

# “Real-time” short form development:

Applying item information  
to obtain “live” score-level reliability estimates  
for evaluating expected short form performance

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KALLEN MA, BRICKELL T, LANGE RT, FRENCH L, KRATZ A, AND CARLOZZI NE

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# Best practices: Short form development

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Use content expertise + detailed item-level psychometrics

Identify a subset of items with targeted characteristics

# Spreadsheet example 1

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# Objective

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Develop an item information-based approach

- Use an interactive framework for “on the spot” of score-level reliability estimates
- Enable “real-time” assessment of a proposed short form’s psychometric properties

# Spreadsheet example 2

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Not yet...

# Item information

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What is it?

What's so great about it?



# Item information values

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Item- and score-level specific

Derived from an item information function

# Item information (II)

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3-parameter logistic model (Birnbaum 1968)

$I_i(\theta) =$

$$2.89 a_i^2 (1 - c_i)$$

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$$[c_i + e^{1.7 a_j (\theta - b_j)}] [1 + e^{-1.7 a_j (\theta - b_j)}]^2$$

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# Item information

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Generally higher when “a” is higher

Higher when “b” is closer to theta

Increases as “c” approaches 0

# Test information

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Test Information (TI)

- $TI = 1 + ( \text{sum} ( \text{Item information} ) )$

# Test information-based equations

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## Test Information (TI)

- $TI = 1 + ( \text{sum} ( \text{Item Information} ) )$

## Expected Standard Error (SE)

- $SE = 1 / ( \text{SQRT} ( TI ) )$

## Expected Reliability (Reli)

- $Reli = 1 - ( 1 / TI )$

# “Supporting” equations

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## Spearman-Brown Reliability Prediction (SB)

- $SB = ( \text{proportion} \times \text{Reli} ) / ( 1 + ( ( \text{proportion} - 1 ) \times \text{Reli} ) )$

## Short Form Performance (Perf)

- $\text{Perf} = \text{Reli} - \text{SB}$

# Spreadsheet example 2

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# Methods

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Traumatic Brain Injury Caregiver Health-Related Quality of Life (TBI-CareQOL) Caregiver Strain item bank

- contains 33 items
- 6-item short form targeted

Score-level-specific item information values estimated

- theta -2.8 to +2.8 (T-score metric: 22 to 78)

Equations for score-level test information and expected SE and reliability embedded in the spreadsheet

Item content and supporting item psychometrics presented

- i.e., slope, thresholds, location

The interactive spreadsheet was projected during an in-person meeting of content and measurement experts

- identified preferred items
- observed, in real time, expected psychometric performance of selected item set

Experts could immediately evaluate the performance of preferred item sets

- test the impact of potential item replacement strategies



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# Results

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Final set of 6 items identified

- appropriate content coverage
- reliable assessment across a wide range of the measurement continuum

Emphasis given to content identified as being clinically important

Estimated score-level reliabilities for the 6-item short form?

# Conclusions

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This approach follows best practices:

- use of content and psychometric expertise

It employs item information values

- determine expected score-level reliabilities
- execute calculations in real time
- provide “on the spot” psychometric performance details of items proposed for a short form

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