PART 1

PSYCHOMETRIC
PROPERTIES OF SURVEY

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Visiting Medical Education Scholar Webinar | Faculty of Medicine, Mahidol University

EXPLORE

PSYCHOMETRIC CONCEPT

Explore the concept of psychometric

DISCUSS

PSYCHOMETRIC PROPERTIES

Discuss psychometric properties of survey

EXAMINE

A SIX-STEP APPROACH

Examine the SIX-STEP APPROACH to ensure psychometric properties of survey

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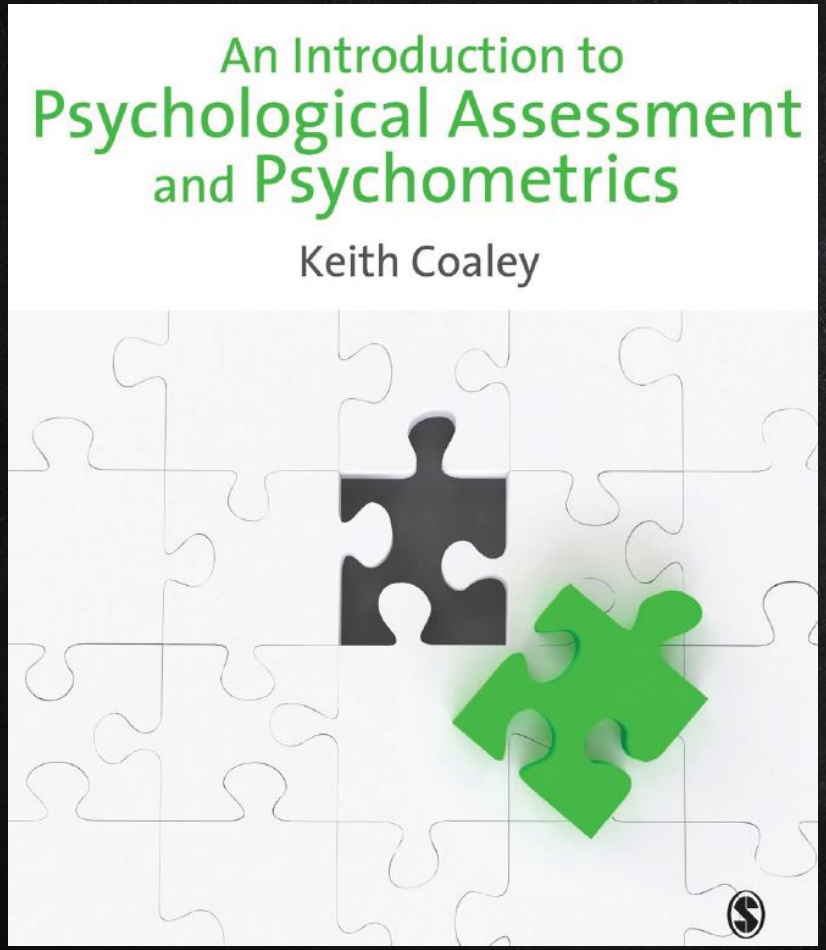


The Survey as a Psychometric Instrument

Psychometrics are designed to do measurement; in fact, the term is an abbreviation for 'psychological measurement'

The basis of psychometrics lies in these things – standardization, reliability and validity.

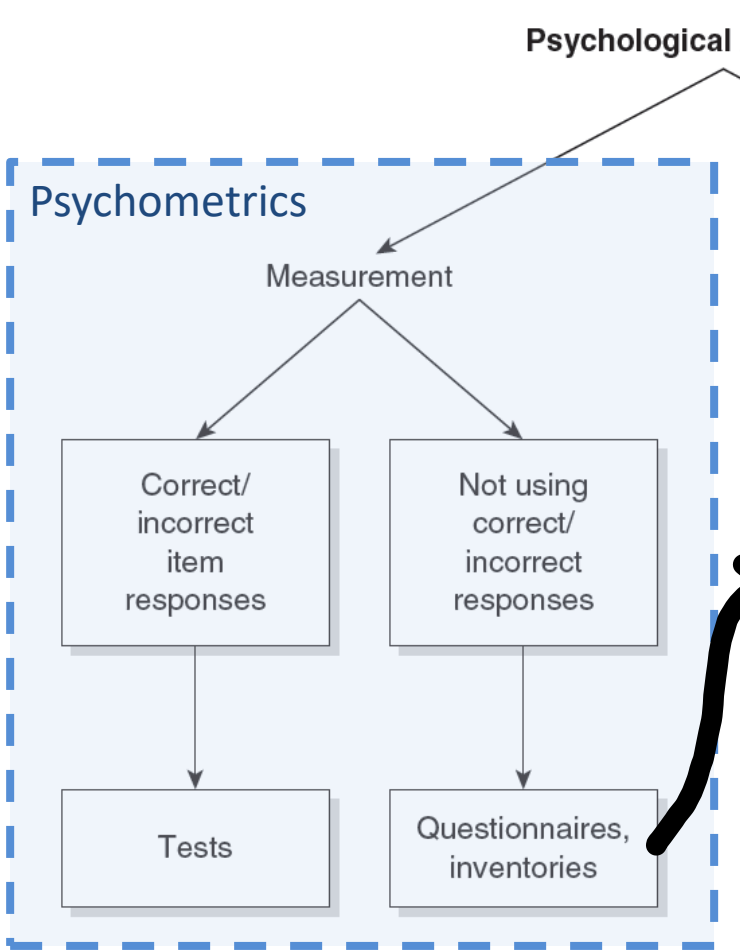
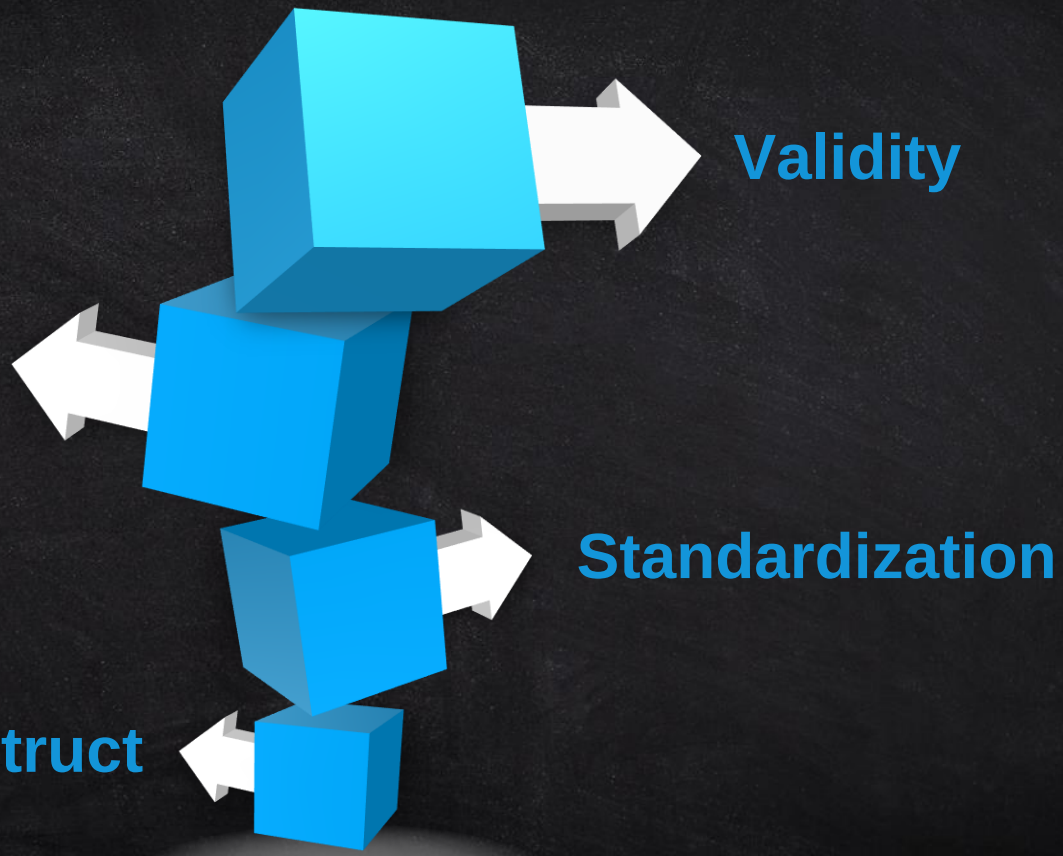


