Using Item Response Modeling Methods to Develop Theory Related to Human Performance

Diane D. Allen, PhD

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Outline

- Theories in human performance
- Process for generating the instrument
- Item Response Modeling
- Instrument
- Results of testing
- Revelations about the theory

Theories of Human Performance

- human performance =

  physical phenomena + choices arising from attitudes and knowledge

- qualitative domains are less readily measured

Measures of Human Performance Related to Movement

Current measures have problems:

- specific but restrictive (single diagnosis)
- aggregate too long to be clinically useful
- self-generated may lack specificity: I'm better
- broad constructs not directly attributable to the intervention
- expert opinion may not meet psychometric standards

New measure needed

Process for Instrument Development (Wilson, 2005)

Building blocks

1. Construct
2. Items
3. Outcome space
4. Measurement model

Generate, Test, and Revise

- interview, write, review content and format, test psychometrics

Advantages of Item Response Modeling

- close relationship with theoretical construct
- focus on items along with overall measure
- association of person ability or attitude and item difficulty or endorseability
- logit scale allows quantitative comparisons
- analysis facilitates comparison with theoretical construct

Construct Starting Point

Movement Continuum Theory (MCT) of Physical Therapy

Cott, et al. (1995)

- movement is a change in position (or holding a position against a force)
- influenced by internal and external factors
- disabling factors can diminish; physical therapy can enhance

Respondent Levels on Self-Perception of Movement Capability

6	**Competitive** athletes, performers of the physically demanding arts; people who do highly physical work.
5	Person who regularly engages in **non-routine** activity such as training, exercise, practice, work.
4	Person who accomplishes usual or normally expected **everyday** activity.
3	Person who has **curtailed** daily activity.
2	Person who requires equipment or **help** to perform usual daily activities.
1	Person who is paralyzed, **unable** to move at will.

Items: Required Greater Specificity of Movement

- Hypothesized six dimensions: flexibility, strength, accuracy, speed, adaptability, and endurance.
- All six are required for persistent, controlled or goal-oriented movement.
- Optimized in the absence of disabling factors such as pain, dizziness, shortness of breath, abnormal muscle tone, tightness, or sensory deficits.

Outcome Space (One Dimension): Parallel to Respondent Levels

6	As **fast** as an athlete or great performer.
5	**Fast** enough for normal activities plus additional activities of choice.
4	**Fast** enough for normal activities.
3	Have difficulty because of **slowed** movement.
2	Need some help for some activities because of **slowed** movement.
1	Need help for many or most activities because of **slowed** movement.

Instrument: Movement Ability Measure

- self-report of movement ability
- 6 levels of movement ability for each item
- 4 items for each of 6 dimensions = 24 items
- 6 levels worded in parallel for each of the 4 items for each dimension

Hypothesized Measurement Model

- One parameter: All items have the same item response function, same discrimination
- Partial credit model: Relationship of response categories differ across items
- Multidimensional vs. unidimensional model

Data Collected

- Over 300 people completed the Movement Ability Measure (MAM), aged 18-101
- 34 people not currently in physical therapy completed the MAM twice
- 34 patients undergoing physical therapy completed the MAM up to three times

Evidence of Reliability
(over all 24 items)

- Internal consistency = .94
- Person separation reliability (EAP) = .95
- Test-retest reliability (two-week interval) = .84
- Standard errors for step estimates range from 0.14 to 0.70 logits
- Standard errors for person estimates range from 0.29 to 0.46 logits

