Limitations and Flaws in the Research Supporting SFSTs

By Joel Wiesen, Ph.D.
Applied Personnel Research
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jwiesen@appliedpersonnelresearch.com

SFST Research Is Flawed

- Flaws in:
  - The original research
  - Later studies
  - Training
  - Field implementation
  - Test content
    -- Removed from driving tasks

My Background

- Industrial Psychologist
- Specialize in testing
- Published test author
- Peer reviewer
- Expert witness in testing cases
- Presenter at professional testing conferences

Overview of Talk

- Criteria for evaluating tests and test research - Professional standards
- Three major NHTSA SFST research reports

APA Testing Standards

- Standards for Educational and Psychological Testing (1999)
- Published jointly by:
  - American Psychological Association
  - American Educational Research Association
  - National Council on Measurement in Education

Definition of a Test

- "An evaluative device or procedure in which a sample of an examinee's behavior in a specified domain is obtained and subsequently evaluated and scored using a standardized process." (Page 183)

SFST Research Studies

- We will look today at:
  - Burns and Moskowitz, 1977
  - Burns and Anderson, 1995
  - Stuster and Burns, 1998

Approach to Each Study

- Summary
- Strengths
- Weaknesses
- Overall evaluation

Burns and Moskowitz, 1977

- Psychophysical Tests for DWI Arrest

Burns and Moskowitz, 1977: Summary

- Goals:
  - Evaluate then current FSTs
  - Develop/evaluate more reliable FSTs
  - Standardize test administration
  - Recommend “best” SFSTs
  - Evaluate relationship between BAC and driving impairment

Burns and Moskowitz, 1977: Summary

- Findings:
  - Correlations of test score with BAC
  - Correlation of BAC with driving
  - Inter-rater reliability

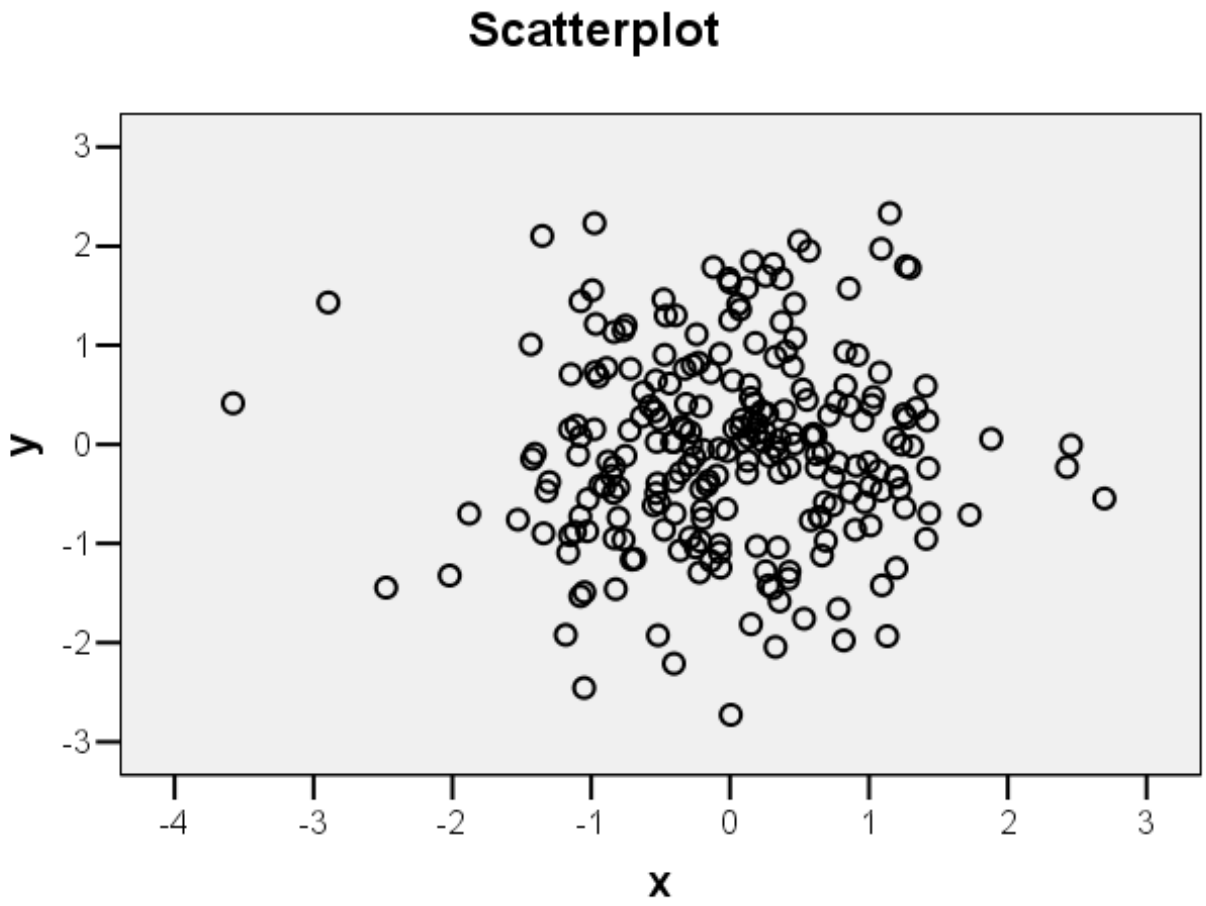
Burns and Moskowitz, 1977: Summary

- Correlations of test scores with BAC:
  - OLS: .48
  - WAT: .55
  - Nystagmus: .67
  - Total score: .67 (Page 17)