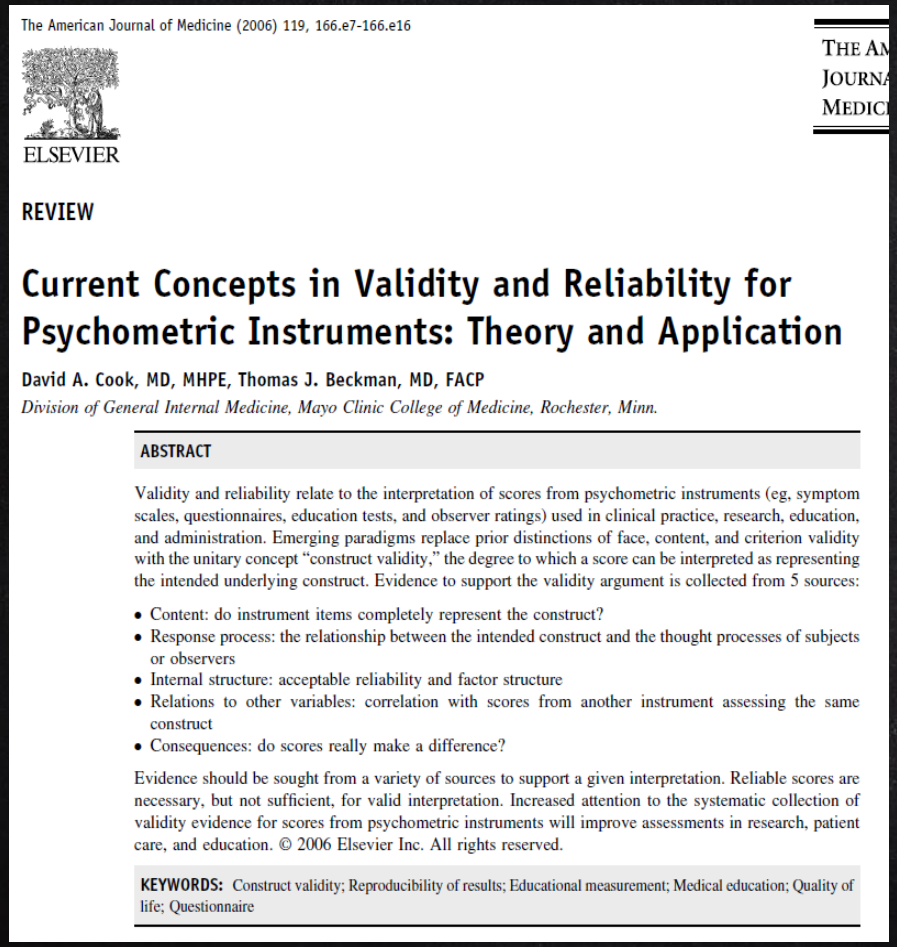
Figure 1.1 A taxonomy of psychological assessment

The survey as a psychometric instrument is a systematic and standardized approach to measure psychological constructs.

Researchers and psychologists use psychometric instruments to gather reliable and valid data, contributing to a better understanding of human behavior and cognition.

The Basis of Psychometrics





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REVIEW

Current Concepts in Validity and Reliability for Psychometric Instruments: Theory and Application

David A. Cook, MD, MHPE, Thomas J. Beckman, MD, FACP

Division of General Internal Medicine, Mayo Clinic College of Medicine, Rochester, Minn.

ABSTRACT

Validity and reliability relate to the interpretation of scores from psychometric instruments (eg, symptom scales, questionnaires, education tests, and observer ratings) used in clinical practice, research, education, and administration. Emerging paradigms replace prior distinctions of face, content, and criterion validity with the unitary concept "construct validity," the degree to which a score can be interpreted as representing the intended underlying construct. Evidence to support the validity argument is collected from 5 sources:

- Content: do instrument items completely represent the construct?
- Response process: the relationship between the intended construct and the thought processes of subjects or observers
- Internal structure: acceptable reliability and factor structure
- Relations to other variables: correlation with scores from another instrument assessing the same construct
- Consequences: do scores really make a difference?

Evidence should be sought from a variety of sources to support a given interpretation. Reliable scores are necessary, but not sufficient, for valid interpretation. Increased attention to the systematic collection of validity evidence for scores from psychometric instruments will improve assessments in research, patient care, and education. © 2006 Elsevier Inc. All rights reserved.

KEYWORDS: Construct validity; Reproducibility of results; Educational measurement; Medical education; Quality of life; Questionnaire

Emerging paradigms replace prior distinctions of face, content, and criterion validity with the unitary concept "**construct validity**," the degree to which a score can be interpreted as representing the intended underlying construct.

Table 3: Reliability analysis of the 15 item MBS based on the final model.

