

Ch. 5: Validity

Copyright © 2024 Michael Diehr
All Rights Reserved
For use only by students enrolled
in my sections of Psyc 402
through the end of the semester.
May not be posted, shared or uploaded
online without permission.

640

Psychology 402 - Fall 2024 - Dr. Michael Diehr

641

Psychology 402 - Fall 2024 - Dr. Michael Diehr

Validity

- History
 - Griggs v. Duke Power
 - Ricci v. DeStefano
- Defining Validity
- Four Kinds of Validity
- Reliability vs. Validity
- Validity as Explained Variance

655

Psychology 402 - Fall 2024 - Dr. Michael Diehr

Griggs v. Duke Power (1971)

- Duke Power company - Coal fired power plant
- 13 people employed as Janitors
- Wanted promotions to next level (coal handler)
- Duke required certain score on IQ test for promotion
- Of 95 employees at power station, 14 were Black, 13 of 14 were janitors
- Legal case: was the IQ test requirement valid or discriminatory?
- Supreme Court decision : “invalid”

656

Psychology 402 - Fall 2024 - Dr. Michael Diehr

Griggs v. Duke Power - 2

- Supreme court found
If a test impacts different ethnic groups
disparately, the business must demonstrate
the test is a “reasonable measure of job
performance”
- In scientific terms: tests must be *valid*
predictors of specific criteria.

657

Psychology 402 - Fall 2024 - Dr. Michael Diehr

Disparate Impact

- aka “Adverse Impact”...
 - disproportional...
 - adverse effect...
 - on a protected class...

658

Psychology 402 - Fall 2024 - Dr. Michael Diehr

Impact

- A negative Effect on
 - Employment or
 - Housing

659

Psychology 402 - Fall 2024 - Dr. Michael Diehr

Disproportionate

- The proportion of a protected class affected by the behavior is different from a non-protected class
 - 80% rule
- Example
 - 50% of men are hired
 - 45% of women are hired
 - $45/50 = 90\%$

660

Psychology 402 - Fall 2024 - Dr. Michael Diehr

Protected Classes

- Federal Law:
 - race, color, religion, national origin, age (40+), sex, pregnancy, citizenship, familial status (kids), veterans, genetic status
- California Law:
 - ...disability, sexual orientation, HIV or medical status, political party, victim of domestic violence

661

Psychology 402 - Fall 2024 - Dr. Michael Diehr

Definitions of Validity

- Agreement between test scores and the thing (construct) it claims to measure
- Many other definitions; some confusing or incompatible with each other
- AREA/NCME (1985, 1999, 2012) "Standards for Educational and Psychological Testing"
- One informal definition: Face Validity
- Three formal definitions: Content, Criterion, Construct

662

Psychology 402 - Fall 2024 - Dr. Michael Diehr

Face Validity

- Common Sense / Informal Analysis
- "I like mechanics magazines" = you like mechanics magazines.
"I never tell a lie" = you never lie
- Issues:
 - What factors might influence a test-taker's response?
 - Face validity is not a proper type of validity
 - Quizzes in magazines or on the Internet -- might appear "face valid" but often low reliability and validity

663

Psychology 402 - Fall 2024 - Dr. Michael Diehr

Does Face Validity Matter?

- Naive view = face validity
- Tests with very little face validity...
 - what does the average test taker feel about the test?
 - motivation?
 - confusion?

664

Psychology 402 - Fall 2024 - Dr. Michael Diehr

Content Validity

- Do the test questions cover the construct?
- Commonly used in education (achievement/ aptitude testing)
- Example: does an Algebra test contain questions about a wide range of Algebra topics?
- This is a Logical, rather than statistical argument
- Fuzzy definition
- Modern theories consider Content Validity a sub-set of other types of validity

665

Psychology 402 - Fall 2024 - Dr. Michael Diehr

Content Validity 2

- If a test is supposed to test a specific *Construct*, problems may arise:
- Construct underrepresentation
 - test questions miss important topics
- Construct-irrelevant variance
 - test scores are influenced by outside factors
 - e.g. anxiety, reading comprehension, IQ, etc...

