The Psychometric Development Process of Recovery Measures and Markers: Classical Test Theory and Item Response Theory

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Presentation Overview

- Warning: We have a wealth of data to discuss

Overview:

- Recovery evaluation at MHCD
- This presentation will focus on process of development of two measurement tools, including advantages and limitation of psychometric methodologies:
  - 1st Classical Test Theory
  - 2nd Rasch Models in IRT
  - 3rd Additional Models in IRT
- How many of you have used Item Response Theory, or have a background knowledge of how it works?

Comparison of CTT and IRT (Hambleton, Swaminathan, Roger, 1991)

Classical Test Theory (CTT)

- **Item characteristics are sample and test dependent**
- Items are commonly at an equal level of the trait
- Reliability and assumption of parallel test-difficulty to obtain
- Equal standard error for all participants

Item Response Theory (IRT)

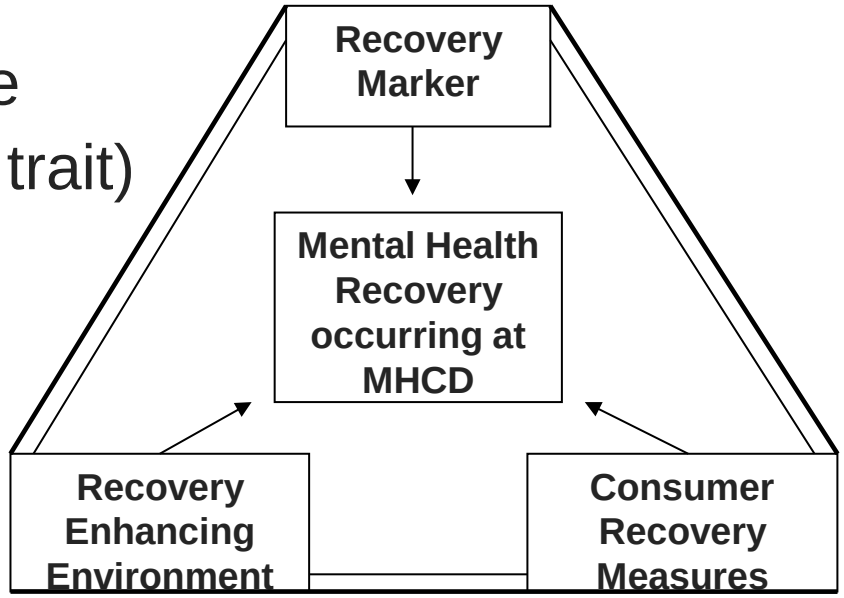
- **Separation of item parameters and participants ability**
- Items are monotonically increasing in the latent trait
- Assumptions of unidimensionality & local independence
- Multiple models (1PL, 2PL & 3PL)

Models of CTT and IRT

- CTT has a single model
- IRT includes a collection of models (validity issues in model selection)
  - **IPL** (Rasch Models) N=100's
    - Difficulty parameters
  - **2PL** N= 1,000's
    - Difficulty and item discrimination parameters
  - **3PL** N= 10,000's
    - Difficulty, item discrimination, & pseudo guessing parameters