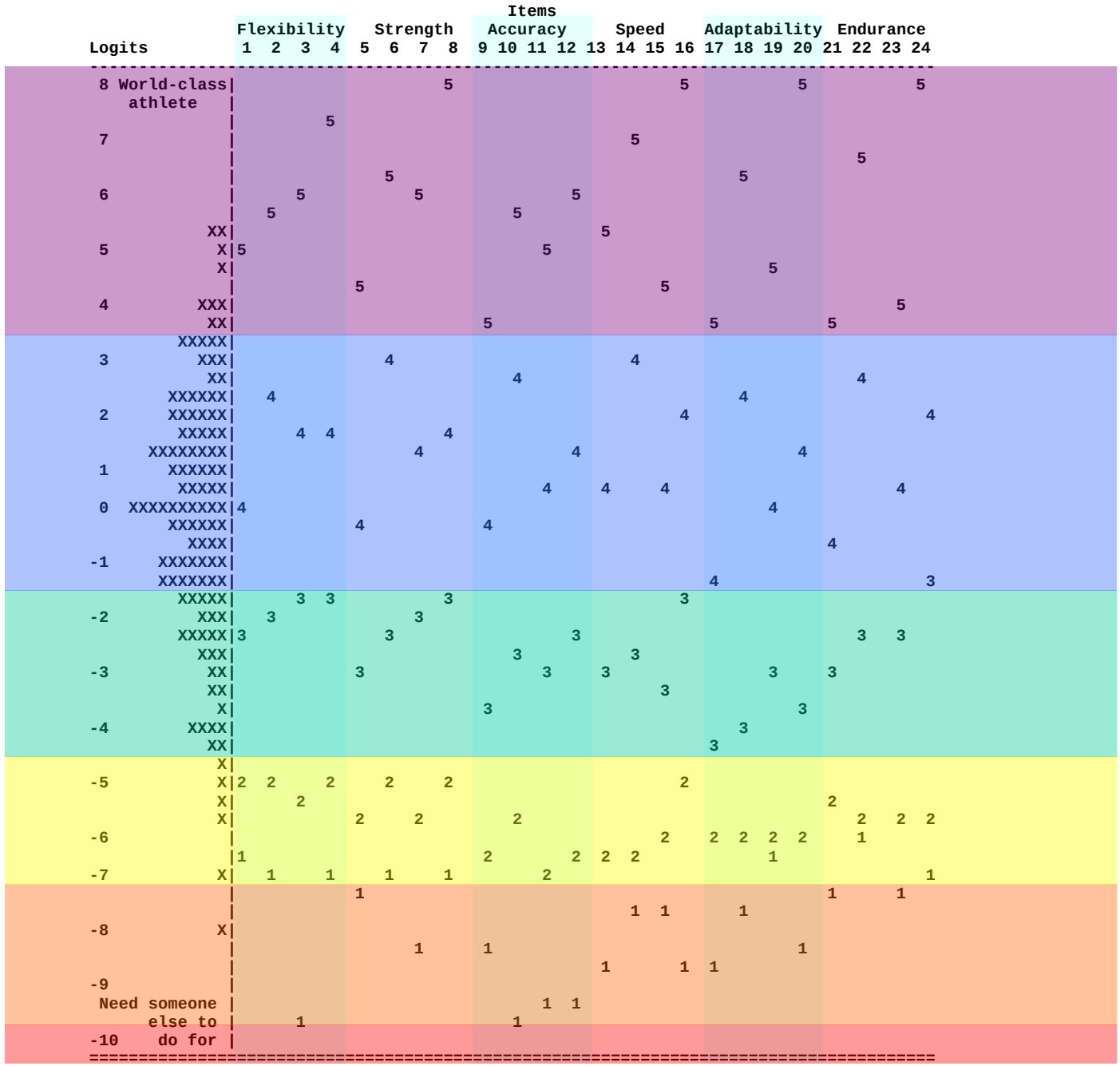
Comparison With Measurement Model

- unidimensional: one item and one step higher than criteria (infit meansquare >1.34, t>1.96)
- multidimensional: no items or steps higher than criteria
- Partial credit model fit better than rating scale model (p< .0001)
- multidimensional model fit better than unidimensional model (p< .0001)

