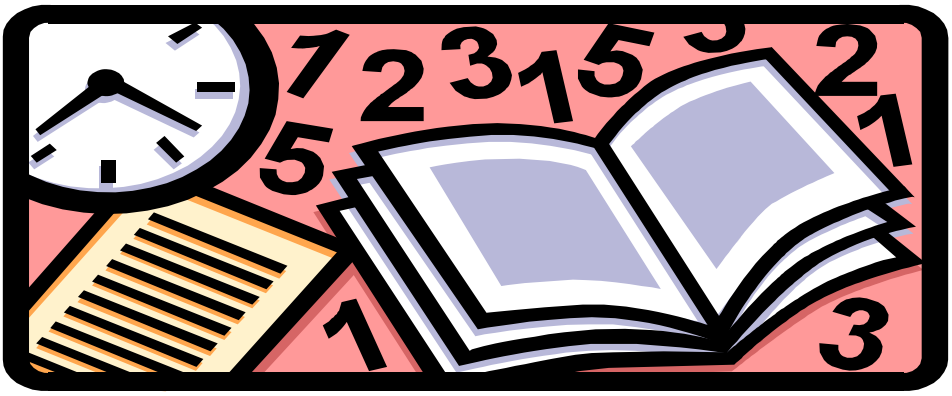

Reliability & Validity

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Measurement Error

A participant's score on a particular measure consists of 2 components:

Observed score = True score + Measurement Error

True Score = score that the participant would have obtained if measurement was perfect—i.e., we were able to measure without error

Measurement Error = the component of the observed score that is the result of factors that distort the score from its true value

$x_{total} = x_{true} + x_{total}$ **and** $\sigma^2_{total} = \sigma^2_{true} + \sigma^2_{total}$

Factors that Influence Measurement Error

- **Transient states** of the participants:
  (transient mood, health, fatigue-level, etc.)
- **Stable attributes** of the participants:
  (individual differences in intelligence, personality, motivation, etc.)
- **Situational factors** of the research setting:
  (room temperature, lighting, crowding, etc.)

Characteristics of Measures and Manipulations

- Precision and clarity of operational definitions
- Training of observers
- Number of independent observations on which a score is based (more is better?)
- Measures that induce fatigue or fear

Actual Mistakes

- Equipment malfunction
- Errors in recording behaviors by observers
- Confusing response formats for self-reports
- Data entry errors

Measurement error undermines the reliability (repeatability) of the measures we use

Reliability

- The reliability of a measure is an inverse function of measurement error:
- The more error, the less reliable the measure
- Reliable measures provide consistent measurement from occasion to occasion

Estimating Reliability

Total Variance in a set of scores	=	Variance due to true scores	+	Variance due to error
Reliability	=	True-score Variance	/	Total Variance

$$r_{tt} = \frac{\sigma^2_{true}}{\sigma^2_{total}}$$

Reliability can range from 0 to 1.0

When a reliability coefficient equals 0, the scores reflect nothing but measurement error

Rule of Thumb: measures with reliability coefficients of 70% or greater have acceptable reliability

Different Methods for Assessing Reliability

- **Test-Retest Reliability**
- **Internal Consistency Reliability**

Test-Retest Reliability

- **Test-retest reliability refers to the consistency of participant's responses over time (usually a few weeks, why?)**
- **Assumes the characteristic being measured is stable over time—not expected to change between test and retest**

$$r_t = \frac{\sum (x - \bar{x})(y - \bar{y})}{(n-1)S_x S_y} \quad \textbf{and} \quad r_{tt} = \frac{2r_t}{1 + r_t}$$