666

Psychology 402 - Fall 2024 - Dr. Michael Diehr

Content Validity

667

Psychology 402 - Fall 2024 - Dr. Michael Diehr

Improving on Content Validity

668

Psychology 402 - Fall 2024 - Dr. Michael Diehr

Norm vs. Criterion

- Norm-referenced test
 - “Hire the top 5% of applicants”
 - Pro - select the best
 - Con - can they do the job?
- Criterion-referenced test
 - “Hire those who can do _____”
 - Pro - they can do the job
 - Con - not selecting the best

669

Psychology 402 - Fall 2024 - Dr. Michael Diehr

Criterion Validity

- Criterion -- a well defined measure of performance *in the real world*
- Criterion validity -- the correlation between a test score and the specific criterion

670

Psychology 402 - Fall 2024 - Dr. Michael Diehr

Predictive vs. Concurrent

- Predictive
High School SAT score (predictor) predicts later College GPA (criterion)
- Concurrent
Work samples from mechanics

671

Psychology 402 - Fall 2024 - Dr. Michael Diehr

Measuring Validity

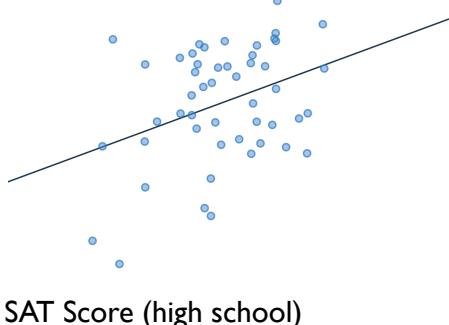
- General: relationship between test and what it's supposed to be measuring
- Specific: Pearson product-moment correlation (r) between Test Score (X) and criterion (Y)

672

Psychology 402 - Fall 2024 - Dr. Michael Diehr

Criterion Validity Example

College GPA (first year)



SAT Score (high school)

673

- SAT vs GPA
- Validity = $R_{X,C}$
- Predictive
- $R=0.360$
- $R^2=13.0\%$

Psychology 402 - Fall 2024 - Dr. Michael Diehr

How much Validity?

- Validity is often lower than you want
- $r > 0.60$ is rare
- $r = 0.40$ or lower is common
- $r^2 = \%$ of variance explained
 - $r = .60$ means just 36% of variation in the criterion scores explained by the predictor score (thus, 64% is not explained)
 - $r = .40$ means 16% of variance explained (84% not)

674

Psychology 402 - Fall 2024 - Dr. Michael Diehr

Evaluating Validity Coefficients

- Validity depends on the cause of the correlations
- And on the meaning of the criterion
- If the reason for the relationship changes, validity may change as well.
- Examples:
 - Different *subjects*
 - Different *situation*
 - Different *criterion*

675

Psychology 402 - Fall 2024 - Dr. Michael Diehr

Problems with Criterion Validity

- “what is the criteria?”
- Some criteria are obvious and sensible:
E.g. using SAT to predict college GPA
- For many constructs, it’s not clear:
E.g. intelligence. IQ test used to predict ____?
- Without a *specific* criterion, you can’t calculate criterion validity!

676

Psychology 402 - Fall 2024 - Dr. Michael Diehr

Construct Validity

- Construct = theoretical entity. In soft sciences, usually not directly observable or measurable.
- Solution -- the world is complicated. In Psychology (as in other sciences) things can exist even if they aren't easy to measure.
- Method -- collect evidence for the construct via multiple **methods**, multiple **sources**, multiple **subjects**

677

Psychology 402 - Fall 2024 - Dr. Michael Diehr

Construct Evidence

- **Convergent Evidence** – data from multiple sources all tend to point to the same conclusion.
- **Divergent Evidence (aka Discriminant Evidence)** – evidence that a Construct is not the same as another

678

Psychology 402 - Fall 2024 - Dr. Michael Diehr

Construct Validity Example

- Construct: Insomnia
- Convergent correlations - R should be strong (either positive or negative)
 - # of hours slept
 - tired feeling
 - another test of insomnia
- Divergent correlations - R should be weak (close to zero)
 - education
 - IQ

679

Psychology 402 - Fall 2024 - Dr. Michael Diehr

Construct Validity Example

| | An old test of insomnia | # of hours slept | Feeling Tired | IQ | Education |
|--|-------------------------|------------------|---------------|-----------|-----------|
| Correlation between your test of insomnia and... | ✓ | ✓ | ✓ | none | none |
| Which kind of Construct validity? | Convergent | Convergent | Convergent | Divergent | Divergent |