No	Item	SFL	[b]Domain
1	My mentor gives me useful advice when I tell him my needs, my worries, and my difficulties.	0.85	Mentoring relationship structure
2	My mentor likes to give me constructive advice on what I initiate.	0.88	
3	My mentor gives me information to help me in my actions and in solving my problems.	0.91	
4	My mentor and I are working towards mutually agreed upon goals.	0.89	
5	We have established a good understanding of the type of changes that would be good for me.	0.88	
6	My mentor and I agree about the things I will need to do to help improve my situation.	0.88	
7	We agree on what is important for me to work on.	0.83	
8	I believe that the way we are working on my situation is correct.	0.91	
9	My mentor understands my needs, my worries, and my problems.	0.92	Engagement
10	My mentor listens attentively to the needs, worries, and achievements that I share with him.	0.90	
11	When meeting, my mentor talks more than I do.	0.61	Autonomy support
12	Often, my mentor makes decisions for me.	0.73	
13	My mentor values me even after I experience failures.	0.84	Competency support
14	My mentor often tells me what I do well.	0.86	
15	My mentor congratulates me when I do something right.	0.84	

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12			
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14			
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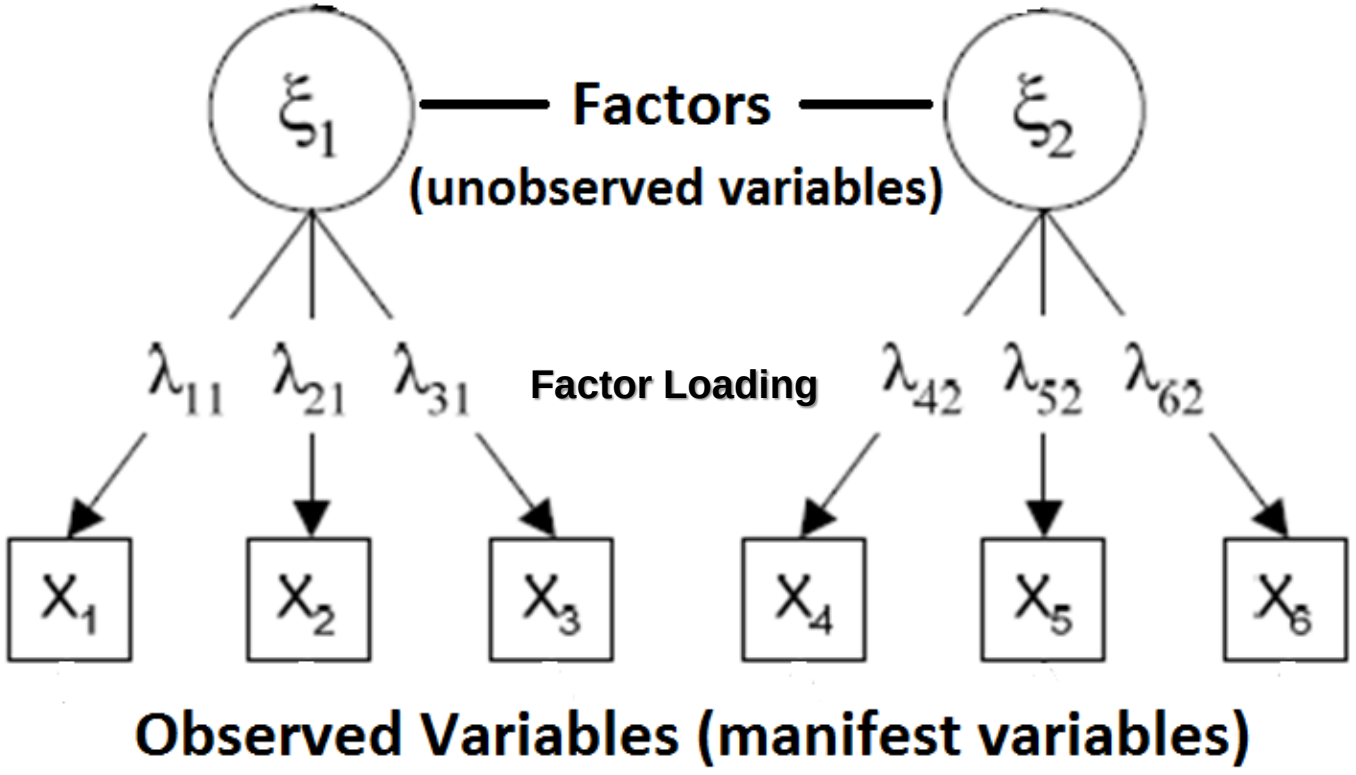
B