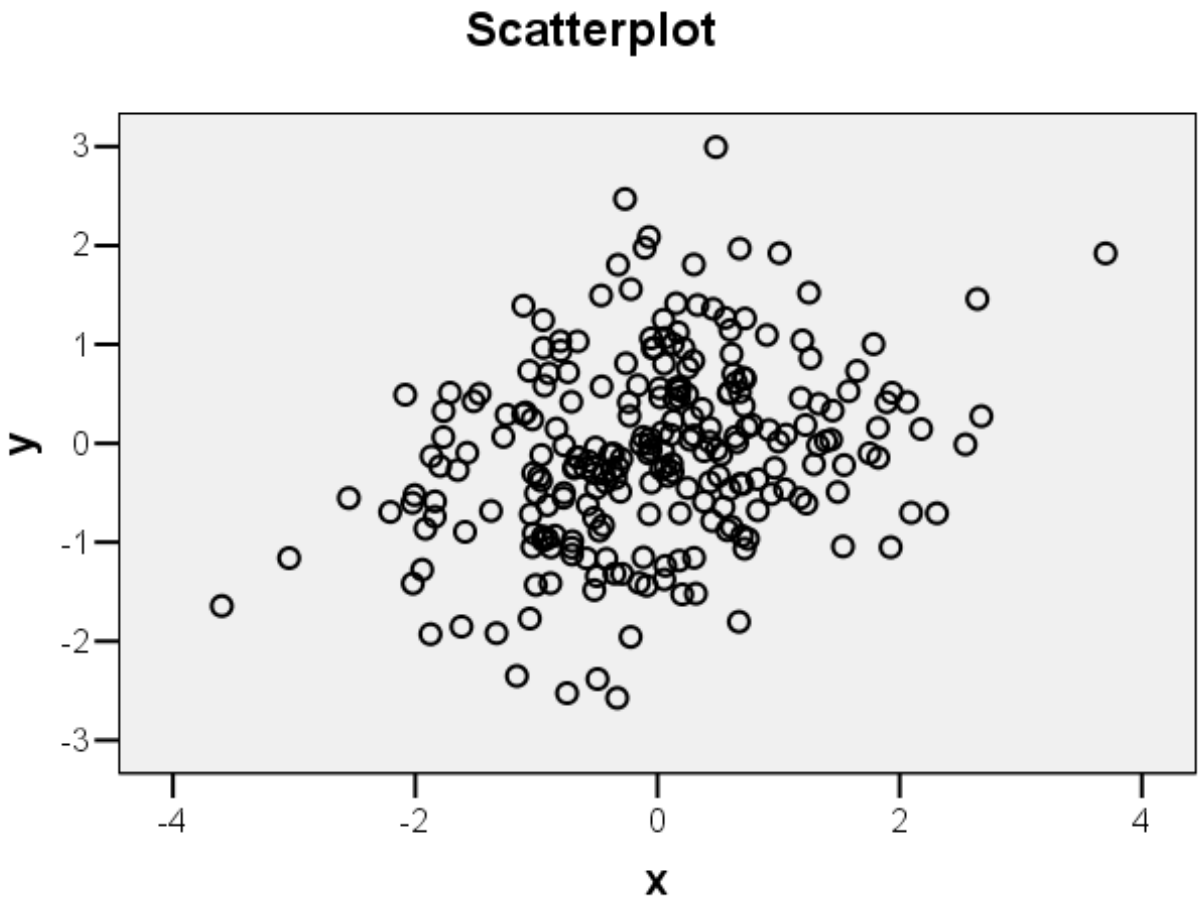
Review of Correlation Coefficients

- A correlation is a statistic, denoted as r
- Correlations are numerically calculated
- r can range from -1 to +1
- r = 0 means there is no linear relationship
- r = 1 means a perfect linear relationship
- r = -1 means a perfect linear relationship