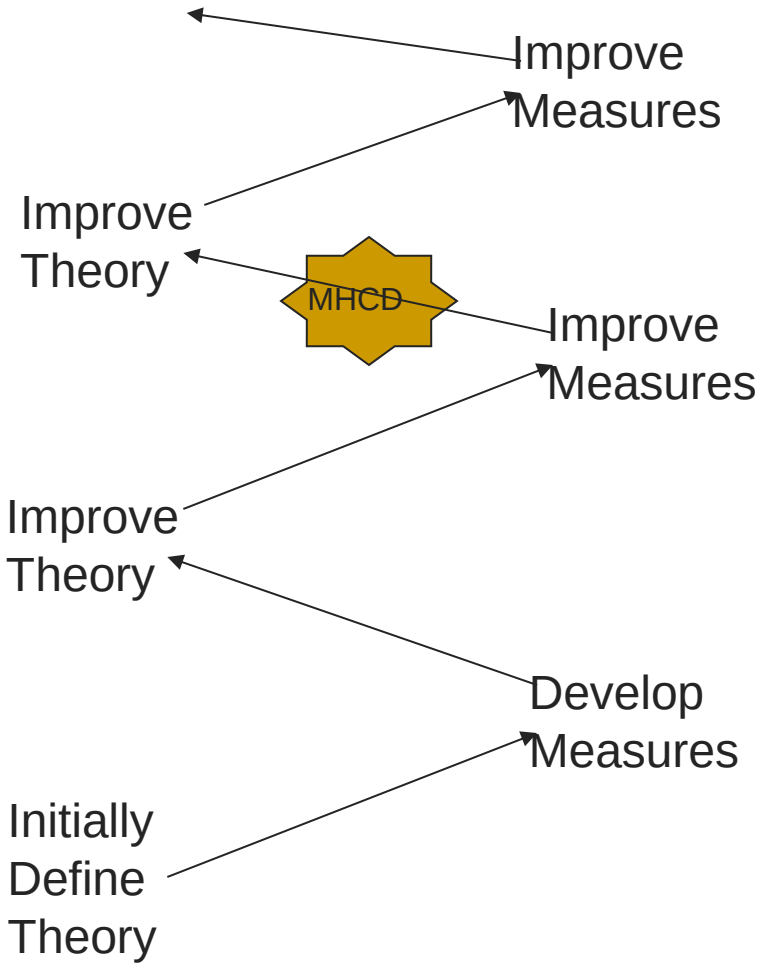
Measurement Approach at MHCD

- The Mental Health Center of Denver is large, non-profit community-based mental health center providing services for adults, children and families
  - In the Evaluation and Research Department, we hold the assumption that we fit data to match a model (data driven)
- We are in process of creating measurement tools to evaluate mental health recovery (latent trait) in adult consumers, using 3 measures:
  - Consumer Recovery Measures
  - Recovery Markers
  - Recovery Enhancing Environment



Theory and Measurement

- The relationship between theory and measurement is critical for **latent constructs** to be able to provide a feedback loop for quality improvement
- Measurement revised the underlying constructs of a theory which, in turn, revises the measurement tool
- Continuous Process



Example 1: Consumer Recovery Measures

Consumer Name	Client, Test J.	**ID #**	999999	**Team**	805
Birth Date	12/01/1936	**Psychiatry Only**	Y	**Age**	69

Consumer Recovery Measure

Assessment Date 05/09/2006 ?

Select the answer that best descibes how you feel

How are you feeling today?	A little worse than usual
Lately I feel like I've been making important contributions.	Basically agree
I have hope for the future.	Basically disagree
I am reaching my goals.	Strongly agree
I have this feeling things are going to be just fine.	Strongly disagree
Recently my life has felt meaningful.	Basically agree
Recently I have been motivated to try new things.	Basically disagree
There are some people who cause me a lot of fear.	Strongly agree
I get a lot of support during the hard times.	Strongly disagree
In most situations, I feel totally safe.	Basically agree
My life is often disrupted by my symptoms.	Basically disagree
Sometimes I'm afraid someone might hurt me.	Strongly agree
I have people in my life I can really count on.	Strongly disagree
Life's pressures lead me to lose control.	Basically agree
I have friends or family I really like.	Strongly agree
My symptoms interfere less and less with my life.	Strongly agree
When my symptoms occur, I am able to manage them without falling apart.	Strongly disagree

Beginning the Psychometric Process: Classical Test Theory

- Conducted an Exploratory Factor analysis which revealed 5 factors and explained approximately 57% of the variance
- Conducted Cronbach's alpha reliability analysis
  - Active/growth orientation (α = .67)
  - Hope (α = .77)
  - Symptom Interference (α = .88)
  - Safety (α = .72)
  - Social Network (α = .63)
- Total Scale = .88

What would we think of this scale based on this analysis?

Step 2: Rasch Modeling Rating Scale Model (1PL)