C

A

Questions were answered using the following five-point scale:
1 = Does not apply at all to my situation
2 = Does not apply much to my situation
3 = Applies a little to my situation
4 = Applies well to my situation
5 = Applies very well to my situation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Factors
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(unobserved variables)
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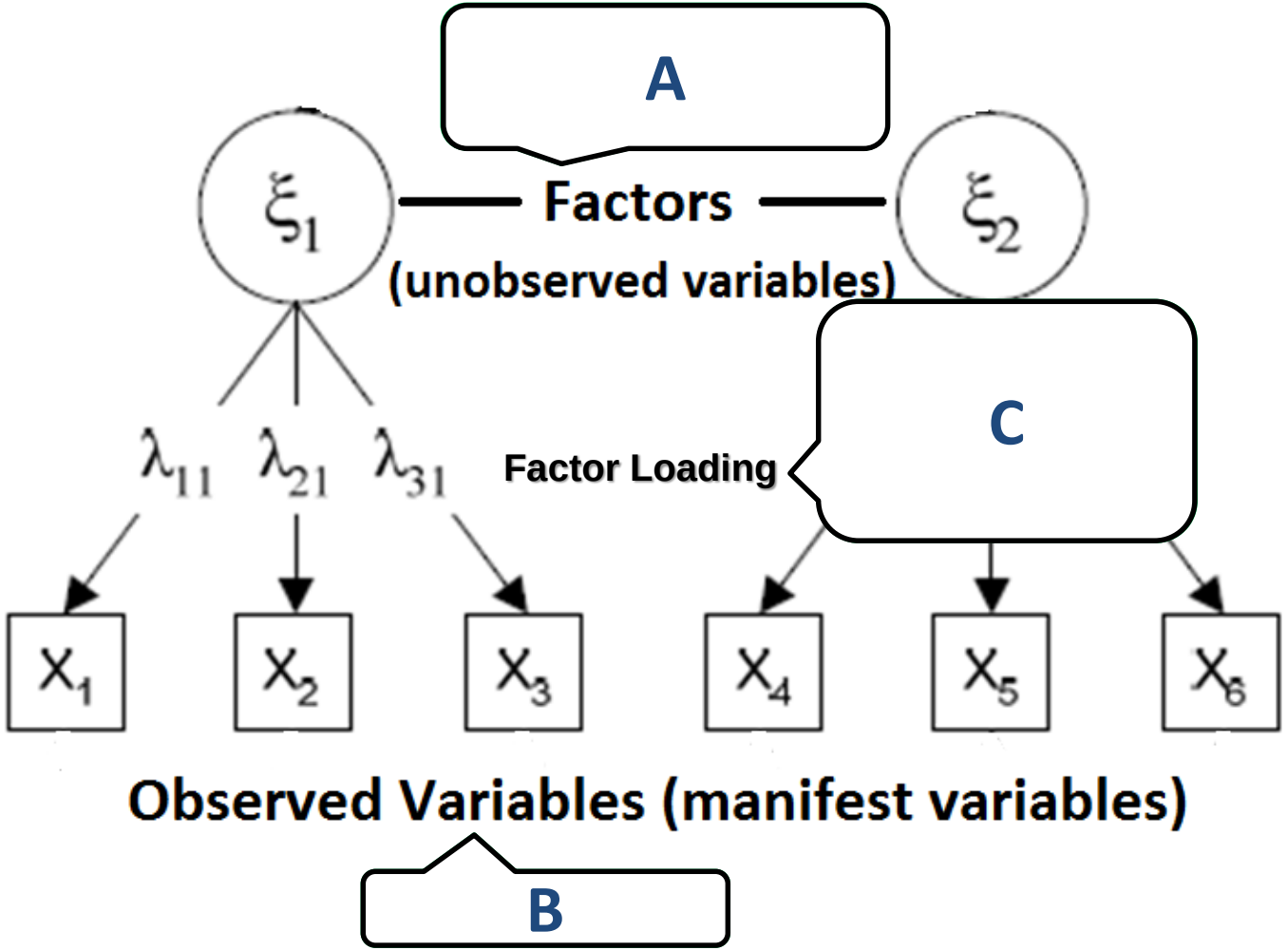
Observed Variables (manifest variables)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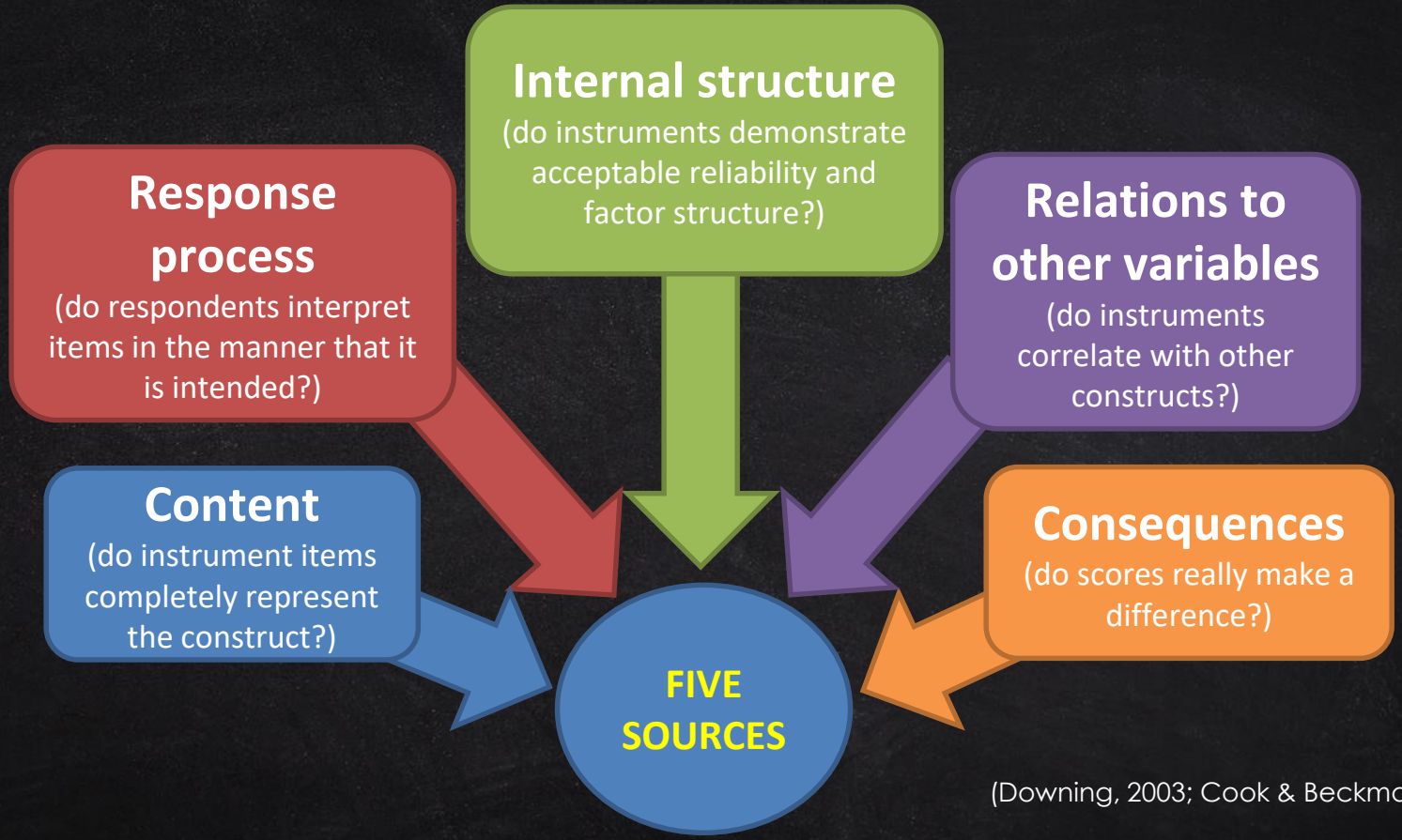

(Downing, 2003; Cook & Beckman, 2006)

Evidence to support the **CONSTRUCT VALIDITY**

Content

- Item writer qualifications
- Well-written items
- Evidence that items adequately represent domain
    - Item blueprint
    - Representativeness of item blueprint to domain
    - Logical/empirical relationship of items to domain
- Sensitivity review (cultural/context sensitivity)

Ensures that the survey items comprehensively and accurately represent the construct being measured. This evidence is gathered by **expert judgment**, assessing whether the survey items cover the domain of interest adequately. Content validity is crucial for ensuring that the survey's content reflects the breadth and depth of the construct.

(Downing, 2003; Cook & Beckman, 2006; Yusoff et al., 2021)

Content (do instrument items completely represent the construct?)

Table 1 The final definition of resilience domains and the total items representing the domains

Resilience domain	Definition	Number of items[a]
Control	The quality of being composed and controlled in adversities, and is influenced by the present state inside a person	37 items
Involvement	Being committed to deal with the adversities, and is influenced by the present state externally	26 items
Resourceful	The ability to find appropriate solutions from available resources to deal with adversities, and is oriented for future state externally	19 items
Growth	Being able to grow stronger from adversity, and is oriented for future state internally	7 items

[a]The full list of 89 items can be referred to the supplementary file A

Medical professional resilience scale (MeRS) (Rahman et al., 2021)

Content (do instrument items completely represent the construct?)

Table 1 The final definition of resilience

Resilience domain	Definition
Control	The quality of and is influen
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Growth	

[a]The full li

i. ***I-CVI*** (item-level content validity index): The proportion of content experts giving an item a relevance rating of 3 or 4.
ii. ***S-CVI*** (scale-level content validity index): The average of the I-CVI scores for all items on a scale (i.e., a resilience domain).

The acceptable I-CVI value was set at a minimum of 0.78, while the acceptable S-CVI value was at a minimum of 0.80 [24, 26]. Based on the I-CVI values, items with I-CVI less than 0.80 were rejected, items with I-CVI at least 0.83 but less than 1 were re-discussed, and items with I-CVI of 1.0 were accepted.