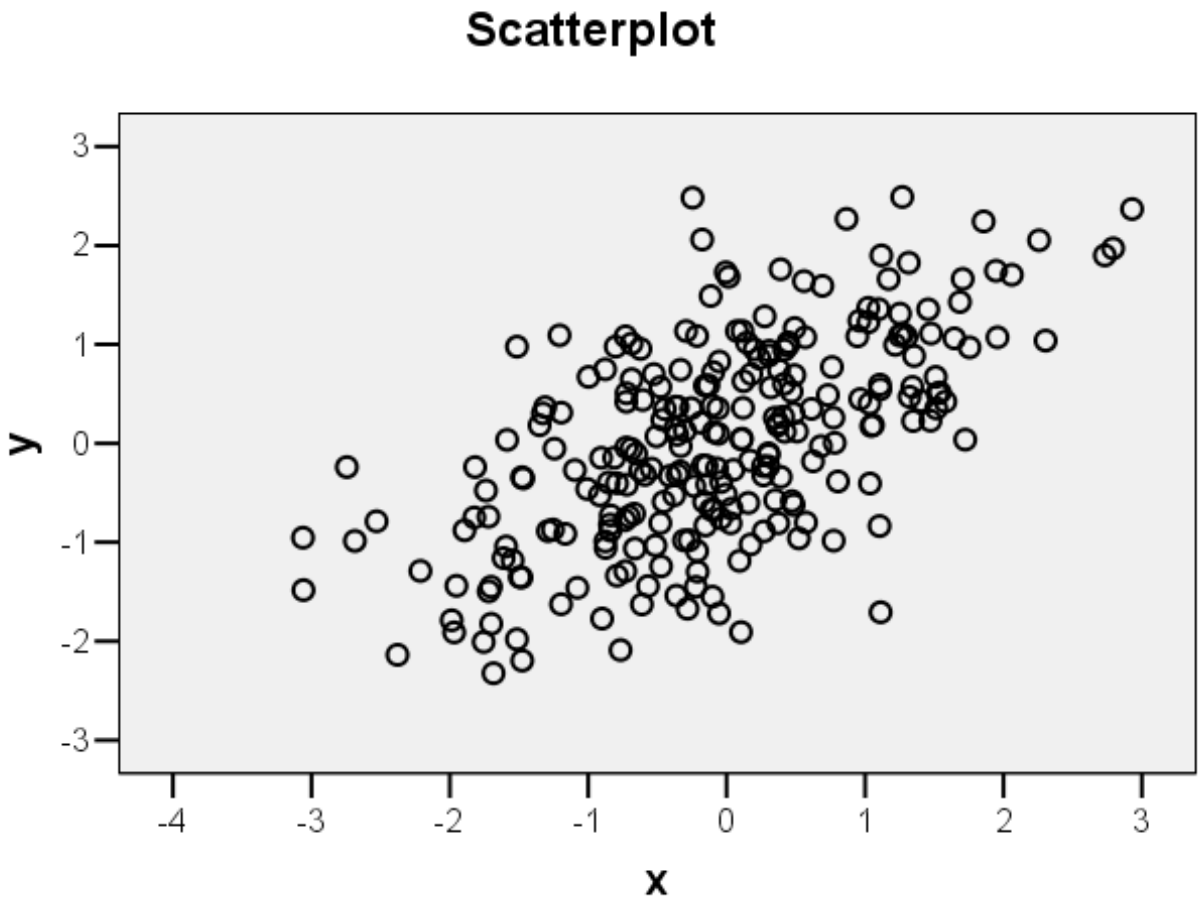
Correlation Of Zero



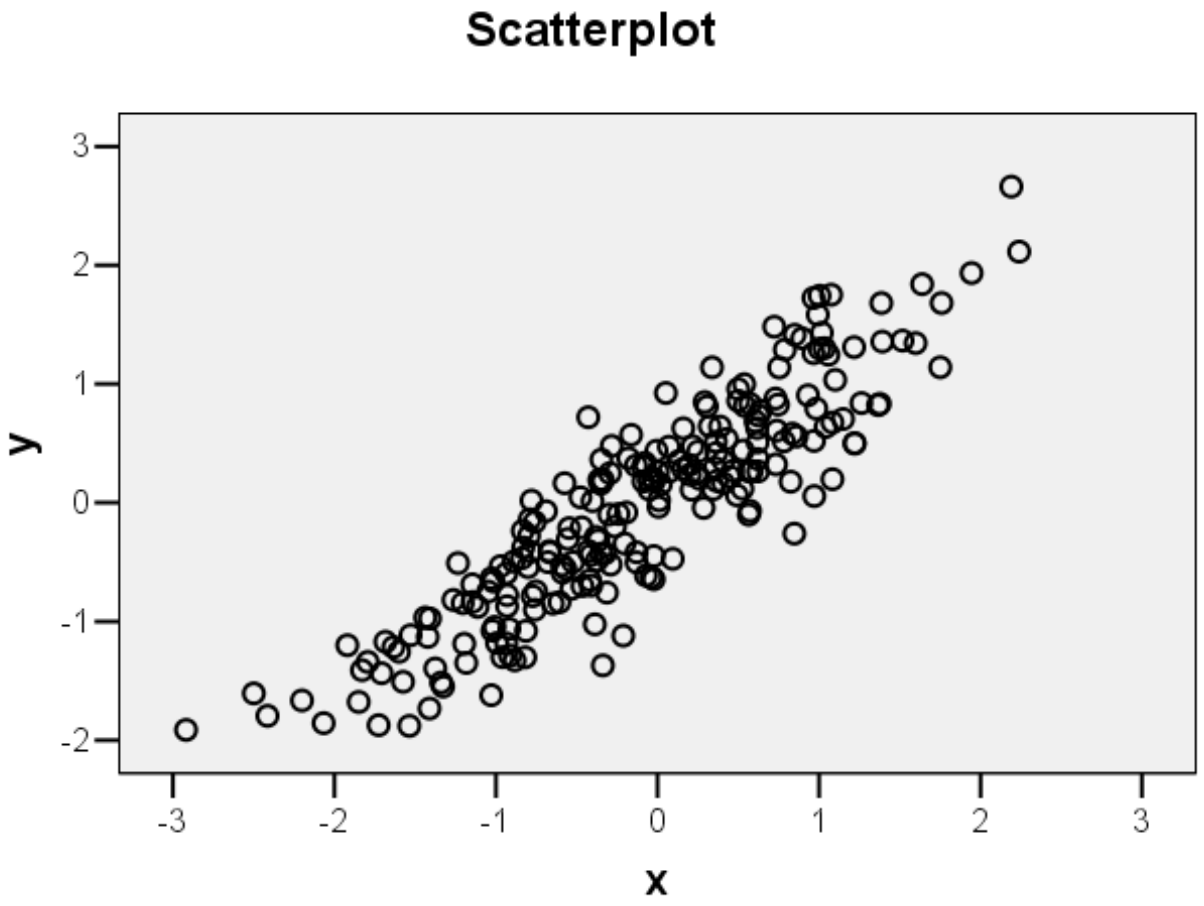
Correlation Of .30



Correlation Of .60



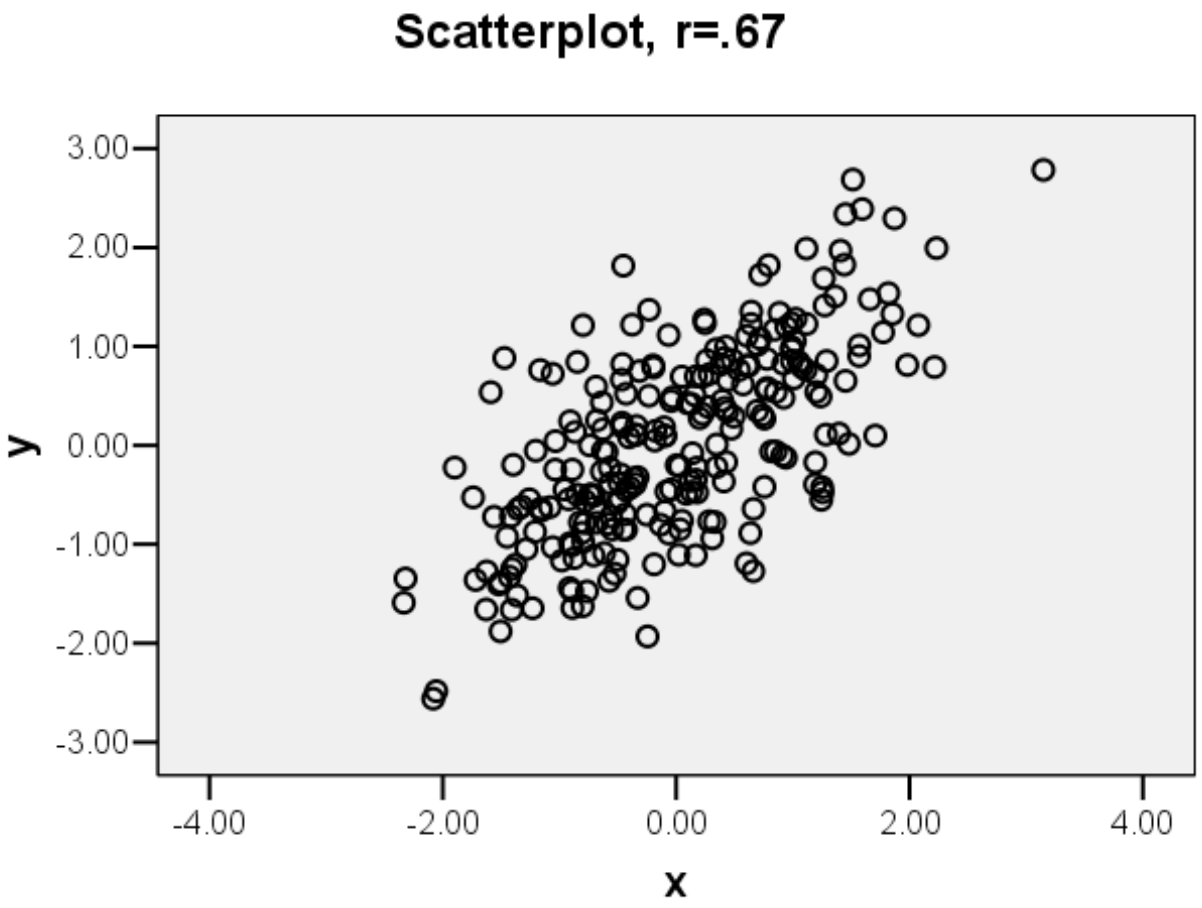
Correlation Of .90



Burns and Moskowitz, 1977: Summary

- Correlations of test score with BAC:
  - OLS: r = .48
  - WAT: r = .55
  - Nystagmus: r = .67
  - Total score: r = .67 (Page 17)