Further Evidence of Validity

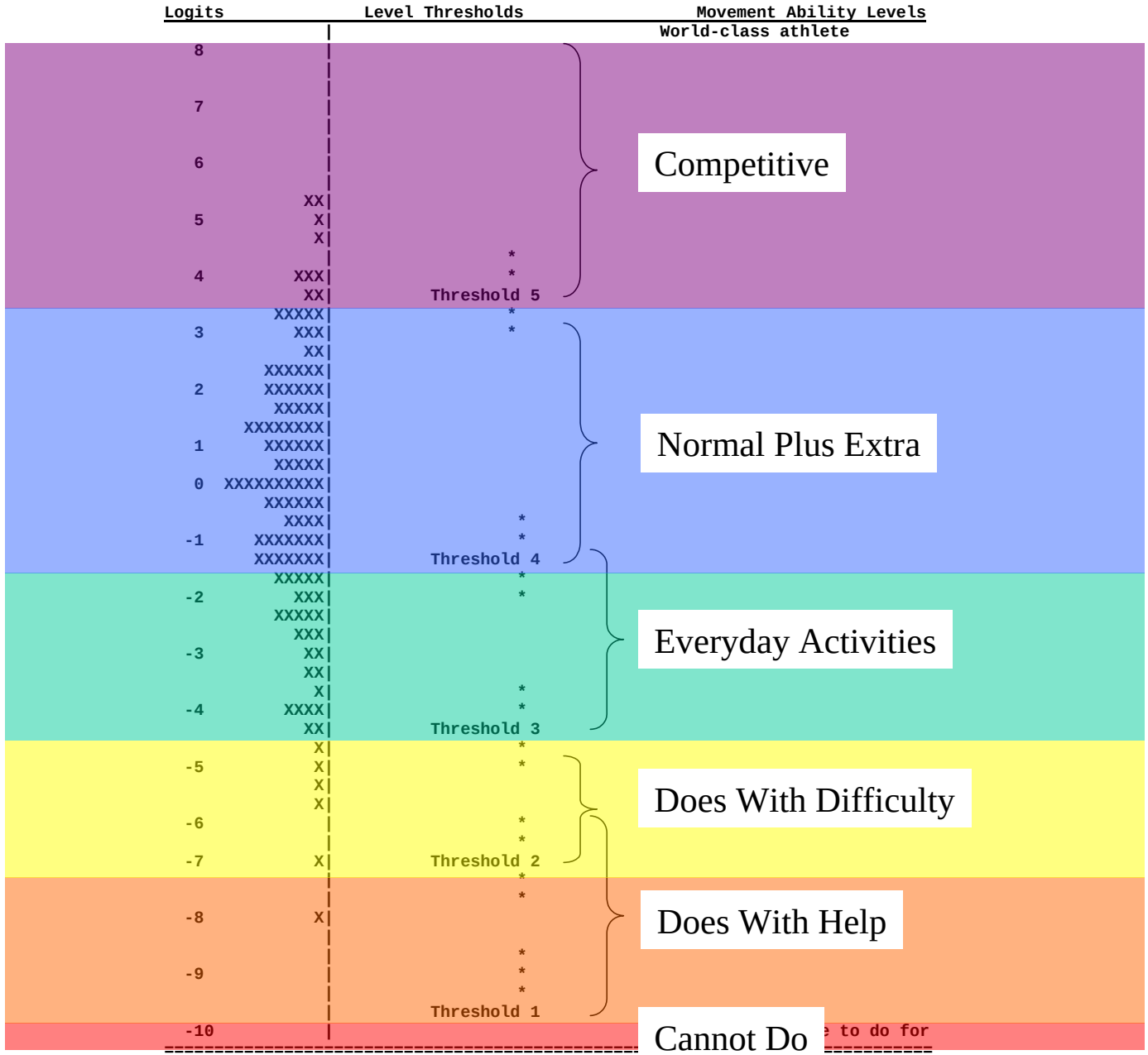
- The items functioned as predicted.
- The movement level thresholds were distinct from one another.
- There were few gaps in content coverage.