Domains	Items	I-CVI	S-CVI
Growth	I can succeed if I keep trying	1.00	0.95
	I believe everything happens for a reason	1.00	
	When I face new situations, I will learn from it	1.00	
	I believe there is a wisdom behind everything in life	1.00	
	I believe every problem comes with a solution	0.83	
	I seek help to achieve my goals if necessary	0.83	
	I believe by helping others, I am helping myself too	1.00	

Content (d

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ABC of Content Validation and Content Validity Index Calculation

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ABSTRACT

There are five sources of validity evidence that are content, response process, internal structure, relation to other variables, and consequences. Content validity is the extent of a measurement tool represents the measured construct and it is considered as an essential evidence to support the validity of a measurement tool such as a questionnaire for research. Since content validity is vital to ensure the overall validity, therefore content validation should be performed systematically based on the evidence and best practice. This paper describes a systematic approach to quantify content validity in the form of content validity index based on the evidence and best practice.

Keywords: *Content validity, Content validation, Content validity index, Questionnaire validation, Validity*

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VI

95

Response process

- Clarity of language
- Clarity of instructions
- Comprehension of items
- Comprehension of rating scores
- Respondent's format familiarity
- Interpretation of score reporting

Focuses on how respondents interpret and respond to survey items. This evidence is gathered through cognitive interviews, observations, or thinking aloud protocols, where participants verbalize their thought processes while completing the survey. Response process validity helps ensure that survey items are interpreted as intended and that response options are appropriate for the target population.

(Downing, 2003; Cook & Beckman, 2006; Yusoff et al., 2021)

Response process (do respondents interpret items in the manner that it is intended?)

Table 1 The final definition of resilience domains and the total items representing the domains

Resilience domain	Definition	Number of items[a]
Control	The quality of being composed and controlled in adversities, and is influenced by the present state inside a person	37 items
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i ***I-FVI*** (item-level face validity index): The proportion of test respondents giving an item a clarity rating of 3 or 4.

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The acceptable I-FVI value was set at a minimum of 0.80, while the acceptable S-FVI value was at a minimum of 0.83 [25]. Based on the I-FVI values, items with I-FVI ess than 0.80 were rejected, and items with I-FVI more than 0.80 were accepted.

Domains	Items	I-CVI	S-CVI	I-FVI	S-FVI
Growth	I can succeed if I keep trying	1.00	0.95	0.90	0.93
	I believe everything happens for a reason	1.00		0.90	
	When I face new situations, I will learn from it	1.00		1.00	
	I believe there is a wisdom behind everything in life	1.00		0.90	
	I believe every problem comes with a solution	0.83		1.00	
	I seek help to achieve my goals if necessary	0.83		1.00	
	I believe by helping others, I am helping myself too	1.00		0.90	
	I have goals to achieve	1.00		0.90	
	I believe good planning is a key to success	1.00		0.90	

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S-FVI
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ABSTRACT

Validity evidence can be supported by five sources that are content, response process, internal structure, relation to other variables, and consequences. Response process validity measures the thought processes of users of the tested inventory as they respond to the assessment tool. These are commonly evaluated in the form of clarity of instructions and language used in the assessment tool, as well as the comprehension of instruction after training or an observation session. Response process validity contributes to the overall validity of an assessment tool; therefore, it should be quantified systematically based on the evidence and best practice. This paper describes a systematic approach to quantify response process validity in the form of face validity index based on the evidence.

Keywords: *Validity, Response process, Face validity, Questionnaire, Face validity index*

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Internal structure

- Item factor analysis
- Item reliability
- Item analysis data:
    - Item difficulty
    - Item discrimination

Examines the internal consistency and structure of the survey items. This evidence is gathered through statistical analyses such as factor analysis, exploratory and confirmatory factor analysis, or item response theory. Internal structure validity assesses whether the survey items measure a single underlying construct or multiple dimensions and whether they exhibit consistent patterns of relationships.

(Downing, 2003; Cook & Beckman, 2006; Yusoff et al., 2021)

Table 3 The I-CVI, S-CVI, I-FVI, S-FVI, Factor Loading and Reliability of the Four Domains of MeRS (Final Model)

Domains	Items	I-CVI	S-CVI	I-FVI	S-FVI	Factor Loading	Gronbach's Alpha	Eigenvalue (rotated)	Total % of variance
Growth	I can succeed if I keep trying	1.00	0.95	0.90	0.93	0.726	0.89	6.138	14.97
	I believe everything happens for a reason	1.00		0.90		0.672			
	When I face new situations, I will learn from it	1.00		1.00		0.640			
	I believe there is a wisdom behind everything in life	1.00		0.90		0.638			
	I believe every problem comes with a solution	0.83		1.00		0.635			
	I seek help to achieve my goals if necessary	0.83		1.00		0.584			
	I believe by helping others, I am helping myself too	1.00		0.90		0.576			
	I have goals to achieve	1.00		0.90		0.569			
	I believe good planning is a key to success	1.00		0.90		0.565			
	I believe self-motivation will change the final outcome	0.83		0.90		0.561			
	I believe hard work really pays off in the end	0.80		1.00		0.526			
	I am aware of my strengths and abilities	1.00		1.00		0.475			
	I am positive I will be successful in the future	1.00		0.90		0.465			
	When my work is criticized, I cope positively by trying harder the next time	1.00		0.90		0.448			
	Believing in myself helps me to face any difficulties	1.00		0.90		0.423			
Control	I am firm with my stand	1.00	0.93	0.80	0.89	0.628	0.818	4.679	11.41
	I can adapt to change at work situations	1.00		1.00		0.604			
	People always believe in me to make difficult decision	0.83		0.70		0.586			
	I am comfortable working in new environment	1.00		0.80		0.548			
	I spend my life doing something great	0.83		0.80		0.501			
	I have good coping skills when dealing with stress	0.80		0.90		0.491			
	I am proud of my own accomplishments	0.83		0.80		0.489			
	I become a stronger person when facing difficulties at work	1.00		1.00		0.478			
	I always give my best at work	1.00		1.00		0.472			
	I feel energetic doing my work even in difficult situations	0.83		1.00		0.459			
	I can maintain interest in my work	1.00		0.90		0.419			
	My colleagues can always rely on me	1.00		1.00		0.407			
Involvement	I can stay calm in hard situations	1.00	0.92	0.90	0.92	0.751	0.719	3.279	8.00
	I can handle unpleasant feelings	0.83		0.80		0.724			
	I always try to stay calm in any situation	1.00		0.90		0.564			
	I can control my anger	1.00		1.00		0.544			
	I am in control of my surroundings	0.83		0.90		0.504			
	I am good at adapting myself to different situations	0.83		1.00		0.461			
Resourceful	I know who to talk to when I have a problem	1.00	1.00	0.90	0.90	0.764	0.779	3.152	7.69
	I know where to go if I need help	1.00		1.00		0.738			
	I always have someone by my side when I have problems	1.00		0.80		0.702			
	I figure out ways to solve my problems by talking about them	1.00		0.90		0.683			

I-CVI item-level content validity index; *S-CVI* scale-level content validity index; *I-FVI* item-level face validity index; *S-FVI* scale-level face validity index

Internal structure

(do instruments demonstrate acceptable reliability and factor structure?)

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I-CVI Item-level content validity index; *S-CVI* scale-level content validity index; *I-FVI* Item-level face validity index; *S-FVI* scale-level face validity index

Internal structure

(do instruments demonstrate acceptable reliability and factor structure?)

