Rasch-scaling of PHQ-9 and GAD-7
Consequences for repeated assessments

Jan R. Böhnke & Jaime Delgadillo

H·Y·M·S
THE HULL YORK MEDICAL SCHOOL

Improving Access to Psychological Therapies

"Improving Access to Psychological Therapies is an NHS programme rolling out services across England offering interventions approved by the National Institute of Health and Clinical Excellence (NICE) for treating people with depression and anxiety disorders."

(http://www.iapt.nhs.uk/)

IAPT in Numbers

- End of 2012: One million patients treated

- Last documented quarter (07-09/2014):
  - 151 services across country completely up and running (HSCIC web transfer)
  - 300,000 new referrals
    - 200,000 entered treatment
  - 280,000 ended treatment
  - 61% of all referrals entering treatment "improved reliably"

http://www.hscic.gov.uk

Monitoring in IAPT

"Routine outcomes measurement is central to improving service quality - and accountability"

(http://www.iapt.nhs.uk/)

Monitoring in IAPT

IAPT uses two core instruments

- PHQ-9 to assess severity of depression
- GAD-7 to assess severity of anxiety

- Both instruments use the same response format:
  - 0 = not at all
  - 1 = several days
  - 2 = more than half the days
  - 3 = nearly everyday

Kroenke, Spitzer, & Williams (2001). *Journal of General Internal Medicine*, *16*, 606 – 613.
Spitzer, Kroenke, Williams & Löwe (2006). *Archives of Internal Medicine*, *166*, 1092–1097.

Monitoring in IAPT: PHQ-9

Over the last two weeks, how often have you been bothered by any of the following problems?
Little interest or pleasure in doing things?
Feeling down, depressed, or hopeless?
Trouble falling or staying asleep, or sleeping too much?
Feeling tired or having little energy?
Poor appetite or overeating?
Feeling bad about yourself - or that you are a failure or have let yourself or your family down?
Trouble concentrating on things, such as reading the newspaper or watching television?
Moving or speaking so slowly that other people could have noticed? Or the opposite - being so fidgety or restless that you have been moving around a lot more than usual?
Thoughts that you would be better off dead, or of hurting yourself in some way?

Monitoring in IAPT: GAD-7

Over the last two weeks, how often have you been bothered by any of the following problems?
Feeling nervous, anxious or on edge?
Not being able to stop or control worrying?
Worrying too much about different things?
Trouble relaxing?
Being so restless that it is hard to sit still?
Becoming easily annoyed or irritable?
Feeling afraid as if something awful might happen?

Different Instruments? Different Constructs?

- Do different patient reported outcome measures (PROMs) *actually* assess different constructs?
- Rather they seem to address one factor...
  - "General psychological distress"
- ...and only very little additional variation specific to different instruments

Reininghaus & Priebe (2012). *British Journal of Psychiatry*, *201*(4), 262–267.
Caspi, et al. (2014). *Clinical Psychological Science*, *2*, 119–137.

Different Instruments? Different Constructs?

- Instruments in IAPT:
  - Leeds Community Healthcare NHS Trust
  - Patients from 2008 to 2010
  - *N* = 13,390
    - *n* = 11,393 provided responses to at least three items

- Available diagnoses
  - Depression: *N* = 2,547
  - Mixed anxiety and depression: *N* = 2,098
  - Generalised anxiety & anxiety disorders: *N* = 1,822
  - *n* = 2,851: panic disorder, obsessive compulsive disorder, post-traumatic stress disorder, social anxiety, specific phobias, ...
  - *n* = 2,621 NOS

Böhnke, Lutz & Delgadillo (2014). *Journal of Affective Disorders*, *166*, 270–278.

Different Instruments? Different Constructs?

- Bifactor IRT modelling revealed that one factor explained most of the variance observed in three instruments
  - (PHQ-9, GAD-7, WSAS)

  - ω_H = .88
  - ω = .96
    - PHQ-9: ω = .92, ω_S = .05
    - GAD-7: ω = .92, ω_S = .27
    - WSAS: ω = .83, ω_S = .37

Böhnke, Lutz & Delgadillo (2014). *Journal of Affective Disorders*, *166*, 270–278.
Reise, Bonifay & Haviland (2013). *Journal of Personality Assessment*, *95*, 129–140.

New Question...

Since the PHQ-9 and the GAD-7 seem to be so similar: Can they be Rasch-scaled?

