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Examining Differential Item Functioning (DIF) by Educational Attainment on Measures of Depression

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Background

- Depression commonly occurs and is a public health concern
  - 29.9% lifetime risk for US adults (Kessler et al., 2012)
- Individuals with lower levels of education face, on average, more social and economic challenges
- Individuals with lower educational attainment and depression education are vulnerable on multiple levels
- Effective treatment for this population begins with accurate and appropriate assessment tools

Differential Item Functioning (DIF)

DIF exists when there is a difference in the strength of the relationship between a questionnaire item and a concept across groups

Previous Research on DIF by Education

- Most DIF by education studies have been done on the Mini-Mental State Exam and have found significant DIF on 4-5 items
  - Mini-Mental State Exam shows DIF by education
  - (Murden et al., 1991; Ramirez et al., 2006; Jones & Gallo, 2002; Crane et al., 2006)

- Little to no DIF by education found on Mattis Dementia Rating Scale
  - 4 items problematic, only 1 showed any large effect (digit span backwards)
  - (Teresi et al., 2000)

- PROMIS Depression scale showed DIF on 3 items
  - DIF by gender, age, and education
  - Small effect overall, large effect for some individuals
  - (Teresi et al., 2009)

Study Method

- Secondary data analysis of data from a study linking PROMIS to legacy measures of depression
- 3 internet panel samples (for details see Choi et al., 2014)
  - **PROMIS 1 Wave 1**: recruited by Polimetrix online
  - **NIH Toolbox calibration**: recruited by Greenfield Online
  - **PROsetta Stone**: recruited by Op4G

Participants

- NIH Toolbox (*N* = 748)
  - Age: 18 – 92 years, *mean* = 47
  - 56% female
  - 78% White, 9% Black
- PROMIS 1 Wave 1 (*N* = 744)
  - Age: 18 – 88 years, *mean* = 51
  - 52% female
  - 80% White, 10% Black
- PROsetta Stone (*N* = 1104)
  - Age: 18 – 88 years, *mean* = 46
  - 52% female
  - 72% White, 11% Black

	NIH Toolbox N = 748	PROMIS 1 Wave 1 N = 744	PROsetta Stone N = 1104
Age, Mean (SD)	47.2 (15.2)	51.0 (18.8)	46.3 (17.5)
Gender, N (%)			
Male	328 (44)	357 (48)	528 (48)
Female	420 (56)	386 (52)	576 (52)
Missing	0 (0)	1 (<1)	0 (0)
Education, N (%)			
High school or less	205 (27)	171 (23)	465 (42)
Some college or technical school	326 (44)	334 (45)	305 (28)
College graduate or above	217 (29)	239 (32)	334 (30)
Missing	0 (0)	0 (0)	0 (0)
Ethnicity, N (%)			
Non-Hispanic or Non-Latinx	634 (85)	670 (90)	929 (84)
Hispanic or Latinx	114 (15)	70 (9)	175 (16)
Missing	0 (0)	4 (1)	0 (0)
Race, N (%)			
White or Caucasian	585 (78)	592 (80)	793 (72)
Black or African American	67 (9)	72 (10)	124 (11)
Asian	16 (2)	3 (<1)	58 (5)
American Indian or Alaska Native	13 (2)	6 (<1)	7 (1)
Native Hawaiian or Pacific Islander	5 (1)	0 (0)	7 (1)
Biracial or Multiracial	16 (2)	71 (10)	33 (3)
Other	46 (6)	N/A	82 (7)
Missing	0 (0)	0 (0)	0 (0)

Measures

	PROMIS Depression (Cella et al., 2010)	BDI-II (Beck et al., 1996)	PHQ-9 (Kroenke et al., 2001)	CES-D (Radloff, 1977)
NIH Toolbox Calibration	✓ (20 items)		✓	✓
PROMIS 1 Wave 1	✓ (28 items)			✓
PROsetta Stone	✓ (15 items)	✓		

Hypothesis

DIF will be observed across levels of educational attainment for complex items on legacy measures of depression (BDI-II, CES-D, PHQ-9)