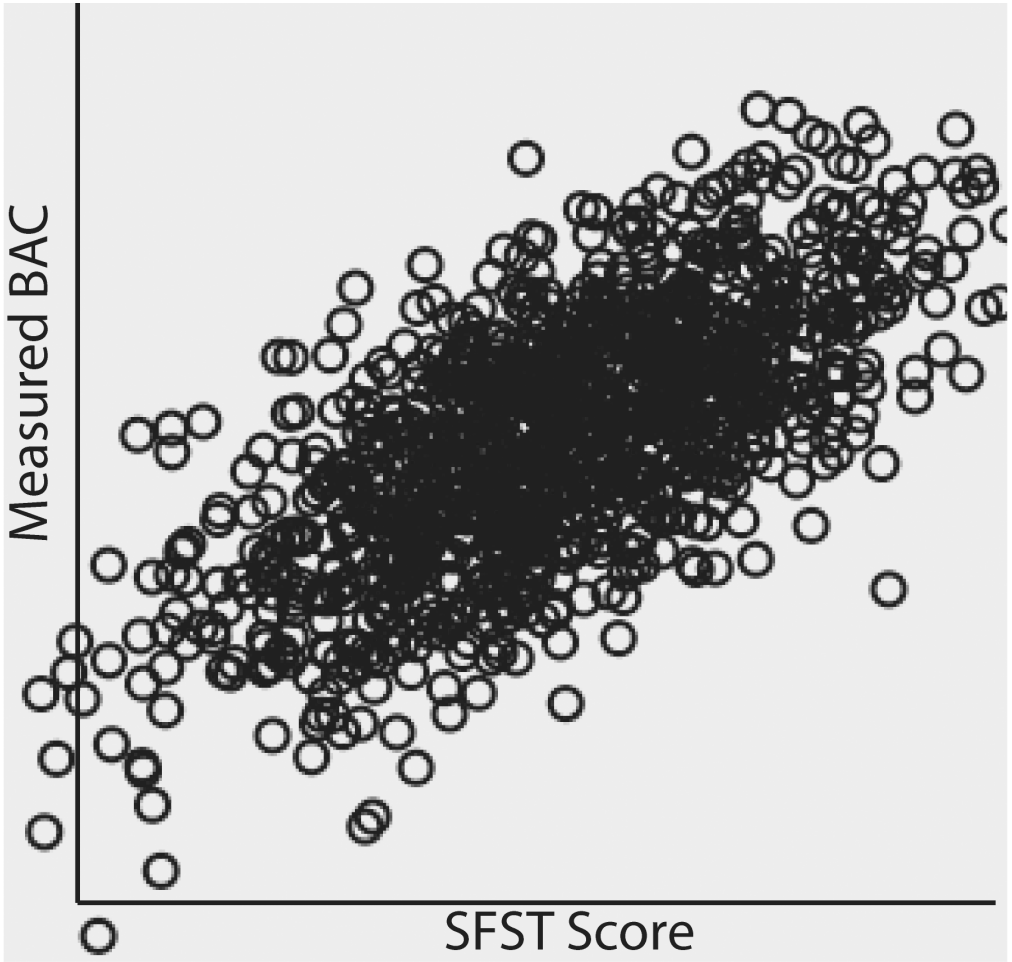
Correlation Of .67



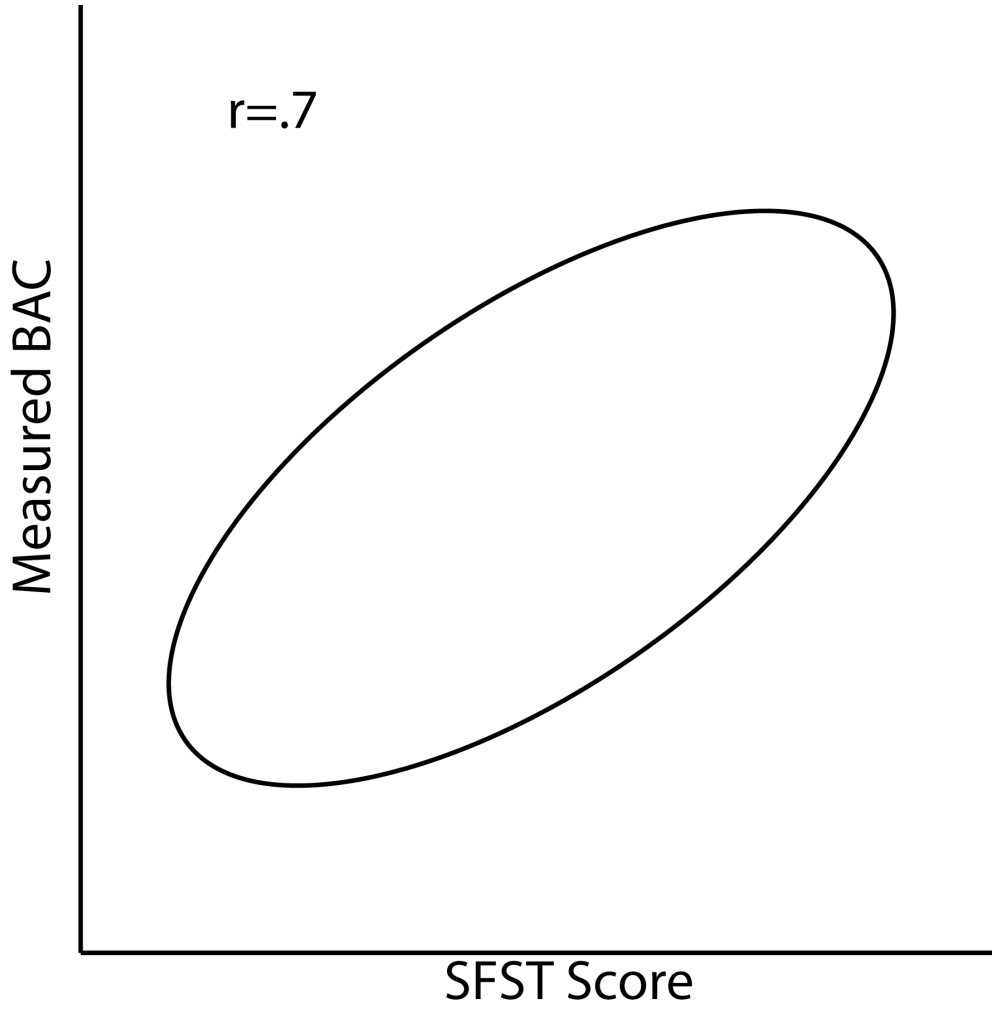
Correlation and SFST Decisions

- Understand some limits of SFSTs
- False Alarm Rates

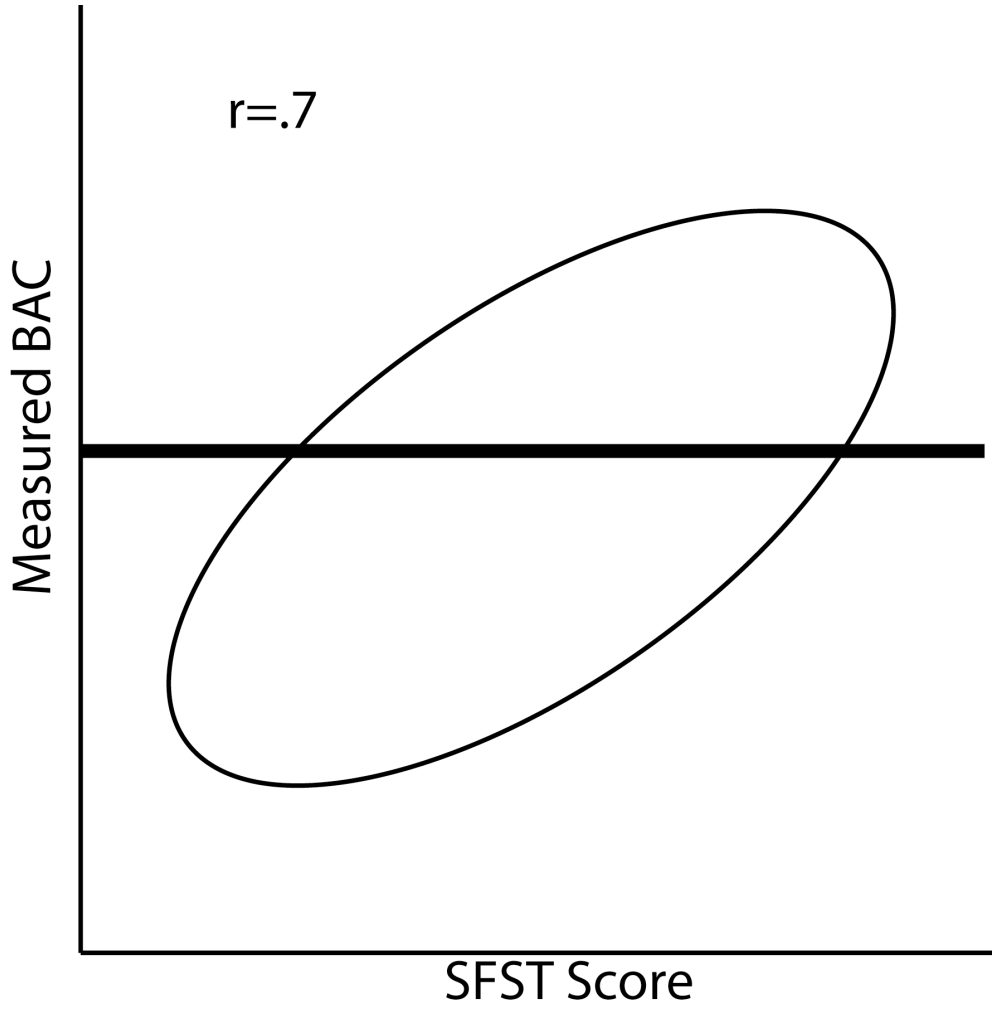
Correlation and SFST Decisions



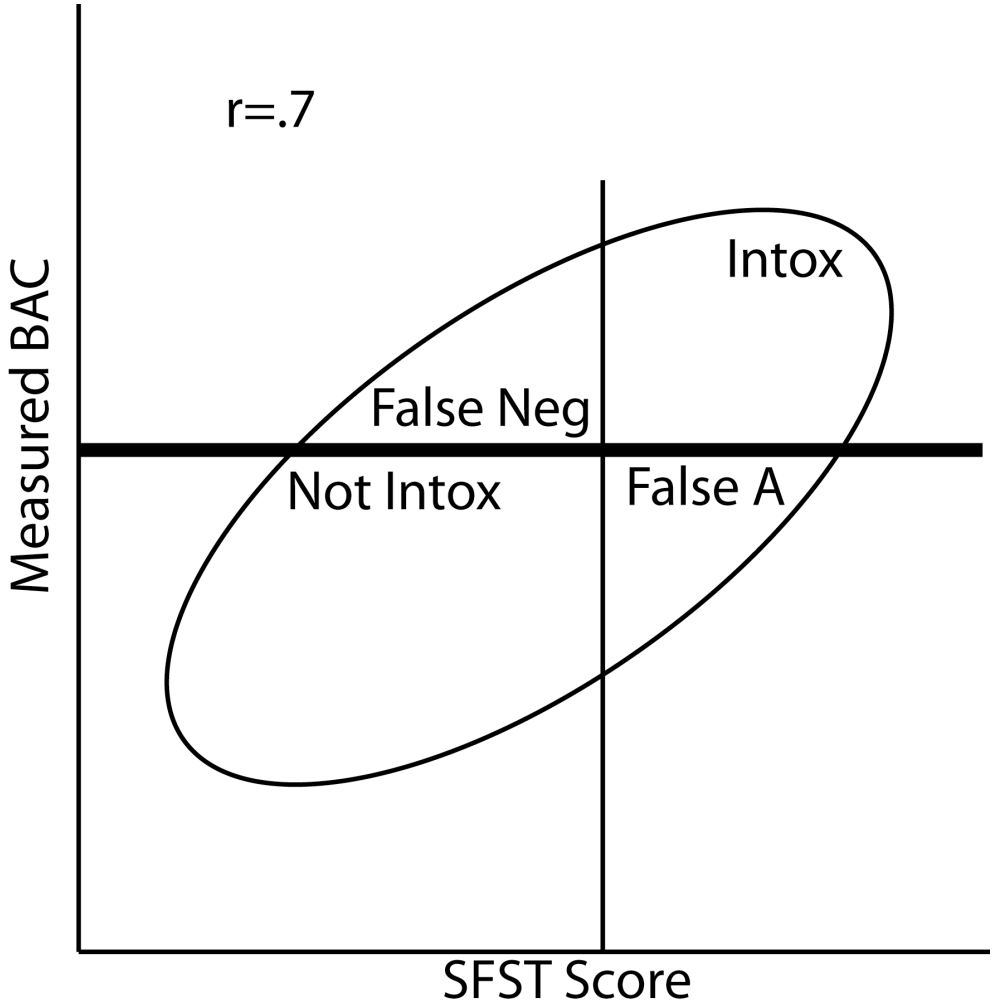
Correlation and SFST Decisions



Correlation and SFST Decisions



Correlation and SFST Decisions



Correlation and SFST Decisions

- Decrease false alarms and false negatives
- Only ONE WAY to do this
- Increase the validity of test
  - Make the oval thinner

Correlation and SFST Decisions

- To improve validity:
  - Improve the test
  - Improve the training of test administrators