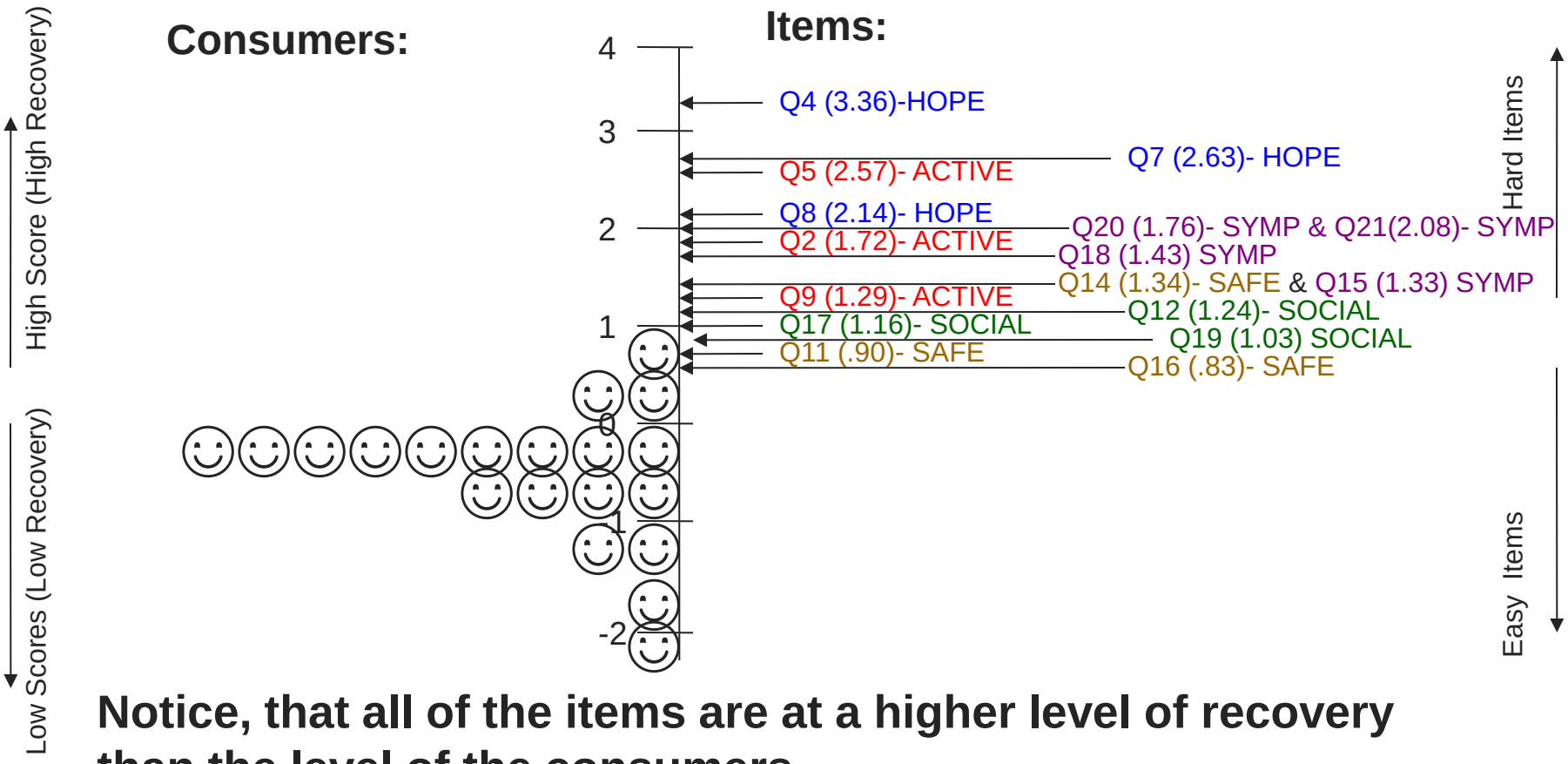
In IRT, a validity issue is selecting a model that is appropriate for your data. Most commonly, you begin with the most simplest model (Rasch Model) and if it fits, you can stop, if not you can try a more complicated model. (some people do not agree with this concept)

For example, our data is a Likert-type scale so we used a Rasch Rating Scale Model, which produced the following reliabilities:

Domain	Number of items	Marginal Reliability (IRT)
Active	3	.754
Hope	3	.783
Symptom	4	.841
Safe	3	.724
Social	3	.750
Total CRM	16	.916

Again, the IRT analysis both produce acceptable reliabilities, but…

Additional Information Provided by Rasch Rating Scale Model (IRT): Item Person Map



Notice, that all of the items are at a higher level of recovery than the level of the consumers

Now, What is our psychometric interpretation of the scale?

Comparison of CTT and IRT results for Example 1

- By only reviewing the CTT analysis the psychometrics seemed fine
- With the additional information provided by the Rasch model we understand that our questions are too difficult for our sample,
- Therefore, we need to create more items that display less recovery (to measure small changes)

Example 2: Recovery Markers

- Indicators usually associated with individual's recovery, but are not necessary for recovery
- Includes 6 dimensions with varying response sets:
  - Employment (8 response categories)
  - Education/Training (7 response categories)
  - Active/Growth orientation (6 response categories)
  - Symptom Interference (5 response categories)
  - Housing * (9 response categories)
  - Engagement/role with service provider (6 response categories)
  - Substance Abuse- level of use (6 response categories)
  - Substance Abuse- level of change* (5 response categories)

Consumer Name	Client, Test T.		**ID #**	999999	**Sex**
Birth Date	12/08/1944		**Psychiatry Only**		**Age**

Recovery Markers - Page 1 - Employment

Name Client Test

Date of Report 05/05/2005 ?