Analytical Strategy

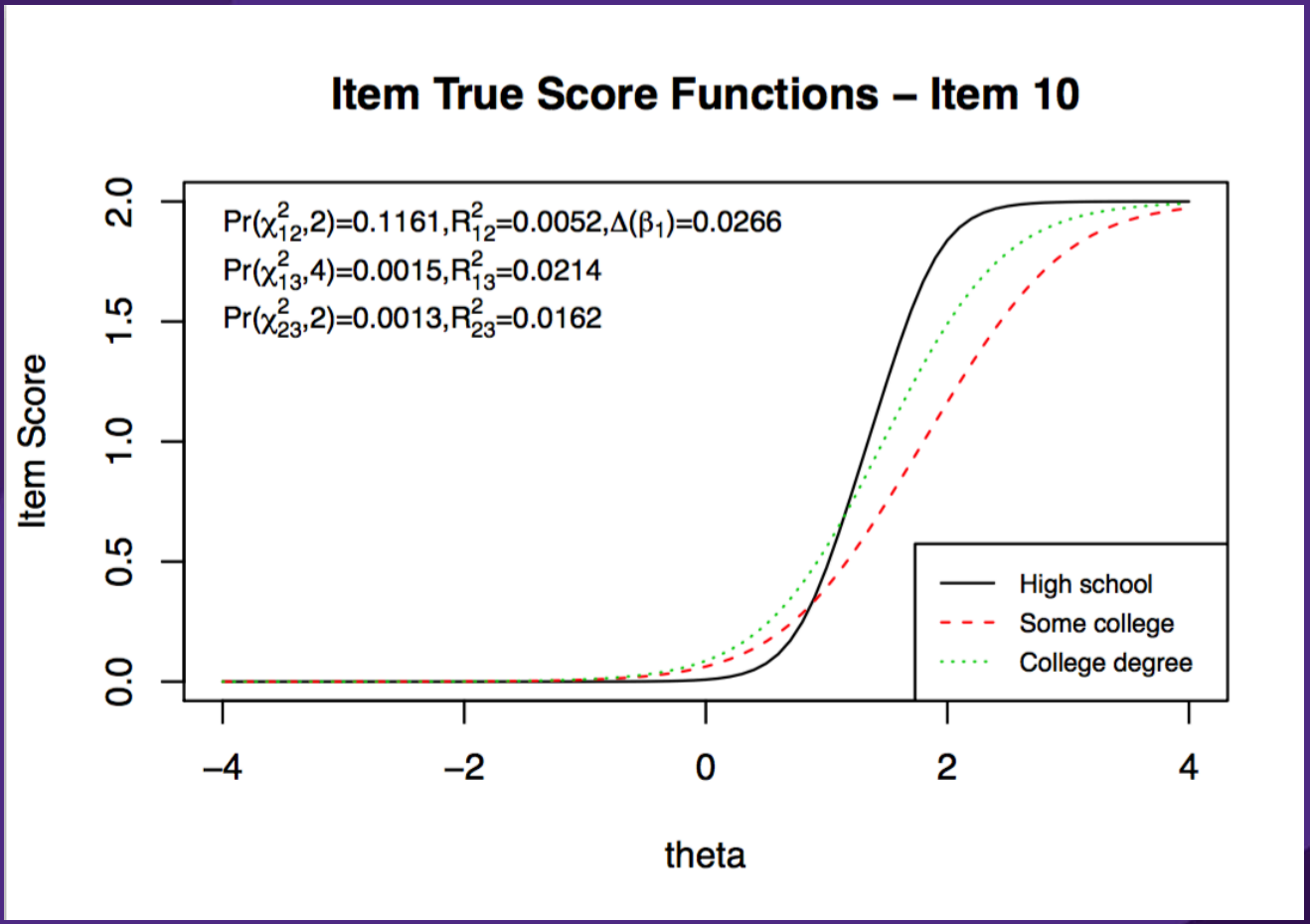
- Educational attainment 3 groups provided most accurate information
  - High school or less, some college or technical school, college graduate or above
- McFadden's pseudo R^2 as cutoff for flagging items for DIF
  - Different cutoffs chosen for each sample and measure
  - Effect size of DIF