680

Psychology 402 - Fall 2024 - Dr. Michael Diehr

The Love Test

- Rubin (1970)'s Love Scale
- From Literature, created 198 items on Likert scale
- Result: a "Love" scale and a "Liking" scale
- Love scale had 3 factors: attachment, caring, intimacy
- Convergent evidence:
 - lovers vs. friends
 - eye contact
- Divergent evidence:
 - possible to love someone w/o liking them



681

Psychology 402 - Fall 2024 - Dr. Michael Diehr

All Validity is Construct Validity?

- Modern theory: only one type of validity -- Construct validity
- Other types of validity are sub-types of Construct validity.

682

Psychology 402 - Fall 2024 - Dr. Michael Diehr

Ricci v. DeStefano (2009)

- Written and Oral test for promotion to firefighter Captain position in Newhaven CT
- Pass rate: Whites 64%, African Americans 38%, Hispanics 38%
- Scoring rule: only top scores eligible
- None of the African Americans would get promotion
- City, worried about Disparate Impact, denied promotions to everyone
- 18 White employees filed suit against the city
- Question: was this the right action to take?

683

Psychology 402 - Fall 2024 - Dr. Michael Diehr

Ricci v. DeStefano 2

- Supreme court decision:
- Found City *did the wrong thing*
- Race-based action can be taken only if “demonstrate a strong basis in evidence that, had it not taken the action, it would have been liable under the disparate-impact statute”
- Tests are discriminatory:
 - if they are not valid for the job.
 - Not just because protected classes get different results.

684

Psychology 402 - Fall 2024 - Dr. Michael Diehr

4 Kinds of Validity

| | Description | Notes | Statistic(s) |
|------------------|---|---|--|
| Face | do items “look” valid? | informal, improper, non-scientific | none |
| Content | do test questions cover the topic? | logic & expert judgement | none |
| Criterion | does the test predict a specific outcome? | requires a well-defined criterion | Pearson's R (correlation) between Test and Criterion |
| Construct | does the test measure what it claims | modern theory: all validity is Construct validity | Convergent and Divergent correlations (Pearson's R) |

685

Psychology 402 - Fall 2024 - Dr. Michael Diehr

Reliability vs. Validity

- Validity coefficient is the correlation between a test and the criterion
- We know that **Test Measurements** and **Criterion Measurements** are unreliable
- The maximum validity is the square root of the product of their individual reliabilities.

$$r_{12max} = \sqrt{r_{11}r_{22}}$$

- If the tests have low reliability, validity can be hidden

686

Psychology 402 - Fall 2024 - Dr. Michael Diehr

Reliability vs. Validity : Example

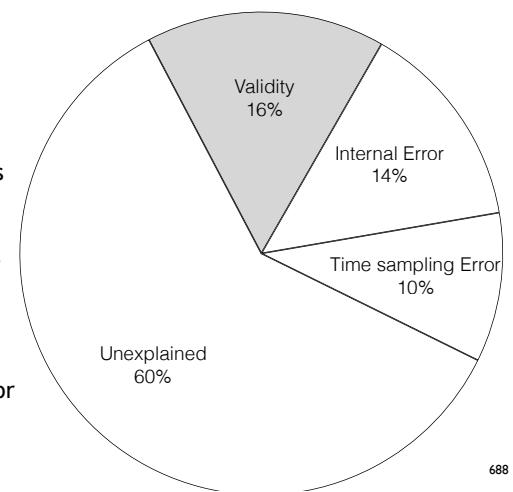
| Reliability of Test | Reliability of Criterion | Maximum Possible Validity | | |
|---------------------|--------------------------|---------------------------|------------|----------------|
| | | DSM-V Depression | R | R ² |
| 1 | 1 | 1 | 100% | |
| 0.8 | 1 | 0.89 | 79% | |
| 0.6 | 1 | 0.77 | 59% | |
| 0.4 | 1 | 0.63 | 40% | |
| 0.2 | 1 | 0.45 | 20% | |
| 1 | 0.5 | 0.71 | 50% | |
| 0.8 | 0.5 | 0.63 | 40% | |
| 0.6 | 0.5 | 0.55 | 30% | |
| 0.4 | 0.5 | 0.45 | 20% | |
| 0.2 | 0.5 | 0.32 | 10% | |