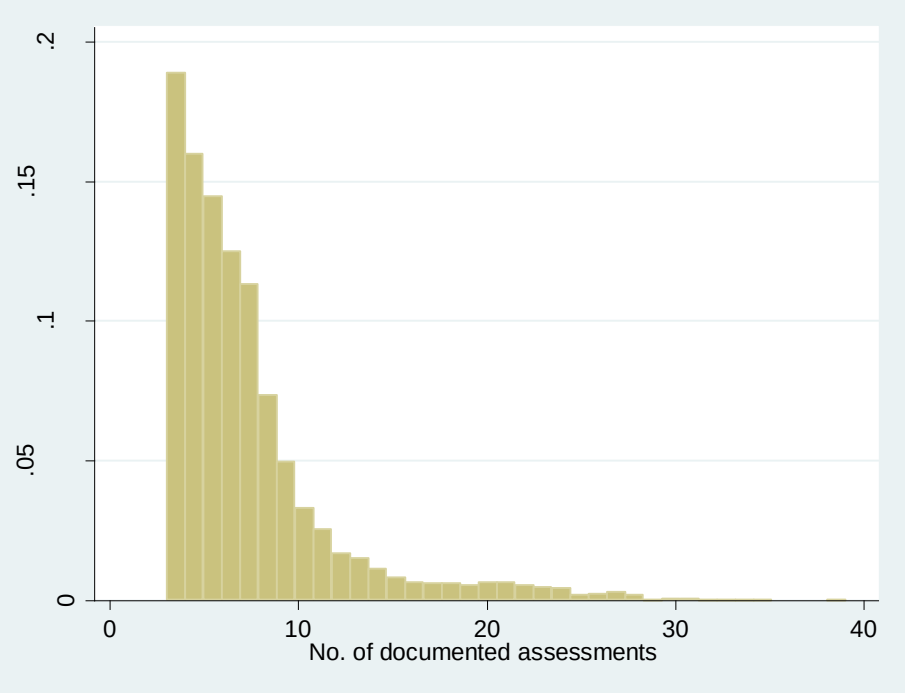
Bohnke & Lutz (2014). Using item and test information to optimize targeted assessments of psychological distress. *Assessment*, *21*, 679–693.

METHODS

Sample

- *N* = 6244 assessments
  - *N* = 5879 screenings
  - *N* = 5652 last assessments

- Follow-up data
  - Last assessment of every case...
  - ...with three documented assessments
  - ...and three item responses across the two instruments