Internal Consistency (Reliability)

Factor Loading (Factor Analysis)

Constructs

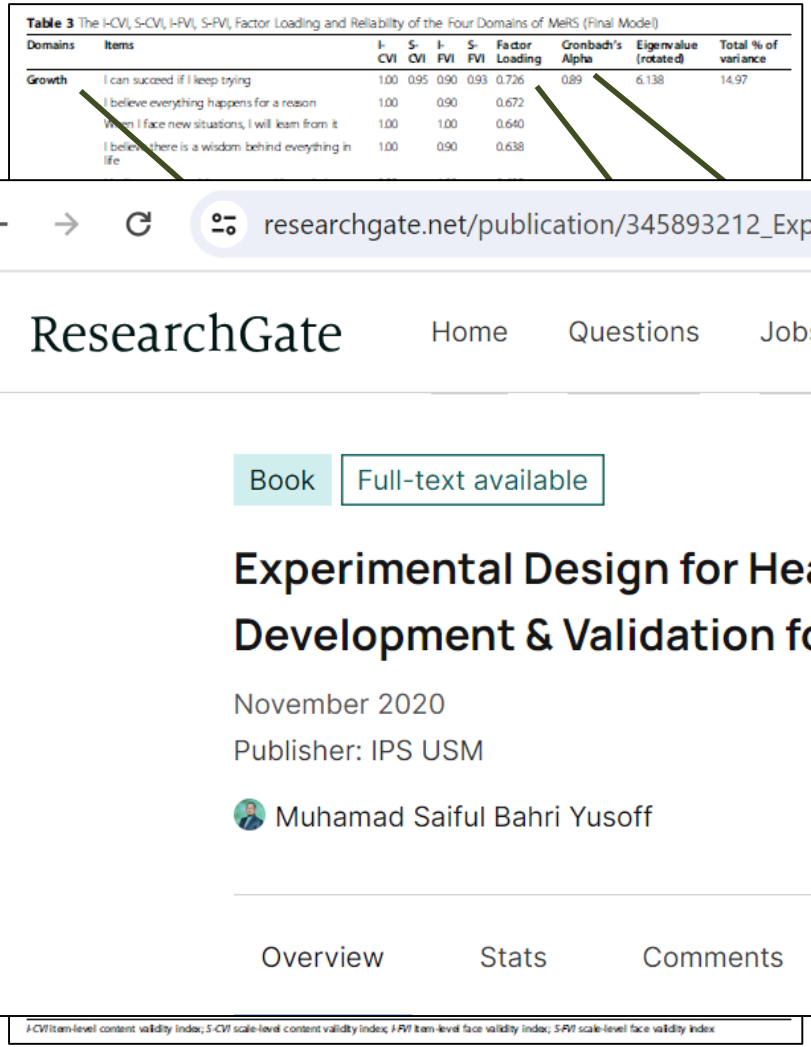

Table 3 The I-CVI, S-CVI, I-FVI, S-FVI, Factor Loading and Reliability of the Four Domains of MeRS (Final Model)

Domains	Items	I-CVI	S-CVI	I-FVI	S-FVI	Factor Loading	Gronbach's Alpha	Eigenvalue (rotated)	Total % of variance
Growth	I can succeed if I keep trying	1.00	0.95	0.90	0.93	0.726	0.89	6.138	14.97
	I believe everything happens for a reason	1.00		0.90		0.672			
	When I face new situations, I will learn from it	1.00		1.00		0.640			
	I believe there is a wisdom behind everything in life	1.00		0.90		0.638			

I-CVI item-level content validity index; *S-CVI* scale-level content validity index; *I-FVI* item-level face validity index; *S-FVI* scale-level face validity index

Internal structure

(do instruments demonstrate acceptable reliability and

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November 2020

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Muhamad Saiful Bahri Yusoff

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Relationship to other variables

- Correlation with other relevant variables
- Convergent correlations - internal/external (similar measures)
- Divergent correlations - internal/external (dissimilar measures)
- Test-criterion correlations – sensitivity and specificity (ROC)

Assesses the relationship between the survey scores and other variables that are theoretically related to the construct being measured. This evidence is gathered through correlational analyses, regression analysis, or experimental designs. Relation to other variables validity examines whether the survey scores demonstrate expected patterns of association with external criteria, providing evidence of convergent and discriminant validity.

(Downing, 2003; Cook & Beckman, 2006; Yusoff et al., 2021)

Relations to other variables (do instruments correlate with other constructs?)

Table 3.1 Correlation between Total MeRS score and Total Burnout score (N=354)

Variables	Mean (SD)	r[a]	p-value
Total MeRS score	112.16 (13.75)	-0.510	<0.001*
Total Burnout score	49.56 (17.38)		

*Statistically significant at α=0.01; [a]Pearson correlation coefficie

(Hau et al., 2023, thesis)

The survey scores demonstrated the expected patterns of association with external criteria (Burnout score)

There is a negative moderate correlation between total MeRS score and total Burnout score

Consequences

- Impact of item scores on target group
- Consequences on learners/future learning
- Positive consequences outweigh unintended negative consequences
- Reasonableness of method of establishing cut-off score

Examines the impact or consequences of survey scores on individuals, organizations, or society. This evidence is gathered by investigating the outcomes or effects of using survey scores for decision-making purposes. Consequences validity assesses whether survey scores lead to desired outcomes, such as improved performance, enhanced understanding, or informed decision-making, and whether unintended consequences are minimized.

(Downing, 2003; Cook & Beckman, 2006; Yusoff et al., 2021)

Consequences (do scores really make a difference?)

Table 2 The total score for MeRS with a corresponding level of resilience competency

MeRS domain (n item)	Level of resilience competency (total score)		
	Developing (low)	Established (moderate)	Exceptional (high)
Growth (15)	15–27	28–47	48–60
Control (12)	12–21	22–38	39–48
Involvement (6)	6–11	12–18	19–24
Resourceful (4)	4–7	8–12	13–16
Global score (37)	37–66	67–118	119–148