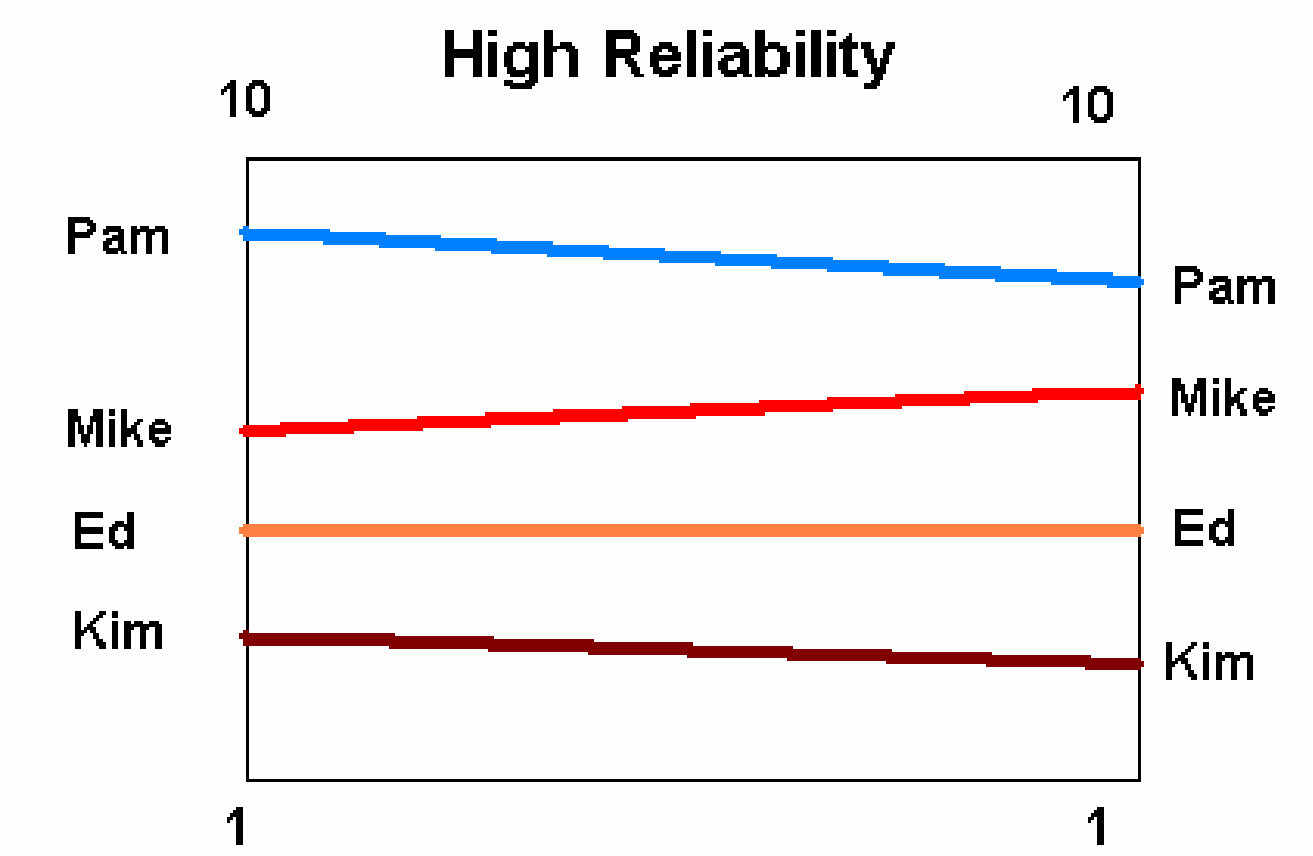
Internal Consistency Reliability

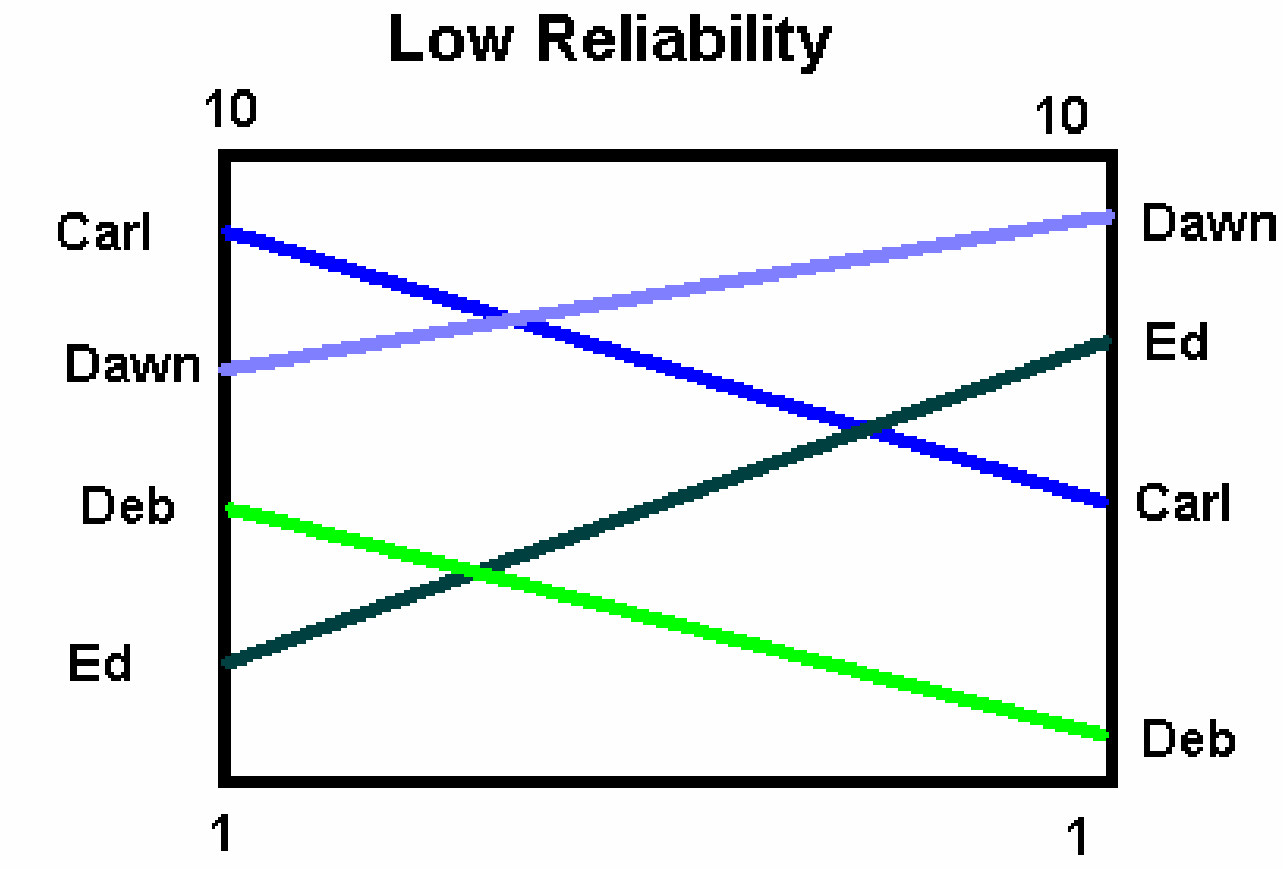
- Relevant for measures that consist of more than 1 item (e.g., total scores on scales, or when several behavioral observations are used to obtain a single score)
- Internal consistency refers to inter-item reliability, and assesses the degree of consistency among the items in a scale, or the different observations used to derive a score
- Want to be sure that all the items (or observations) are measuring the same construct

Estimates of Internal Consistency

- **Item-total** score consistency
- **Split-half reliability**: randomly divide items into 2 subsets and examine the consistency in total scores across the 2 subsets (any drawbacks?)