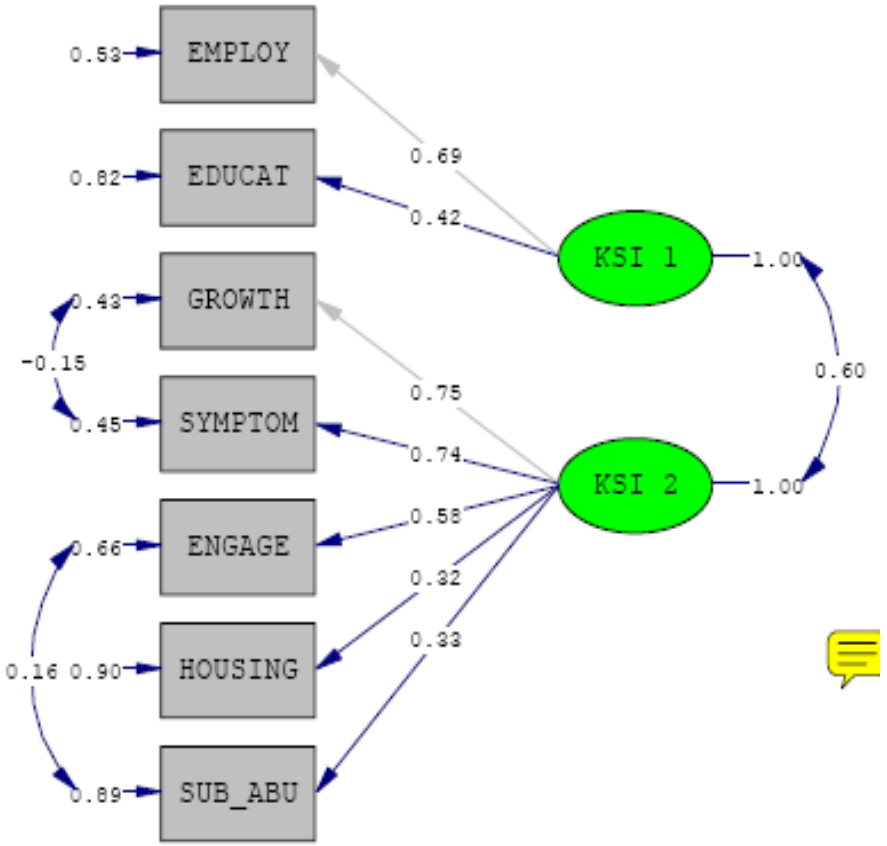
Please rate where the person is at on the specified date (e.g. March 1) based on evidence from self-report, interviews, behavioral observations, and/or outside reports (e.g. family or friends).
On each page select only one choice per category.

Employment

- (•) A - No interest in work
- ( ) B - Interest in work, no action
- ( ) C - Active job search
- ( ) D - Non-paid work/volunteer
- ( ) E - Part-time supported
- ( ) F - Full-time supported
- ( ) G - Part-time independent
- ( ) H - Full-time independent
- ( ) I - Retired
- ( ) J - Care giving role
- ( ) K - Unknown

Choose A - no interest in working
Choose B - talks about wanting to get a job but no action yet
Choose C - e.g. filling out applications, learning job skills
Choose D - any regular (e.g. weekly) non-paid work role
Choose E - 30 hours or less paid employment (currently enrolled in SE program)
Choose F - more than 30 hours paid employment (currently enrolled in SE program)
Choose G - 30 hours or less paid employment (independent)
Choose H - More than 30 hours paid employment (independent)
Choose I - 60 years or older and chooses not to work. Do not include unemployment due to extreme disability
Choose J - Cares for a child or family member at least 20 hours per week
Choose K - Not enough information to rate at this time