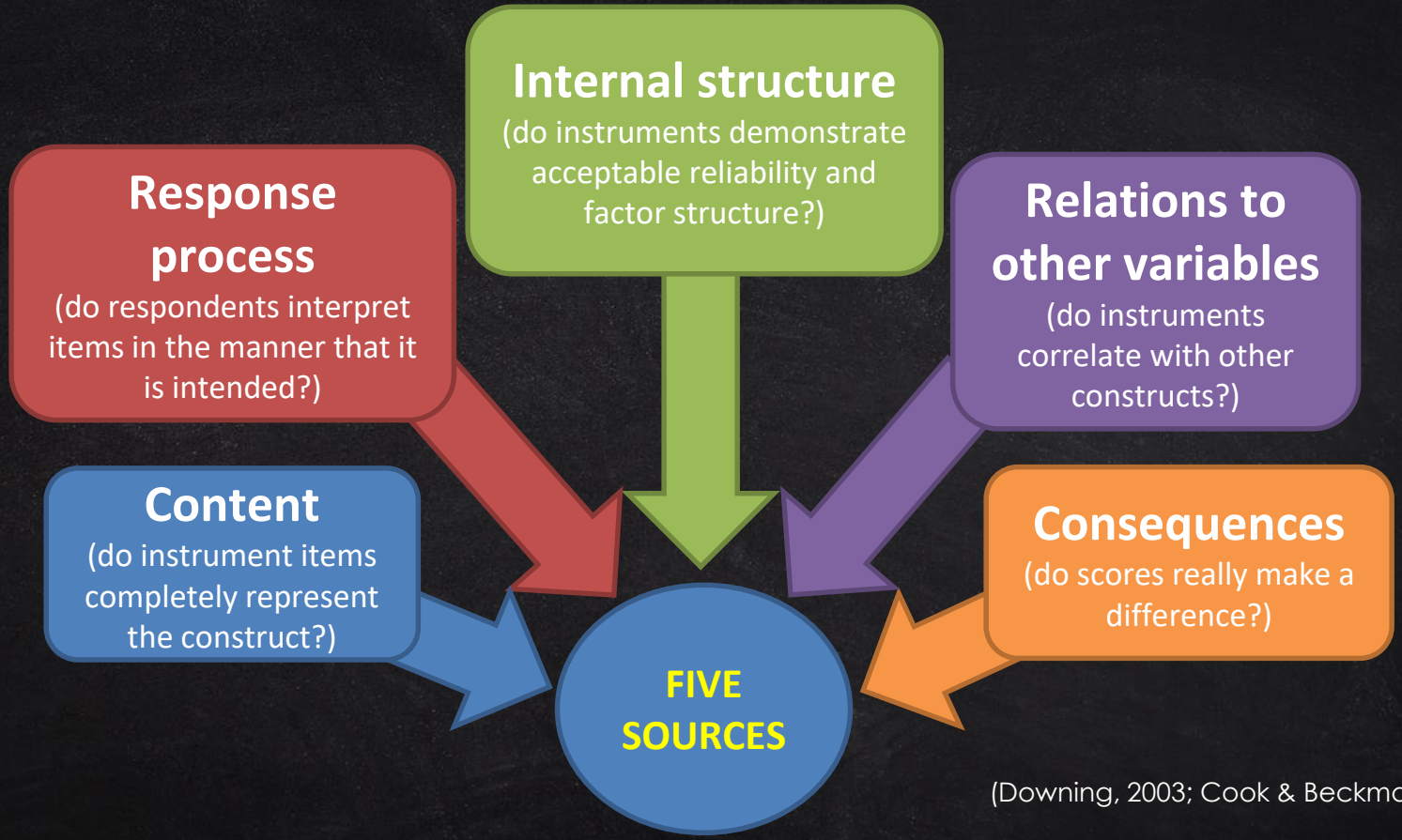
(Rahman et al., 2021)

Table 2.5 Level of resilience among respondents (N=354)

Level of resilience	Frequency, n (%)
Developing/low (MeRS 37-66)	1 (0.3)
Established/moderate (MeRS 67-118)	274 (77.4)
Exceptional/high (MeRS 119-148)	79 (22.3)

(Hau et al., 2023, thesis)

Enhanced understanding of resilience categories among the target group



(Downing, 2003; Cook & Beckman, 2006)

Evidence to support the **CONSTRUCT VALIDITY**

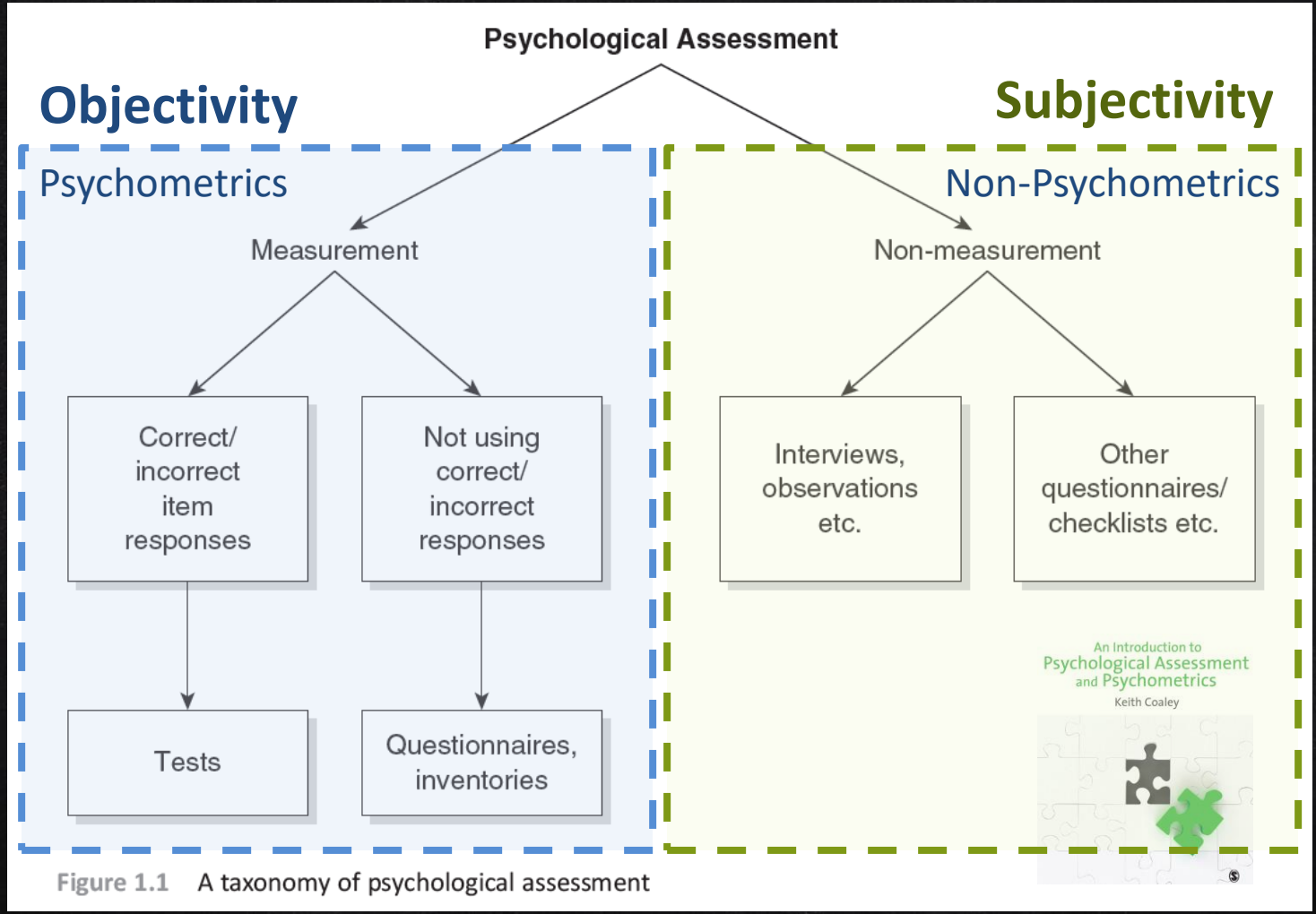


Figure 1.1 A taxonomy of psychological assessment

Perspective

The Power of Subjectivity in the Assessment of Medical Trainees

Olle ten Cate, PhD, and Glenn Regehr, PhD

Academic Medicine, Vol. 94, No. 3 / March 2019

Abstract

Objectivity in the assessment of students and trainees has been a hallmark of quality since the introduction of multiple-choice items in the 1960s. In medical education, this has extended to the structured examination of clinical skills and workplace-based assessment.

such as reliability, have consistently shown disappointing results. This raises questions about the extent to which objectivity in such assessments can be ensured.