- Hard to improve
  - After 30 years of improvements

Burns and Moskowitz, 1977: Summary

- Correlations of SFSTs with driving simulation reaction time:
  - OLS: r = .15
  - WAT: r = .12
  - Nystagmus: r = .27 (Page 55)

Burns and Moskowitz, 1977: Summary

- Inter-rater reliability (Page 33)
  - OLS: .82
  - WAT: .80
  - Nystagmus: .90
  - Total: .92

Reliability

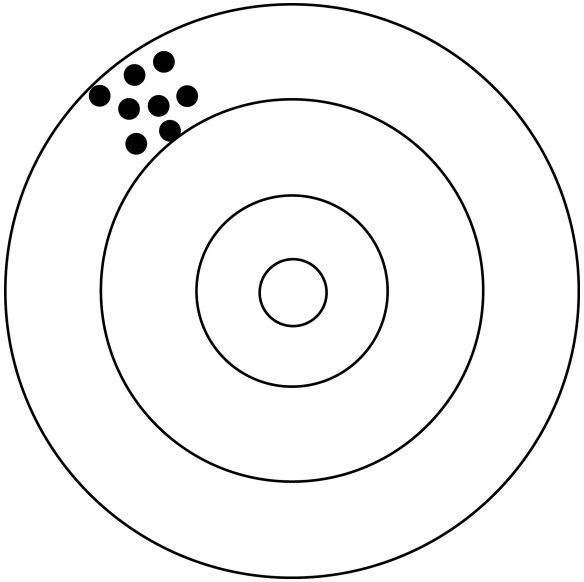
- The degree to which test scores are repeatable
- Would a suspect get the same score if:
  - he/she had the same BAC tomorrow and were tested again tomorrow
  - tested twice by two trained administrators
  - the test were given at different times of day, or in different locations.