Items and Respondents Mapped on Same Construct



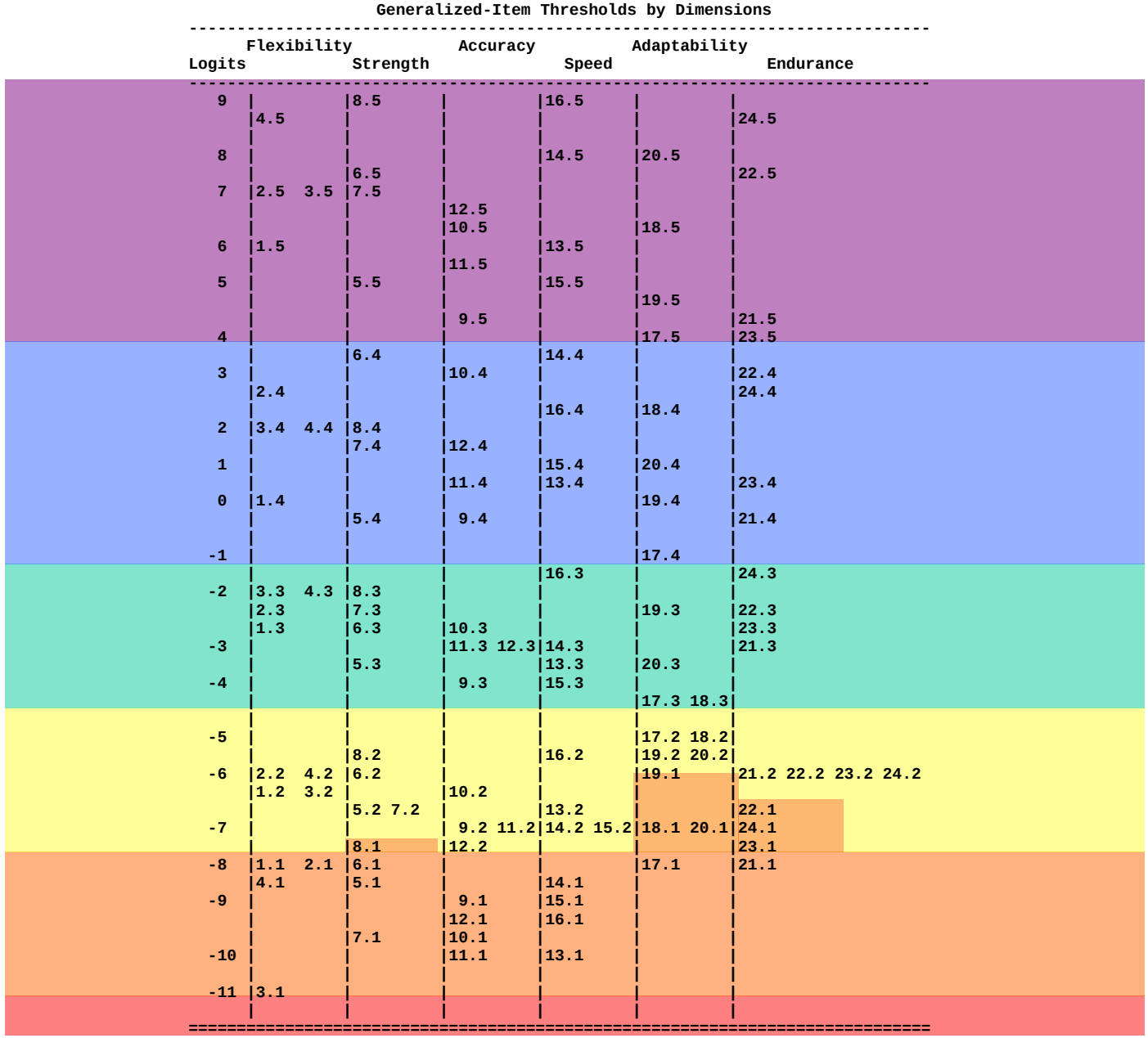
Each X represents 2.6 respondents

Movement Level Thresholds with 95% Confidence Intervals



Construct: Self-Perception of Movement Capability

Item and threshold locations for the Six Dimensions



Validity, continued

- People who claimed to be healthy perceived higher movement ability than those who did not ($p < .00005$)
- People claiming movement problems this week perceived lower movement ability than those who did not ($p < .05$)
- Physical therapist-completed initial MAMs were not significantly different from patient-completed MAMs ($p = .5$)