687

Psychology 402 - Fall 2024 - Dr. Michael Diehr

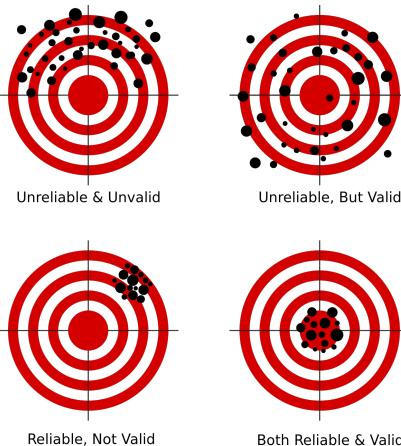
Variance: Reliability & Validity

- Variance in test scores can be divided into different portions
- In this example, only 16% is useful (validly predicts criterion)
- Other sources of error are known or unknown



688

Reliability vs. Validity



- Target shooting analogy
- Similar to accuracy vs. precision

Psychology 402 - Fall 2024 - Dr. Michael Diehr

689

Reliability or Validity Part 1

| Procedure | Reliability or Validity | What kind? |
|---|-------------------------|------------|
| Correlation of IQ scores with ability to handle 30 tons of coal per day | | |
| Correlation between SAT scores taken in Junior vs. Senior year of High School | | |
| Having a committee review a high school history exam to make sure the questions cover all required topics | | |
| Correlation between scores on two different versions of a Final Exam | | |

692

Psychology 402 - Fall 2024 - Dr. Michael Diehr

Reliability or Validity Part 2

| Procedure | Reliability or Validity | What kind? |
|--|-------------------------|------------|
| Showing that your new measure of Anxiety correlates with an old measure of Anxiety, and does not correlate with IQ | | |
| Showing that everyone in your research lab can rate "grumpy" expressions the same way | | |
| Looking at a question about depression and deciding that it measures depression. | | |
| Showing that questions on your test all correlate strongly with each other | | |

693

Psychology 402 - Fall 2024 - Dr. Michael Diehr

Ch. 5 - Part 2

How much validity do you need?

- Clinical Significance
 - Effect Size of Benefits
 - vs Cost and Harm
- Examples:
 - an inexpensive test which can detect 1% of cancers (validity $r^2=1\%$)
 - a written test for airline pilots to detect who is unsafe (validity $r^2=93\%$)
- Answer: it depends

713

Psychology 402 - Fall 2024 - Dr. Michael Diehr

4 Kinds of Validity

| | Description | Notes | Statistic(s) |
|------------------|---|---|--|
| Face | do items "look" valid? | informal, improper, non-scientific | none |
| Content | do test questions cover the topic? | logic & expert judgement | none |
| Criterion | does the test predict a specific outcome? | requires a well-defined criterion | Pearson's R (correlation) between Test and Criterion |
| Construct | does the test measure what it claims | modern theory: all validity is Construct validity | Convergent and Divergent correlations (Pearson's R) |

714

Psychology 402 - Fall 2024 - Dr. Michael Diehr

Constructs, Factors, Facets

- Constructs may be “high” or “low” (also called “top” or “bottom”)
- Top-level constructs are made of smaller constructs
- aka Factors, Facets, Dimensions, Domains, Codes, Types...

716

Psychology 402 - Fall 2024 - Dr. Michael Diehr

Construct: Anxiety

717

Psychology 402 - Fall 2024 - Dr. Michael Diehr

Convergent Validity

- Multiple factors within a construct or multiple measures of a construct
- All correlate with each other strongly

719

Psychology 402 - Fall 2024 - Dr. Michael Diehr

Divergent Validity

- Other factors (not part of a construct)
- Should have low to zero correlation
- What about negative correlations?

720

Psychology 402 - Fall 2024 - Dr. Michael Diehr

Negative Correlations are Easy

- X: I like the taste of vanilla ice cream
- Y: I like the smell of vanilla ice cream
 - 1 Strongly Agree
 - 2 Agree
 - 3 Neutral
 - 4 Disagree
 - 5 Strongly Disagree

721

Psychology 402 - Fall 2024 - Dr. Michael Diehr