Reliability

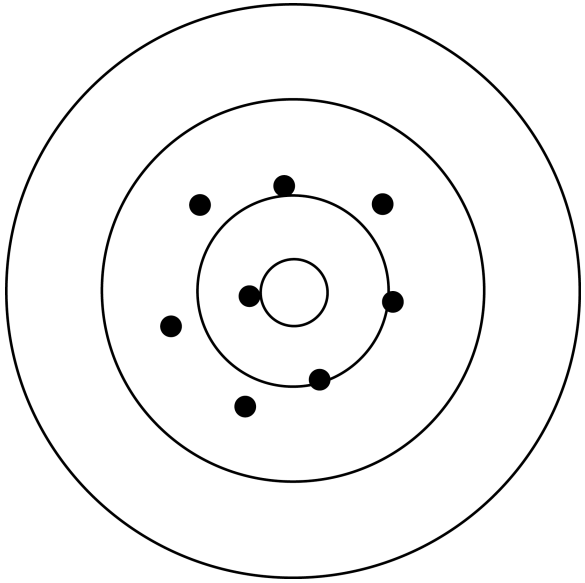
- Reliability is NOT validity

Reliability and Validity

- High reliability
- Low validity



- Low reliability
- High validity



Reliability and Validity

- A test must be reliable to be valid
- A test can be reliable and not valid
- Statistical relationship:

$$\text{Validity} \leq \sqrt{\text{Reliability}}$$

Inter-Rater Reliability

- The degree to which a suspect would get the same score from any trained test administrator

Burns and Moskowitz, 1977: Strengths

- Double-blind design
  - Officers did not see drinkers outside of testing sessions
- 238 participants

Burns and Moskowitz, 1977: Weaknesses

- Report narrative not clear
- Report deficiencies
- Research design not followed
- Data analyses contain errors
- Data analyses not fully reported
- Data analyses biased

Burns and Moskowitz, 1977: Report Narrative Not Clear

- "Q-F-V" used 20 times without explanation
  (e.g., page 19)
  (quantity-frequency-variability index)
- "Mean Test Score (error)" (Pages 23, 24)
  - Used twice with no explanation
  - This is not standard terminology

Burns and Moskowitz, 1977: Report Narrative Not Clear

- Scientists communicate through publications
- Must be clear enough for another scientist to understand and replicate what was done
  - procedure
  - statistical analysis

Burns and Moskowitz, 1977: Report Narrative Not Clear

- Apparatus has 40 peripheral lamps
  - spaced every 5 degrees from 15 to 100 degrees, on left and right (Appendix 9, page 1)
- But 20 lamps would go from 15 to 110 degrees
- There are more places where report is not clear

Burns and Moskowitz, 1977: Report Deficiencies

- Means reported without standard deviations
  (e.g., Tables 1 and 2, pages 11, 21)

APA Publication Manual

- "Be sure to include sufficient descriptive statistics (e.g., … standard deviations)…"
  (Publication Manual of the APA, 2001, page 22)

Means and Standard Deviations

- Descriptive statistics
- Mean:
  - numeric average
  - measure of central tendency (c.f., median)
- Standard deviation
  - calculated from the data
  - a measure of variability (c.f., range)

Means and Standard Deviations

Data	Mean	Standard Deviation
4, 5, 5, 5, 6	5	0.63
1, 2, 5, 8, 9	5	3.2

Means and Standard Deviations

Data	Mean	Standard Deviation
40, 50, 50, 50, 60	50	6.3
14, 15, 15, 15, 16	15	0.63

Burns and Moskowitz, 1977: Report Deficiencies

- t-tests reported, but without degrees of freedom (d.f.)
  (Page 53)

APA Publication Manual

- "When reporting inferential statistics (e.g., t-tests…) include information about the obtained magnitude or value of the test statistic, the **degrees of freedom**, …"
  (Publication Manual of the APA, 2001, Page 22)

What Is A t-test

- t is a statistic used to make an inference about the difference between two means
- t can range from minus infinity to infinity
- t = 0 is expected if the groups do not **differ other than by chance**
- t > 3 is unusual and, so, usually statistically significant (depends on sample size)

Statistical Significance

- Means computed from 2 groups are unlikely to be exactly equal.
- How much of a difference indicates a real difference between the groups' means?
- **A difference unlikely to occur by chance is called "Statistically Significant"**
- Need both t and d.f. to make an inference

Burns and Moskowitz, 1977: Report Deficiencies

- Correlation between BAC and driving simulation not given
- Data collected but no correlation reported
- Mystifying

Burns and Moskowitz, 1977: Research Design Not Followed

- **Officers may not have been blind to dosage**
- More heavy drinkers tested later in study (Page 19)
- Last officer tested:
  - 15 male drinkers, 13 heavy drinkers
  - 14 female drinkers, 0 heavy drinkers (Pg 20)

Burns and Moskowitz, 1977: Data Analyses Contain Errors

- Number of participants summed wrong
  - 29 + 0 reported as 30
  - 12 + 16 reported as 27 (Page 114)
- Can we trust the tabled numbers?
- Were they computer generated?
- There are other errors, some subtle
- What other numbers are reported wrong?

Burns and Moskowitz, 1977: Data Analyses Biased

- "…borderline cases are assumed to fall into the non-error category." (Page 28)
  - No indication of how many such cases
  - This is unheard of in published research
- Other examples of data analysis bias

Burns and Moskowitz, 1977: SFSTs Then vs. Now

- Nystagmus evaluated at 30 and 40 degrees
- "Observation of the characteristic jerking at a gaze of more extreme than 45 degrees should not be relied upon as an index of intoxication." (Page 90)
- Max scores: HGN=20, WAT=10, OLS=10
- Nystagmus test with one eye covered

Burns and Moskowitz, 1977: Evaluation

- Studied tests different from today's SFSTs
- Cannot make statistical statements about the accuracy or reliability of today's SFSTs