$$r_{tt} = \frac{n}{(n-1)}\left\{ 1 - \frac{M(n-M)}{n\sigma^2{}_t} \right\}$$


High Reliability
10
10
Pam
Mike
Ed
Kim
Pam
Mike
Ed
Kim
1
1


Low Reliability
10
10
Carl
Dawn
Dawn
Ed
Deb
Carl
Ed
Deb
1
1

Factors affecting Reliability

Extrinsic Factors:

1. Group variability (↓↓)
2. Guessing by the examinees
3. Envoronmental conditions
4. Momentary fluctuations in the examinee

Factors affecting Reliability

Intrinsic Factors:

1. Length of the test (↑↑)
2. Homogeneity of items (↑↑)
3. Facility value (FV) of test items (~0.5)
4. Discrimination index (DI) of test items (↓↓)
5. Range of total scores (↓↓)
6. Scorer reliability

How to improve Reliability?

- Quality of items; concise statements, homogenous words (some sort of uniformity)
- Adequate sampling of content domain; comprehensiveness of items
- Longer assessment – less distorted by chance factors
- Developing a scoring plan (esp. for subjective items – rubrics)
- Ensure **VALIDITY**

Estimating the Validity of a Measure

- A good measure must not only be reliable, but also valid
- A valid measure measures what it is intended to measure
- Validity is not a property of a measure, but an indication of the extent to which an assessment measures a particular construct in a particular context—thus a measure may be valid for one purpose but not another
- A measure cannot be valid unless it is reliable, but a reliable measure may not be valid

Estimating Validity

- Like reliability, validity is not absolute
- Validity is the degree to which variability (individual differences) in participant's scores on a particular measure, reflect individual differences in the characteristic or construct we want to measure
- Three types of measurement validity:

  Face Validity

  Construct Validity

  Criterion Validity

Face Validity

- Face validity refers to the extent to which a measure 'appears' to measure what it is supposed to measure
- Not statistical—involves the judgment of the researcher (and the participants)
- A measure has face validity—'if people think it does'
- Just because a measure has face validity does not ensure that it is a valid measure (and measures lacking face validity can be valid)

Construct Validity

- Most scientific investigations involve hypothetical constructs—entities that cannot be directly observed but are inferred from empirical evidence (e.g., intelligence)
- Construct validity is assessed by studying the relationships between the measure of a construct and scores on measures of other constructs
- We assess construct validity by seeing whether a particular measure relates as it should to other measures

Convergent and Discriminant Validity

- To have construct validity, a measure should both:
- Correlate with other measures that it should be related to (**convergent validity**)
- And, not correlate with measures that it should not correlate with (**discriminant validity**)

Criterion-Related Validity

- Refers to the extent to which a measure distinguishes participants on the basis of a particular behavioral criterion
- The Scholastic Aptitude Test (SAT) is valid to the extent that it distinguishes between students that do well in college versus those that do not
- A valid measure of marital conflict should correlate with behavioral observations.
- A valid measure of depressive symptoms should distinguish between subjects in treatment for depression and those who are not in treatment

Two Types of Criterion-Related Validity

- **Concurrent validity**

  measure and criterion are assessed at the same time

- **Predictive validity**

  elapsed time between the administration of the measure to be validated and the criterion is a relatively long period (e.g., months or years)

Predictive validity refers to a measure's ability to distinguish participants on a relevant behavioral criterion at some point in the future

Examples of Concurrent and Predictive Validity

- High school seniors who score high on the the SAT are better prepared for college than low scorers (**concurrent validity**)
- Probably of greater interest to college admissions administrators, SAT scores predict academic performance four years later (**predictive validity**)

Factors that can lower Validity

- **Unclear directions**
- **Difficult reading vocabulary and sentence structure**
- **Ambiguity in statements**
- **Inadequate time limits**
- **Inappropriate level of difficulty**
- **Poorly constructed test items**
- **Test items inappropriate for the outcomes being measured**
- **Tests that are too short**
- **Improper arrangement of items (complex to easy?)**
- **Identifiable patterns of answers**
- **Teaching**
- **Administration and scoring**
- **Students**
- **Nature of criterion**