In fact, the legitimacy of "objective" assessment of individual trainees,

"objectify" these assessments may be problematically distorting the assessment process itself. In addition, "competence" must meet standards, but it is also context dependent.

Educators are now arriving at the

Medical Teacher

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Assessment in the post-psychometric era: Learning to love the subjective and collective

Brian Hodges

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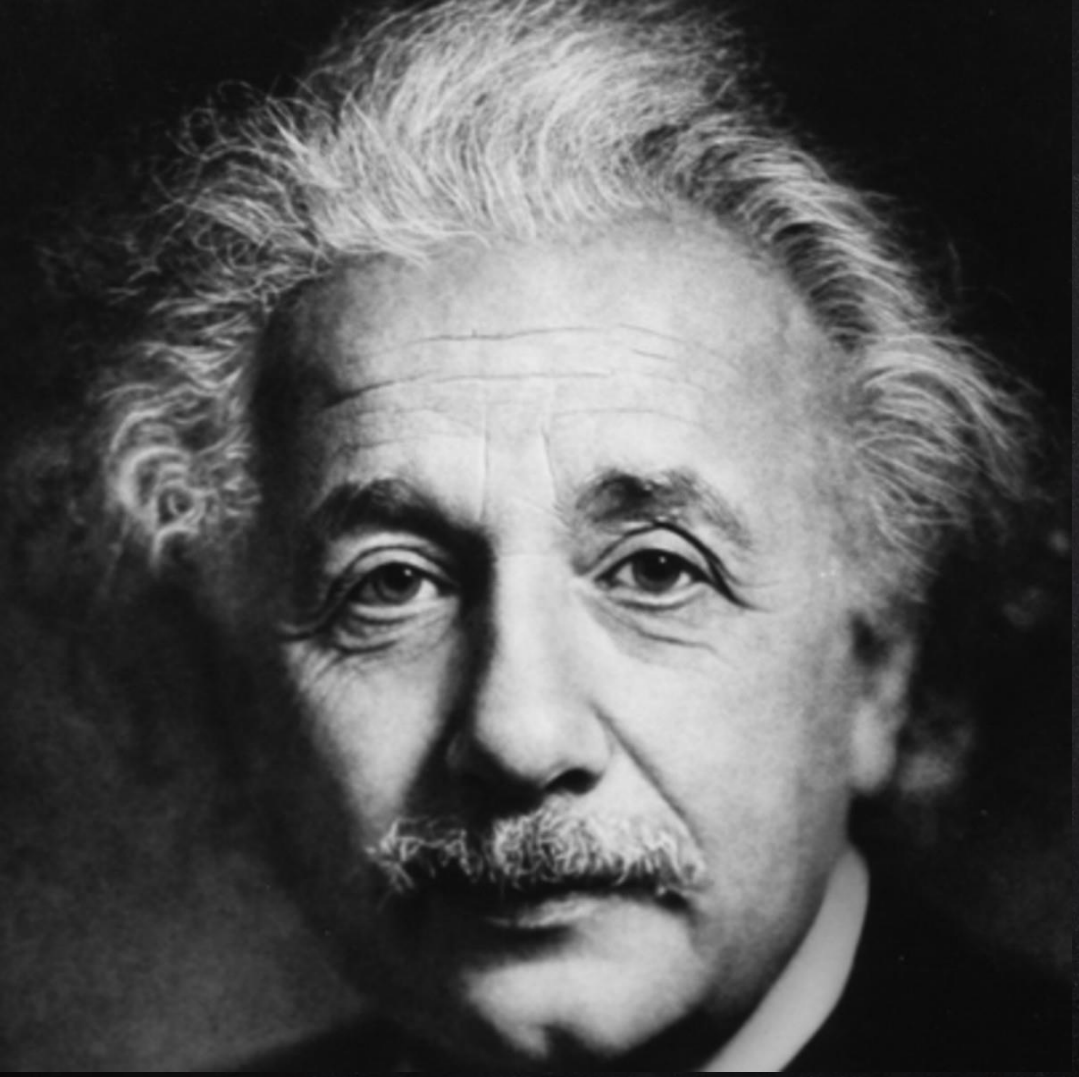
To link to this article: https://doi.org/10.3109/0142159X.2013.789134

Acknowledging and celebrating the reemergence of subjectivity in assessment, Hodges has described health professions education as moving into a "post-psychometric era."

Interestingly, embracing subjectivity not only offers the possibility of richer feedback by defensibly representing differing perspectives on performance across assessments, but it also enables better thinking about the value and defensibility of the moment-by-moment judgments being made by preceptors to enable ad hoc entrustment.

Paradigms

Criterion	Psychometric (Quantitative)	Non-Psychometric (Qualitative)
Truth value	Internal validity	Credibility
Applicability	External validity	Transferability
Consistency	Reliability	Dependability
Neutrality	Objectivity	Confirmability



“Not everything that counts can be counted, and not everything that can be counted counts.”

(Albert Einstein)

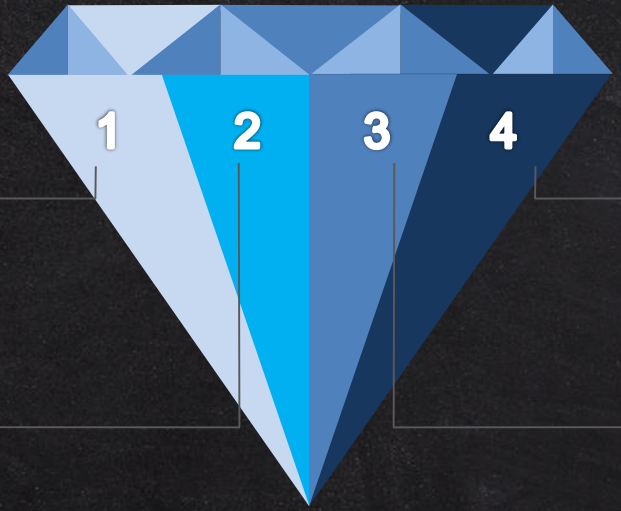
PART 1 – TAKE HOME MESSAGE

Psychometric

Measurement of psychological constructs

Psychometric Properties

It is about standardization, reliability, and validity



Validity Evidence

Sources of evidence to support the validity of underlying constructs

Psychometric instrument

A standardized & systematic approach to measure psychological constructs

Thank You

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