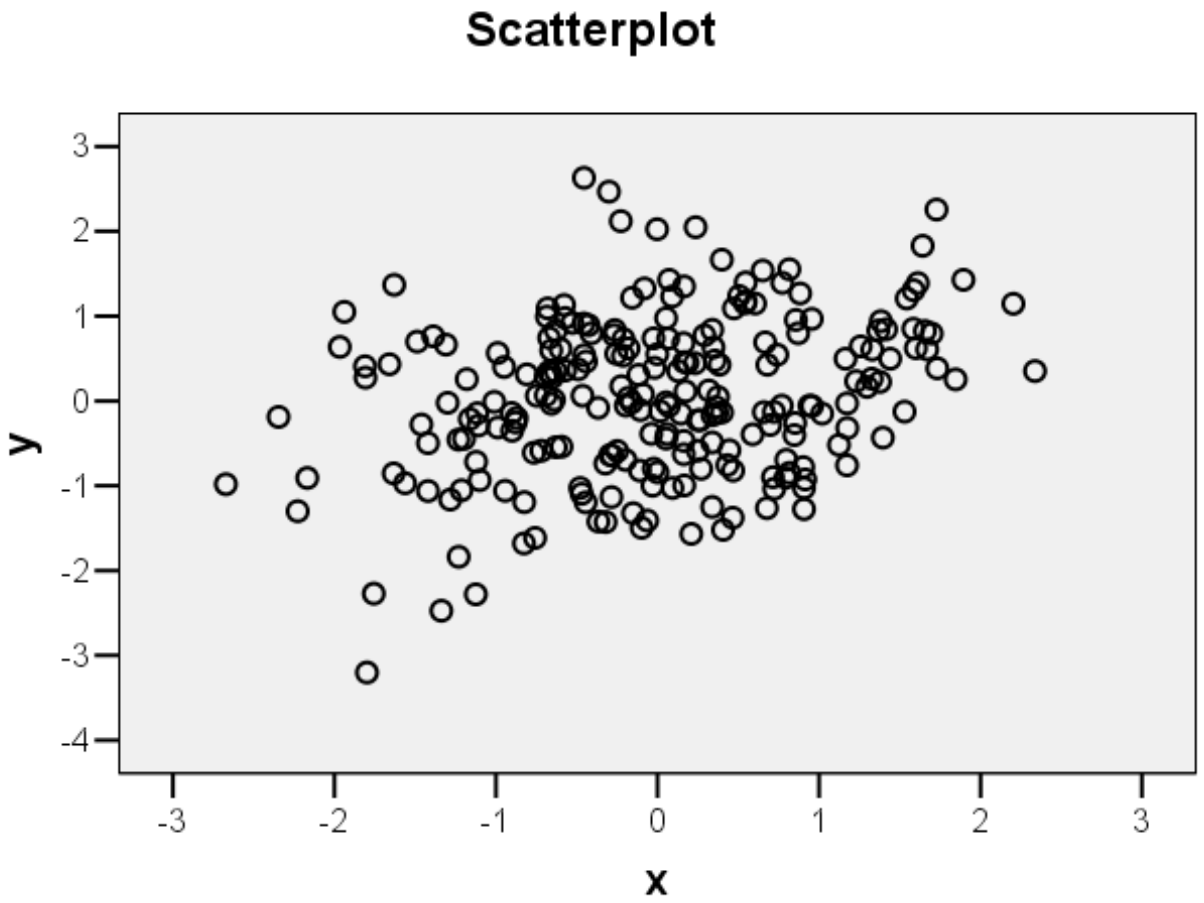
Burns and Moskowitz, 1977: Evaluation

- Selected from existing tests
  - Did not develop new tests
- Selected plausible battery
- Inflated usefulness of battery
- No way to accurately evaluate SFSTs

Burns and Moskowitz, 1977: Evaluation

- Relationship of SFSTs and driving skills
- Correlations between SFSTs and reaction time are:
  - r = .15 for OLS
  - r = .12 for WAT
  - r = .27 for Total Nystagmus (Page 55)

Correlation Of .27



Burns and Moskowitz, 1977: Evaluation

- **Peer review needed**
- This publication is not consistent with professional standards in field of testing
- The scientific community would not accept the conclusions of the authors

Burns and Anderson, 1995

- A Colorado Validation Study of the Standardized Field Sobriety Test (SFST) Battery

Approach to Each Study

- Summary
- Strengths
- Weaknesses
- Overall evaluation

Burns and Anderson, 1995: Summary

- Goal: evaluate arrest decision accuracy

  (Page i, Technical Summary)

  - experienced officers
  - under roadside conditions
  - in winter, spring and summer (Page 4)
- Field Study in Colorado
- 305 participants (234 with complete data)

Burns and Anderson, 1995: Summary

- Findings:
  - Officers' arrest decisions: 93% accurate
  - Officers' release decisions: 64% accurate

  (Page 16)

Burns and Anderson, 1995: Weaknesses

- Report narrative not clear
- Research design deficiencies
- Research design not followed
- Report deficiencies
- Report contains errors
- Data analyses not fully reported

Burns and Anderson, 1995: Report Narrative Not Clear

- Officers did not have PBTs (Page 5)
- PBT results recorded (Page 9)
- Report BAC results on 234 SFSTs (Page 14)
- Observers present and collected PBT for 125 SFSTs (Page 5)
- Who collected BAC for the other 109 SFSTs?
  - When?

Burns and Anderson, 1995: Research Design Deficiencies

- Drivers not arrested asked for PBT (Page 5)
  - If more intoxicated decline, the accuracy of release decisions inflated
- Officers all volunteers (Page 6)
  - May be more proficient with SFSTs
- Officers got refresher training (Page 6)
  - Better trained than the typical officer

Burns and Anderson, 1995: Research Design Deficiencies

- Half of the officers had two roles, at different times: (Page 10)
  - enforcement
  - observers
- May be some conflict of interest
  - I observe you, you observe me

Burns and Anderson, 1995: Research Design Not Followed

- Plan was to collect some data in winter months
  - Start was planned for Dec/Jan
  - Start delayed until end of Feb (Page 27)

Burns and Anderson, 1995: Report Deficiencies

- 305 SFSTs administered
- **135 in March** (Page 10, Figure 2)
- **70 in May, June, and July**, combined
- No analysis of March alone
  - Did officers always use same stop criteria?

Burns and Anderson, 1995: Report Deficiencies

- No 2 by 2 table with SFST and BAC
  - Authors have the data
  - Data not reported
- No correlation reported between SFST and BAC

Burns and Anderson, 1995: Report Deficiencies

- Women were only 18% of the sample
- Women were 38% of the incorrect releases
- Women were 25% of the incorrect arrests. (Page 17)
- **By chance, all would be about 18%**
- Although noted, this was not discussed, nor were additional analyses done by gender.

