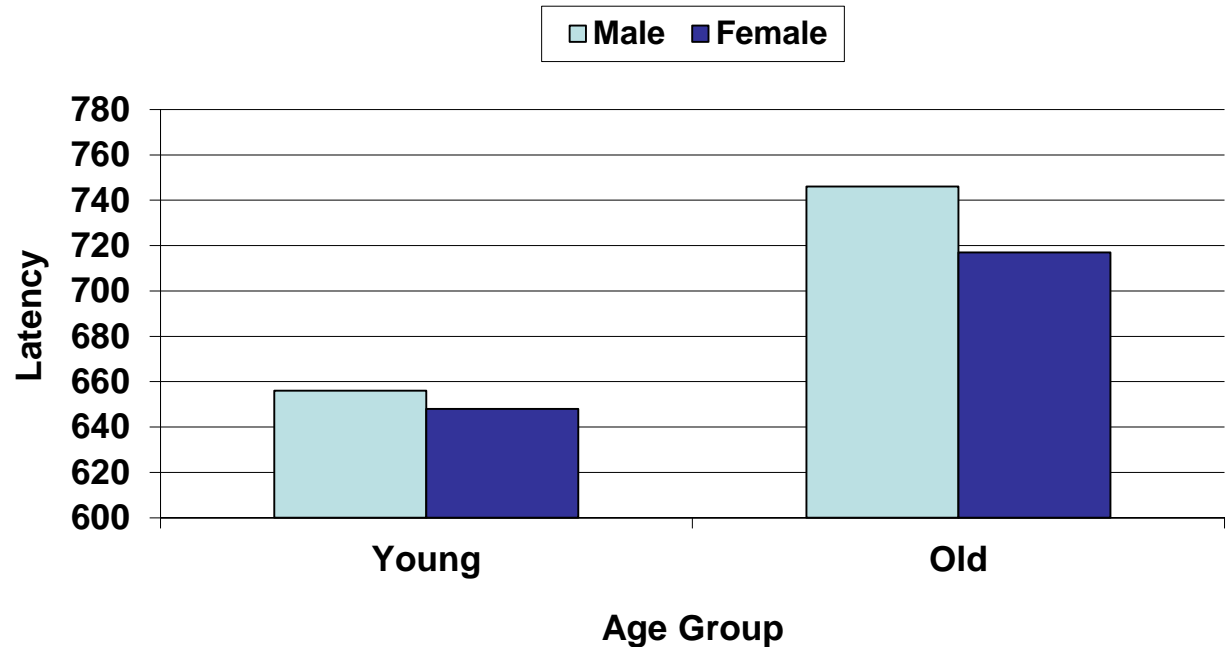
$r = .89$ ($p < .001$)



Analysis of Variance

Enlarged Sample, $N = 100$

- Main Effect
 - Age
 - $F = 338.96^*$
 - Gender
 - $F = 18.36^*$
- Age x Gender Interaction
 - $F = 5.91^*$

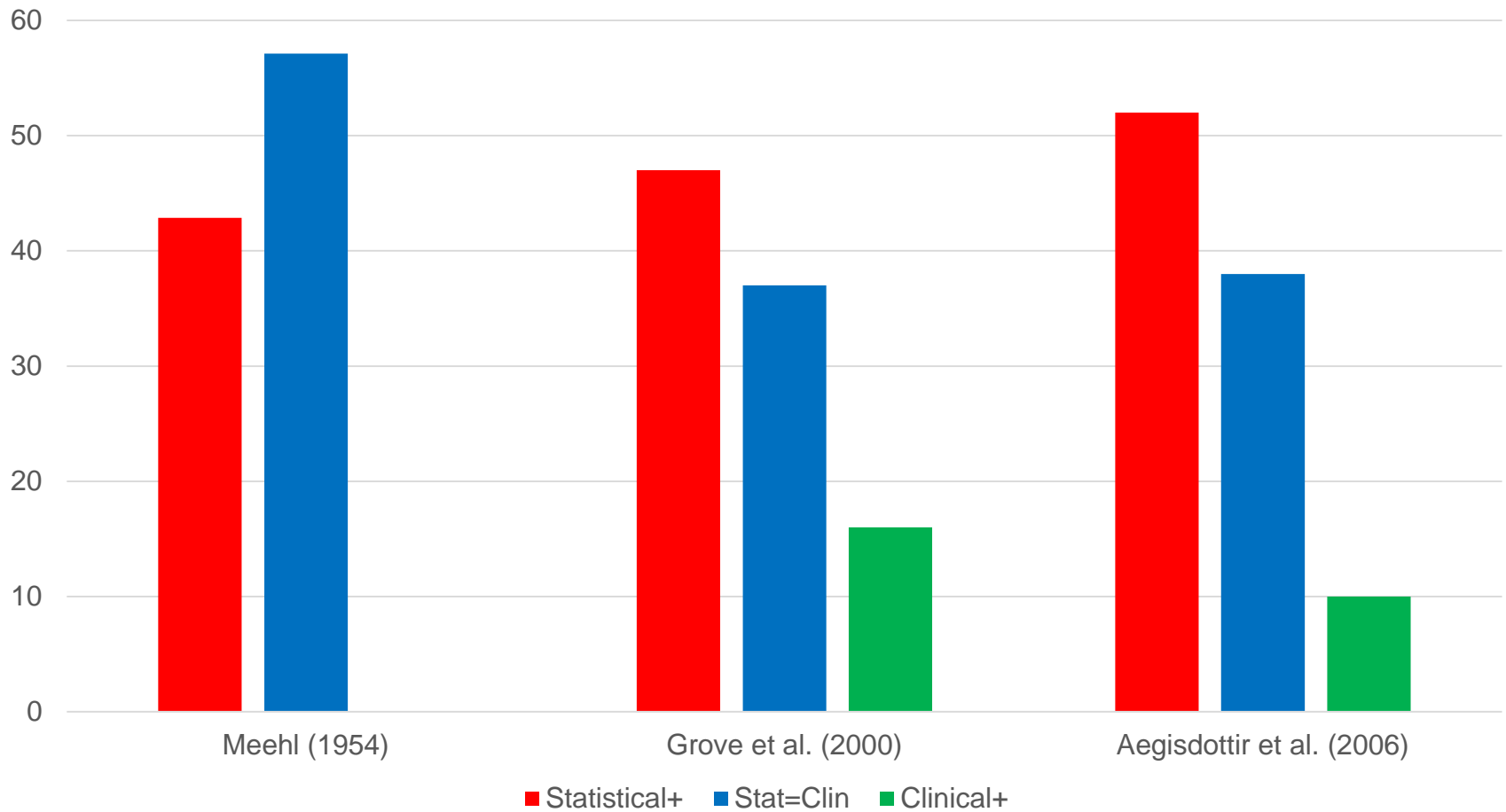


$*p < .05$

Analysis of Variance
Is Mathematically Equivalent to
Multiple Regression

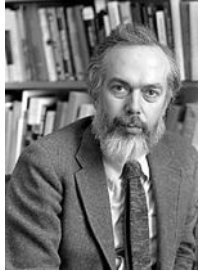
Clinical vs. Statistical Prediction

Results of 3 Meta-Analyses



Statistics as Principled Argument

Abelson (1995)



- [T]he purpose of statistics is to organize a useful argument from quantitative evidence, using a form of principled rhetoric. The word *principled* is crucial. Just because rhetoric is unavoidable... in statistical presentations does not mean that you should say anything you please.
- Beyond its rhetorical function, statistical analysis also has a narrative role. Meaningful research tells a story with some point to it, and statistics can sharpen the story.