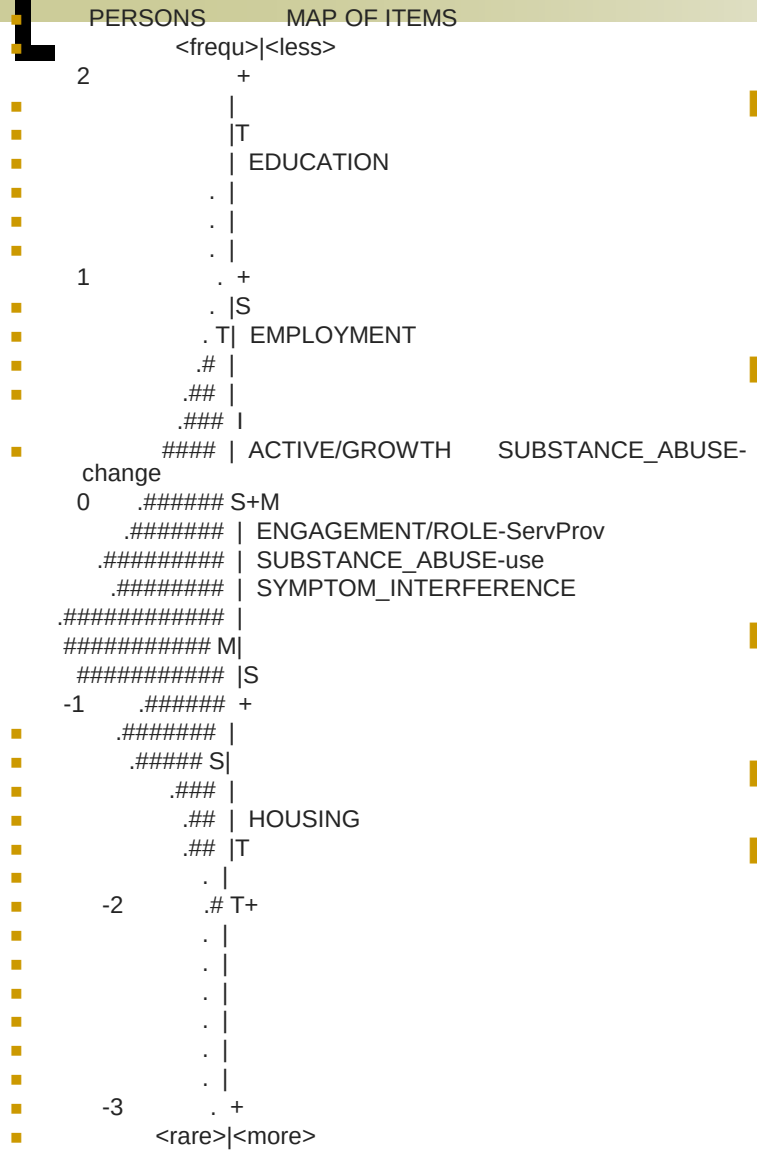
Step 1: CTT Reliability and Factor Analysis



- Internal Reliability estimated Cronbach's alpha = .67
- An experimental factor analysis revealed 1 factors
- A confirmatory factor analysis was conducted on the 1 factor solution
  - $x^2(11)=26.98$, $p=.005$
  - RMSEA = .043

This analysis told us that the scale was not working well, but did not explain why it was not working