DIF Cutoffs

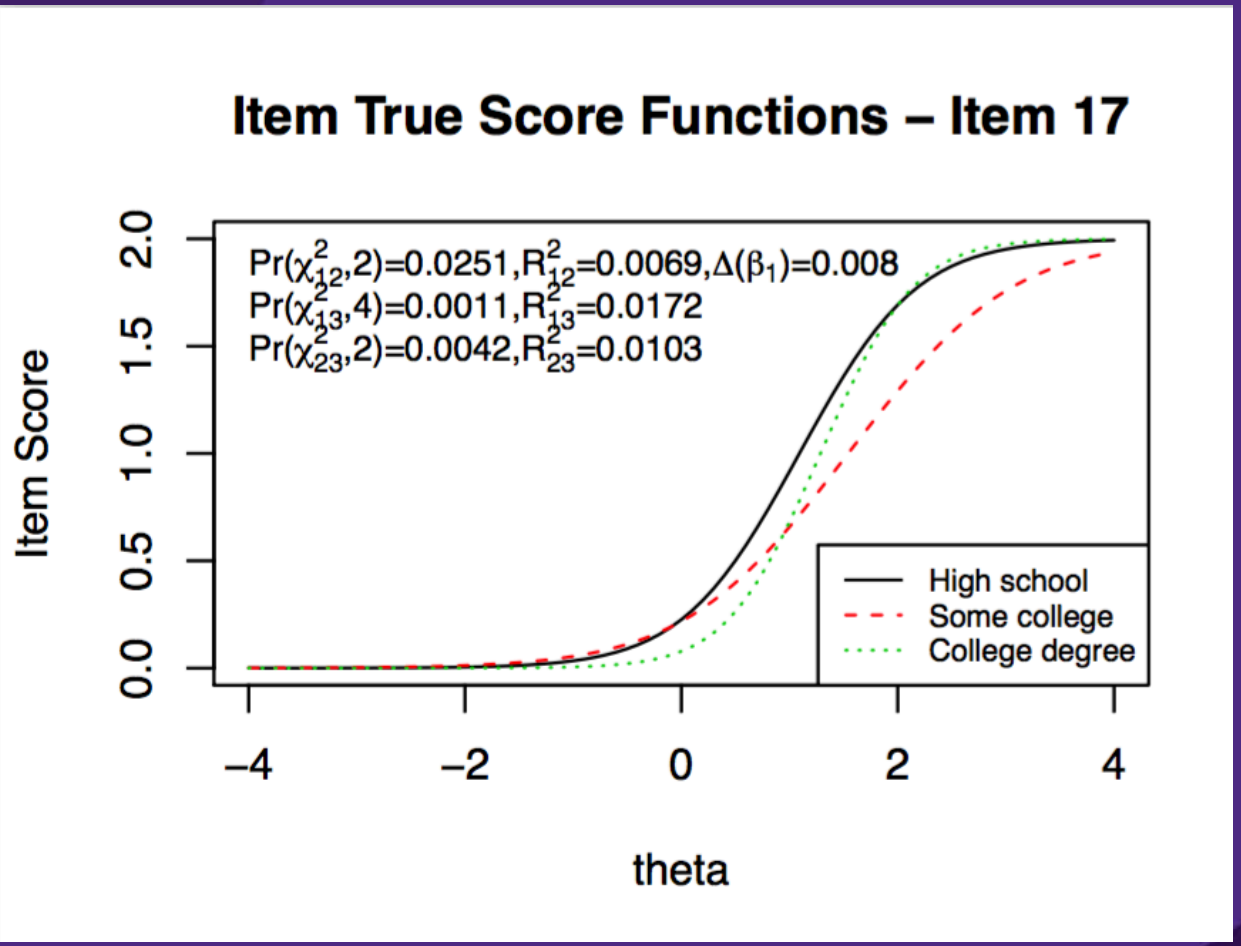
- NIH Toolbox
  - CES-D: R^2 = .01
  - PHQ-9: R^2 = .004
  - PROMIS Depression (20 items): R^2 = .009
- PROMIS 1 Wave 1
  - CES-D: R^2 = .008
  - PROMIS Depression (28 items): R^2 = .007
- PROsetta Stone
  - BDI: R^2 = .01
  - PROMIS Depression (15 items): R^2 = .008

DIF Results

	PROMIS Depression	BDI-II	PHQ-9	CES-D
NIH Toolbox Calibration	**1** .01		**2** .005, .007	**1** **.017**
PROMIS 1 Wave 1	**4** .009, .008, .009, .01			**5** .011, .013, **.022**, .011, .013
PROsetta Stone	**4** **.02**, .011, .013, .008	**1** .012		



CESD Item 10:
I felt fearful



CESD Item 17: I had crying spells

Readability Statistics

- Flesch Kincaid
  = *(0.39 * Average Words/Sentence) + (11.8 * Average Syllables/Word)*
- Gunning Fog Index
  = *0.4 (Average Words/Sentence + Percentage of 'Hard' Words)*
- Coleman Liau
  = *0.0588* Letters/100words – sentences/100 words*
- SMOG
  = *3 + sqrt(# of polysyllabic words)*
- Automated Readability Index
  = *4.71(Characters/Word) + 0.5 (Words/Sentences) – 21.43*
- Average Grade Level
  = *average of the above scores*

Readability Findings

Measure	Flesch Kincaid	Gunning Fog Index	Coleman Liau	SMOG	Automated Readability Index	Average Grade Level
BDI-II	3.8	7.0	3.2	8.2	0	4.4
CES-D	2.0	4.7	2.5	6.4	0	3.1
PHQ-9	5.6	7.4	8.8	8.4	5	7.0
PROMIS Depression 15	1.5	4.5	3.1	6.0	0	3.0
PROMIS Depression 20	2.0	4.9	3.9	6.4	1	3.6
PROMIS Depression 28	1.9	4.8	3.2	6.1	0	3.2

Conclusions

- All measures displayed DIF by education for at least one item
  - Hypothesis partially correct
  - PROMIS items also flagged for DIF
  - Overall, found *higher* item slopes for people with high school education or below
- Level of education needs to be considered during development and administration of instruments measuring depression
- DIF is a useful tool to indicate which items may be more difficult for individuals with lower educational attainment

Clinical Implications

- Measures studied are widely used in clinical settings
- Inaccurate assessment of depressive symptoms in patients with lower educational attainment

→ clinical interview → diagnosis → treatment

Limitations and Future Directions

- Limitations:
  - Internet based samples
  - Number of PROMIS items not consistent across samples
- Going forward closely examine IRT parameters for each item among items flagged
- Explore other methods for analyzing DIF

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