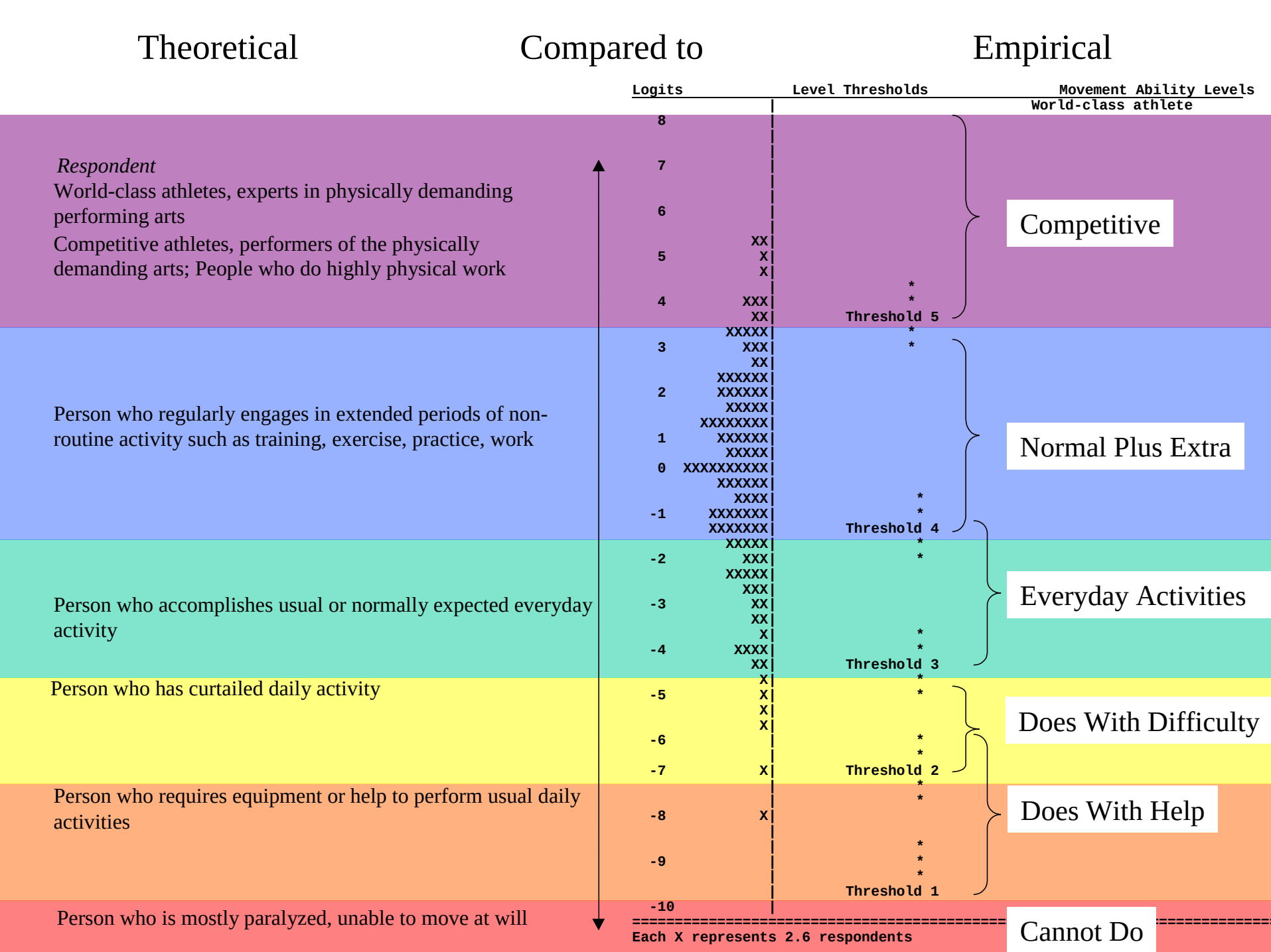
Evidence of Responsiveness

Comparing initial and discharge MAMs from patients undergoing physical therapy:

- effect size = .89 (average gain = 2.40 logits)
- power > 95%
- minimal clinically important difference = .29 logits (= 3 to 5 raw score points out of 144)
- criterion: gains significantly higher for those judged to have completely successful vs. partially successful therapy (difference in gains = 1.5 logits)

Revelations About the Movement Continuum Theory

- A multi-dimensional model using the proposed six dimensions fit the data better than a unidimensional model.
- Movement problems were associated with lower perceived movement ability.
- With physical therapy, the MAM showed a gain in perception of movement ability.


Theoretical
Compared to
Empirical
Logits
Level Thresholds
Movement Ability Levels
World-class athlete
Respondent
World-class athletes, experts in physically demanding performing arts
Competitive athletes, performers of the physically demanding arts; People who do highly physical work
Person who regularly engages in extended periods of non-routine activity such as training, exercise, practice, work
Person who accomplishes usual or normally expected everyday activity
Person who has curtailed daily activity
Person who requires equipment or help to perform usual daily activities
Person who is mostly paralyzed, unable to move at will
8
7
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
Threshold 5
Threshold 4
Threshold 3
Threshold 2
Threshold 1
Each X represents 2.6 respondents
Competitive
Normal Plus Extra
Everyday Activities
Does With Difficulty
Does With Help
Cannot Do

Conclusion

- Movement can be thought of in six dimensions.
- Principles of the Movement Continuum Theory have support.
- The MAM has potential for testing self-perception of movement.
- IRM facilitated close connection between theory, construct, and instrument.

Primary References

Wilson, M. (2005). *Constructing Measures: An Item Response Modeling Approach.* Mahwah, NJ: Erlbaum.

Cott, C. A., Finch, E., Gasner, D., Yoshida, K., Thomas, S. G., & Verrier, M. C. M. (1995). The movement continuum theory of physical therapy. *Physiotherapy Canada*, *47*, 87-95.