Step 2: Partial Credit Rasch Model

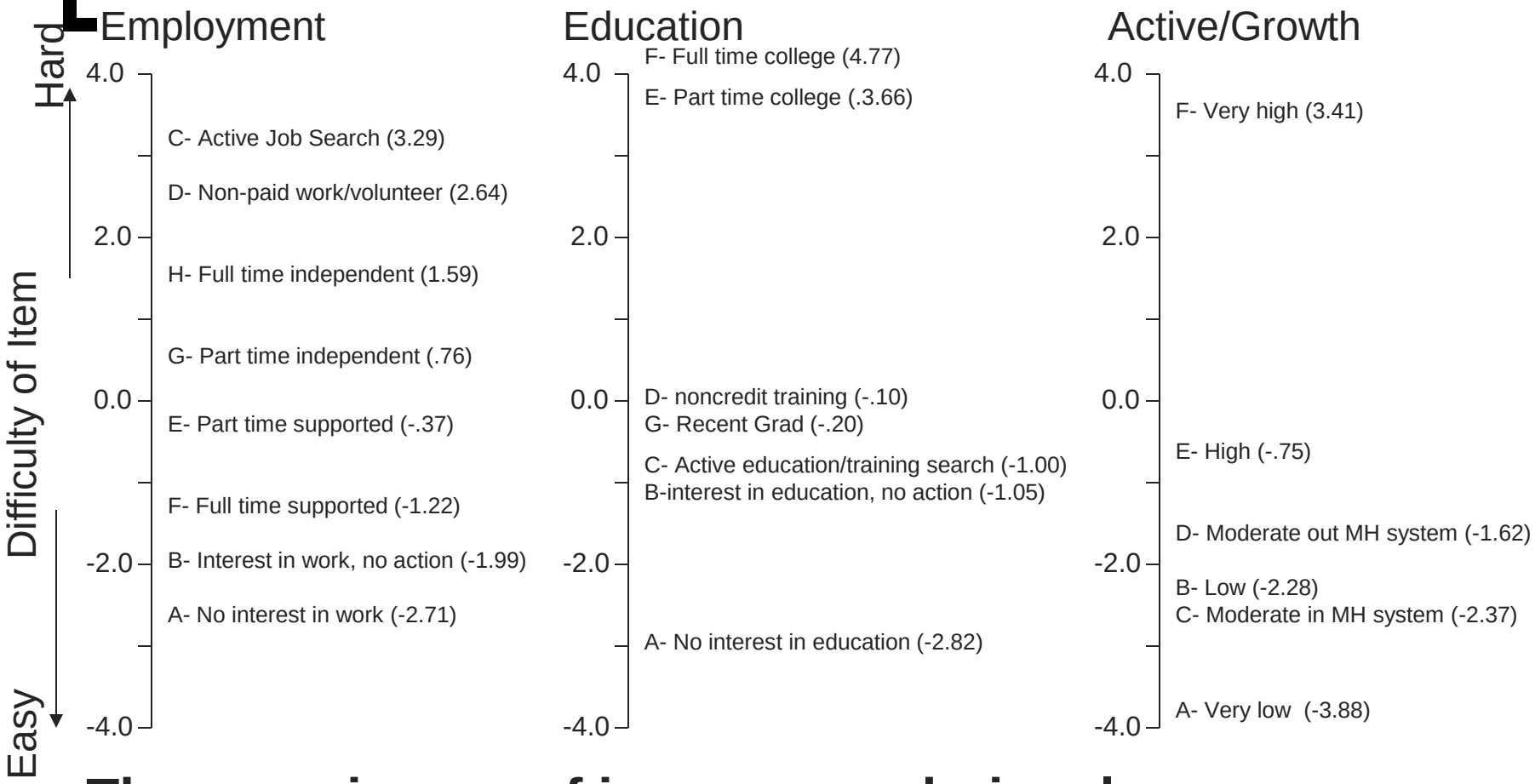


- Index suggesting good model fit for persons
  - -Mean Square Infit = .99
  - -Mean Square Outfit =1.0
- Index suggesting moderate model fit for items
  - -Mean Square Infit = 1.06
  - -Mean Square Outfit =1.03
- Education & Employment are too difficult for the sample
- Housing is the easiest item
- Big gaps with no items measuring the majority of participants

Step 3: Nominal Response Model

- The Nominal Response model is based off of the 2 PL requiring more participants (1,000's)
- Allows us to view the order of the responses within an item, to make sure they are ordered
- We can change the response categories to make sure that they are ordered in terms of difficulty

Example of Nominal Output



There are issues of improper ordering, large gaps, where there are not responses & clumps of responses

Review of Psychometric Process

- 1st CTT analysis
  - determine reliability
- 2nd Rasch modeling
  - determine model fit (reliability), participants ability level & item difficulty
- 3rd Nominal Model
  - Determine model fit (reliability) and ordering of responses within items
- As you increase the complexity of the measurement model, you also increase the required assumptions

Lessons Learned

- Requires time to educate yourself, critical to use appropriate model for your data
- In IRT literature be prepared to read conflicting pieces of information regarding model use (Rasch vs. IRT)
- If you have stakeholders that want to be involved in the analysis, be prepared to example concepts (i.e. IQ)
- Sample size requirements
- Have resource to conduct analysis, stakeholder buy in
  - Purchase software (winstep, bilog, etc..)
  - Computer memory (Maximum Likelihood estimation)

Take home Message

- IRT is beneficial and allows you to see more aspects of measurement than in CTT alone
- As we increase our understanding with IRT, we also increase our assumptions
- Measurement is a critical step in evaluation
- Regardless of which method you use, understanding the benefits and limitations of your measurement model will help to interpret your data

Questions ???

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