Burns and Anderson, 1995: Report Contains Errors

- **13** participants from LPD (Tables 1 and 2)
- **14** participants from LPD (Table 3)

Burns and Anderson, 1995: Data analyses not fully reported

- Gives means for DUI and DWAI (Page 18)
- No standard deviations given

Burns and Anderson, 1995: SFST Then and Now

- Then:
  - WAT: 13 possible errors listed (Page 20)
  - OLS: 5 possible errors listed (Page 22)
- Now:
  - WAT: 8 clues
  - OLS: 4 clues

Burns and Anderson, 1995: Evaluation

- Evaluated **arrest decisions** of specially trained and supervised, volunteer officers, who used SFST **and other data**
- No analyses of the data on SFST validity - Data available, but not analyzed!
- No direct evaluation of SFSTs
- Employed obsolete SFST scoring

Stuster and Burns, 1998

- Validation of the Standardized Field Sobriety Test Battery at BAC's Below 0.10 Percent

Approach to Each Study

- Summary
- Strengths
- Weaknesses
- Overall evaluation

Stuster and Burns, 1998: Summary

- Goals: (Pages 9, 11)
  - Evaluate SFSTs as they assist officer decision making
  - Evaluate modifications to test scoring
  - Do SFSTs identify people at .08 and .04%
  - How reliable/consistent are tests
  - Are modified tests useable and acceptable to officers?

Stuster and Burns, 1998: Summary

- Evaluated SFSTs at .08% and .04% BAC
- Field study of almost 300 stops
- 91% accuracy of officers' decisions (Page 18)
- 79-88% accuracy of SFST decisions (Page 21)
- SFSTs correlated .69 with BAC (Pages 17, 25)
- SFSTs are reliable (Page 26)

Stuster and Burns, 1998: Strengths

- Field study (San Diego PD)
- Improved data collection form (Page 12)
- 297 participants (one refused BAC test)
- Got BACs for all 297 stops (Page 15)

Stuster and Burns, 1998: Weaknesses

- Research design deficiencies
- Report deficiencies
- Report contains errors
- Data analyses not fully reported

Stuster and Burns, 1998: Research Design Deficiencies

- Officers all eager to participate (Page 8)
  - May be more proficient with SFSTs
- Officer **refresher training** (Page 8)
  - Better trained than the typical officer
- Authors **sought out trained experts** (Page 6)
- Officers all from **alcohol enforcement unit**
  - highly experienced (Page 8)

Stuster and Burns, 1998: Research Design Deficiencies

- Research done in San Diego
  - No snow
  - Little rain/fog
  - No winter boots
- Dates: May 23 - November 9
  - Longer daylight

Stuster and Burns, 1998: Research Design Deficiencies

- No data collection instrument for this goal: Are modified tests **useable** and **acceptable** to officers?
- No survey on usability limits
- No systematic interviews

Stuster and Burns, 1998: Report Deficiencies

- Did procedural safeguards work?
- "Requiring officers to record the time of BAC estimates and BAC tests ensured that officers' estimates were not influenced by the results of the chemical tests." (Page 11)
- **Time data collected but not analyzed** or even reported (Page 12)

Stuster and Burns, 1998: Report Deficiencies

- Project staff ride-alongs (Page 11)
  - to monitor data collection
- No statement of number of ride-alongs
- No comparison of data from monitored vs. unmonitored stops

Stuster and Burns, 1998: Report Deficiencies

- "…the officers' mean estimated BACs were very close to the measured BACs..." (Page 15)
- Means can obscure differences
- Better to include also:
  - distribution of difference scores
  - a scatter plot

Stuster and Burns, 1998: Report Deficiencies

- Authors treat false positives with measured BAC between .07% and .08% as if they were over .08%
  - Illegitimate way to inflate accuracy

  (Page 20)
- (Authors also present uninflated rates)

Stuster and Burns, 1998: Report Deficiencies

- Scores for 3 SFSTs combined (Page 17)
- No description of how combined
- Possibilities:
  - Total number of clues
  - Weight clues from WAT more than HGN
  - Overall pass-fail (fail any test = failure)

Stuster and Burns, 1998: Report Deficiencies

- States that BAC measurement has a margin of error of about .01% (Page 20)
  - No citation for this
  - If so, it would put a ceiling on the validity coefficient
  - **Hard to predict an unreliable criterion**
- No discussion of the impact of this

Stuster and Burns, 1998: Report Deficiencies

- "The only appropriate criterion measure to assess the accuracy of SFSTs is BAC." (Page 10)
- But Anderson & Burns (1995) used arrest decision as the criterion.
- But Burns and Moskowitz (1977) included a driving simulation.

Stuster and Burns, 1998: Report Contains Errors

- Arrest accuracy of 91% based on 297 stops
- Only 261 stops had SFST (Page 17)
- Goal: Did SFST assist officers decisions?
- **Why lump SFST and non-SFST stops?**
- Correct analysis on 261 stops not reported

Stuster and Burns, 1998: Data Analyses Not Fully Reported

	Overall Accuracy	**False Alarms (Not Reported)**
HGN	88%	**37%**
WAT	79%	**53%**
OLS	83%	**41%**

(Page 21)

Stuster and Burns, 1998: Data Analyses Can Mislead

- Arrest accuracy rate of 91% reported
- 72% of suspects were over .08% (Page 18)
- Arresting **all** would have 72% accuracy
- **Random** arrests would have 72% accuracy

Stuster and Burns, 1998: SFST Then and Now

- Appendix A describes a Combined Measure scoring of SFSTs
- Fail suspect if:
  - HGN of 0 and WAT > 5
  - HGN of 1 and WAT > 4, etc.
- This study **validates an old scoring system**
  - Applicability to current FSTs uncertain

Stuster and Burns, 1998: Evaluation

- Study evaluated SFSTs two ways
- Evaluated **arrest decisions** of specially trained and supervised officers, who used SFST **and other data**
  - May not be the best criterion
- Evaluated **SFST decisions**
  - **This is relevant**

Stuster and Burns, 1998: Evaluation

- Evaluated **best case**:
  - Highly experienced officers
  - Refresher training
  - Good weather in San Diego

Stuster and Burns, 1998: Evaluation

- Presents evidence for accuracy of test
- Presents evidence for validity of test
- **Ignores false alarm rates**
- Evaluates somewhat obsolete SFST scoring

Stuster and Burns, 1998: Evaluation

- Results are less positive than as presented
- Not clear how much the errors and weaknesses affected the reported findings
  - Might be very much

General Conclusions

- These research reports:
  - Appear biased
  - Have many weaknesses
  - Do not live up to professional standards
  - Cannot be taken at face value
- SFSTs have promise
  - Need more work to perfect them

Wrap up

- Defense may want to focus on:
  - High false alarm rates
  - Level of inter-rater reliability
  - Level of correlation of SFST and BAC
  - Flawed research
  - Research done on old versions of SFSTs
  - Low correlation of BAC & driving ability
  - Inflated estimates of accuracy/validity

Looking Ahead

- FSTs will never have low false alarm rates
  - Especially for people with .07%
- Better SFSTs are possible
- Develop measures of driving skills
  - Reaction time (easy to measure)
  - Judge speed/distance of movement
  - Multi-limb coordination

References

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Seminar CD

- NHTSA SFST research reports
- Several articles on SFSTs
- Annotated bibliography
- Bibliography by Steve Rubenzer, Ph.D.
- Horn Affidavit
- These slides
  (See www:AppliedPersonnelResearch.com\papers for updated\version)

Q&A's

- Questions submitted prior to the conference

Thank You

- An expanded version of this presentation is available on request
- Wiesen@AppliedPersonnelResearch.com