Internal structure evidence of validity

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Outlines

1. Measurement validity & reliability
2. Classical validity
3. The validity
4. Factor analysis
5. Reliability

1. Measurement validity & Reliability

- Measurement → Process of observing & recording.
- Measurement validity → Accuracy.
- Measurement reliability → Precision, consistency, repeatability.

2. Classical validity

- 3Cs:
    1. <u>C</u>ontent
    2. <u>C</u>riterion
    3. <u>C</u>onstruct

3. The validity

- Unitary concept.
- Degree of evidence → Purpose & Intended use of a tool.
- Evidence from 5 sources:

  1. Content.

  2. **<u>Internal structure.</u>**

  3. Relations to other variables

  4. Response process.

  5. Consequences.

The validity

- <u>Construct</u> – Concept to be measured by a tool.
- *Construct = Concept = Domain = Idea*
- Internal structure evidence
  - How <u>relationship</u> between items & components reflect <u>construct</u>.
  - Analyses:
    1. Factor analysis
    2. Reliability

4. Factor Analysis

- Factoring
- Factor analysis

Factoring

- <u>Group</u> things that have <u>common</u> concept.
- <u>Simplify</u>.
- Factoring = Grouping.
- Factor = Construct = Concept.

Orange, motorcycle, bus, durian, banana, car

Anything in common?

Intuitive factoring

- Group them

Orange, durian, banana

Motorcycle, bus, car

into two groups

Intuitive factoring

- Name the groups

Fruit	Motor vehicle
Orange	Motorcycle
Durian	Bus
Banana	Car

factor out the common concept.

Intuitive factoring

Likert-type options [Fruit] 1-2-3-4-5 [Motor Vehicle]

Items	1	2	3	4	5	6
1. Orange	1.00					
2. Durian	**.67**	1.00				
3. Banana	**.70**	**.81**	1.00			
4. Motorcycle	.11	.08	.05	1.00		
5. Bus	.08	.12	.09	*.75*	1.00	
6. Car	.18	.12	.22	*.89*	*.83*	1.00

Correlation matrix

Intuitive Factoring

Items	Factors	
	Fruit	**Motor vehicle**
1. Orange	X	-
2. Durian	X	-
3. Banana	X	-
4. Motorcycle	-	X
5. Bus	-	X
6. Car	-	X

<u>Correlated</u> items → <u>Group</u>.
More items? Impossible.
FA → **objective factoring**.

FA

- Multivariate analysis – >1 outcomes/DVs/Items.
- Numerical items, e.g. Likert scale, VAS scores, laboratory results etc.
- Group correlated items → Factor.
- Factors <u>extracted</u> from items → Latent (unobserved) IVs.
- RQs:
  - Number of factors?
  - Strength of Item-Factor correlation (factor loading)?
- <u>Recall</u> – MLR: 1 DV many IVs (observed).

Classification

1. **Exploratory FA/EFA**
2. Confirmatory FA/CFA

EFA

- Exploratory analysis.
- Objectives: <u>Explore</u> & <u>factor</u> items, <u>generate theory</u>.
- Models:

  - **Full component model.**

  - **<u>Common factor model</u>.**

EFA

- **Full component model**
  - Extraction method: Principal component analysis (PCA)
  - Data reduction → For other analysis.
  - Compress many variables → Smaller number of components.
  - Sum of all variable variances = Sum of component variances.
  - Measurement errors NOT considered.
  - NOT the real FA!

- **Common factor model**
  - Extraction methods:
    - Classical: **Principal axis analysis**.
    - Other variants: Image analysis, alpha analysis, maximum likelihood (ML).
  - Common variances + Error variances.
  - The 'Real' FA.
  - Main results:
    - Number of factors extracted.
    - Factor loadings.
    - Factor-factor correlations.

EFA

- To simplify EFA results → Factor <u>Rotation</u>:
  - Types:
    - **Orthogonal method** – uncorrelated factors.
      - Varimax, Quartimax, Equamax
    - **Oblique method** – correlated factors.
      - *Oblimin*, Promax
- Obtain clear factors and factor loadings.

Classification

1. Exploratory FA/EFA
2. **<u>Confirmatory FA/CFA</u>**

CFA

- Confirmatory analysis.
- Also common factor model.
- Structural Equation Modeling (SEM) analysis:
  - <u>Measurement model (CFA)</u>
  - Structural model (path analysis)
- Commonly ML estimation.
- Model fit assessment.

CFA

- For example, factor explaining between these items:

I love fast food
I hate vegetable
I hate eating fruits
I hate exercise

→ Obesity

Strong theoretical basis from **EFA, theory, LR.**

CFA

I love cat
I hate snake
I love traveling
I love snorkeling
I support ABC football team
I love driving car
I love computer game
I like to have everything in symmetry
I love Twitter
My favorite food is nasi ayam
I enjoy eating pisang goreng
I spend most of my time in front of computer
I love Facebook

?

?

?
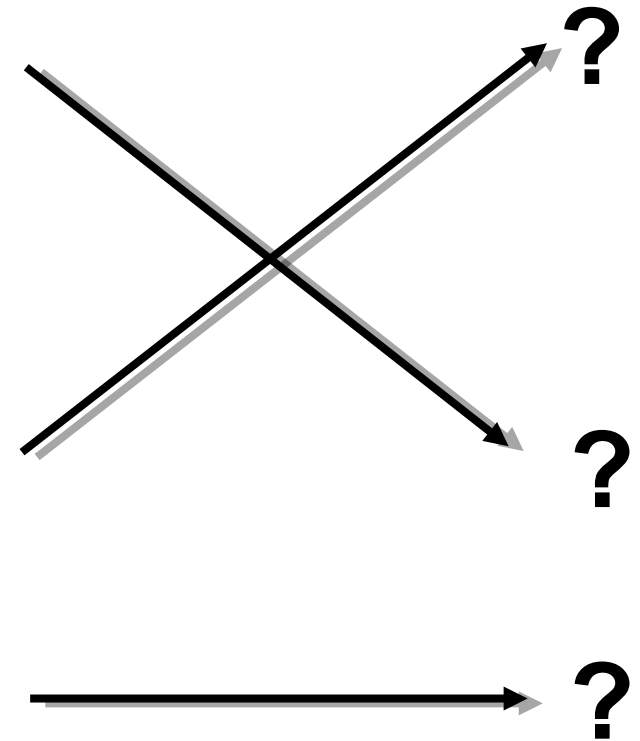
Factors? No idea → EFA

EFA vs CFA

EFA	CFA
Exploratory	Confirmatory
No need theory	Theory
Explore to get theory	Confirm theory
Item not fixed to factor	Item fixed to factor
Rotation	No rotation
No Hx testing	Hx testing & model fit

5. Reliability

- Part of validity evidence.
- Types:
    1. Test-retest reliability
    2. Parallel-forms reliability
    3. Interrater reliability
    4. **<u>Internal consistency reliability</u>**

Internal consistency reliability

- <u>Consistent</u> responses in a construct.
- <u>Homogenous</u> → ↑Reliability.
- Heterogenous → ↓Reliability.
- Advantage: Measure 1x only.
- **EFA: Cronbach's alpha coefficient.**
- **CFA: Omega coefficient.**
- Not reliable **0** → **1** Perfectly reliable.
- Aim > **0.7**.

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