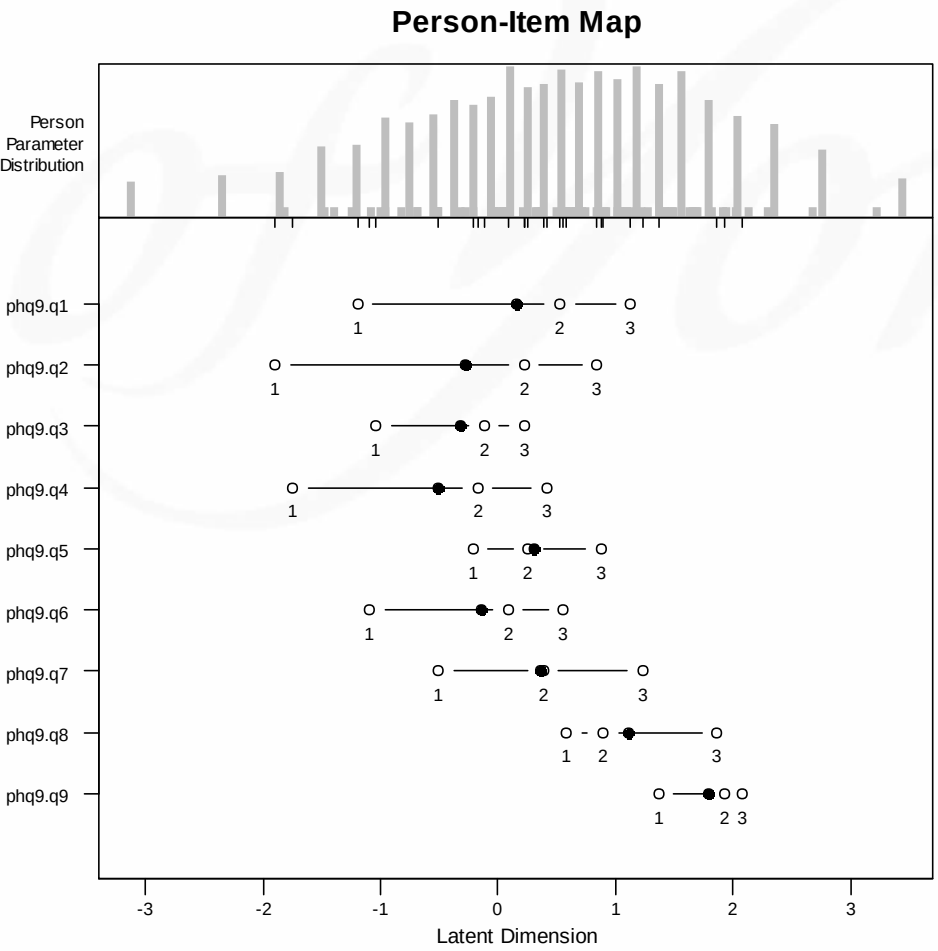
R Packages Used

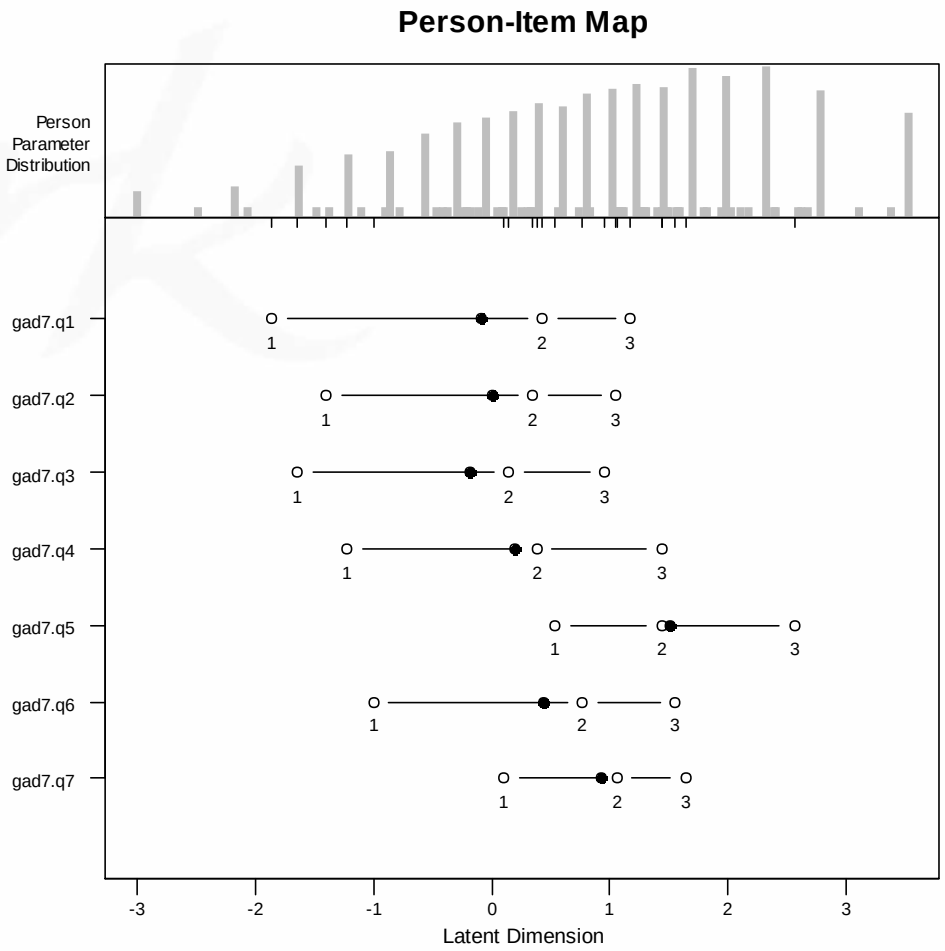
- Thomas Kiefer, Alexander Robitzsch and Margaret Wu (2015). **TAM**: Test Analysis Modules. R package version 1.5-2.
- Alexander Robitzsch (2015). **sirt**: Supplementary Item Response Theory Models. R package version 1.5-0.

- Mair, P., & Hatzinger, R. (2007). Extended Rasch modeling: The **eRm** package for the application of IRT models in R. *Journal of Statistical Software*, *20*(9), 1-20

RESULTS

Single Scale Analyses: PHQ-9 & GAD-7





Single Scale Analyses: PHQ-9 & GAD-7

- Item fit statistics for single scales:

	OUTFIT	INFIT
phq9_q1	.810	.809
phq9_q2	.670	.691
phq9_q3	1.049	1.022
phq9_q4	.854	.873
phq9_q5	1.057	1.032
phq9_q6	.884	.895
phq9_q7	.912	.914
phq9_q8	1.107	1.079
phq9_q9	.934	1.002

	OUTFIT	INFIT
gad7_q1	.869	.862
gad7_q2	.605	.631
gad7_q3	.614	.630
gad7_q4	.761	.773
gad7_q5	1.027	1.037
gad7_q6	1.273	1.242
gad7_q7	1.083	1.076

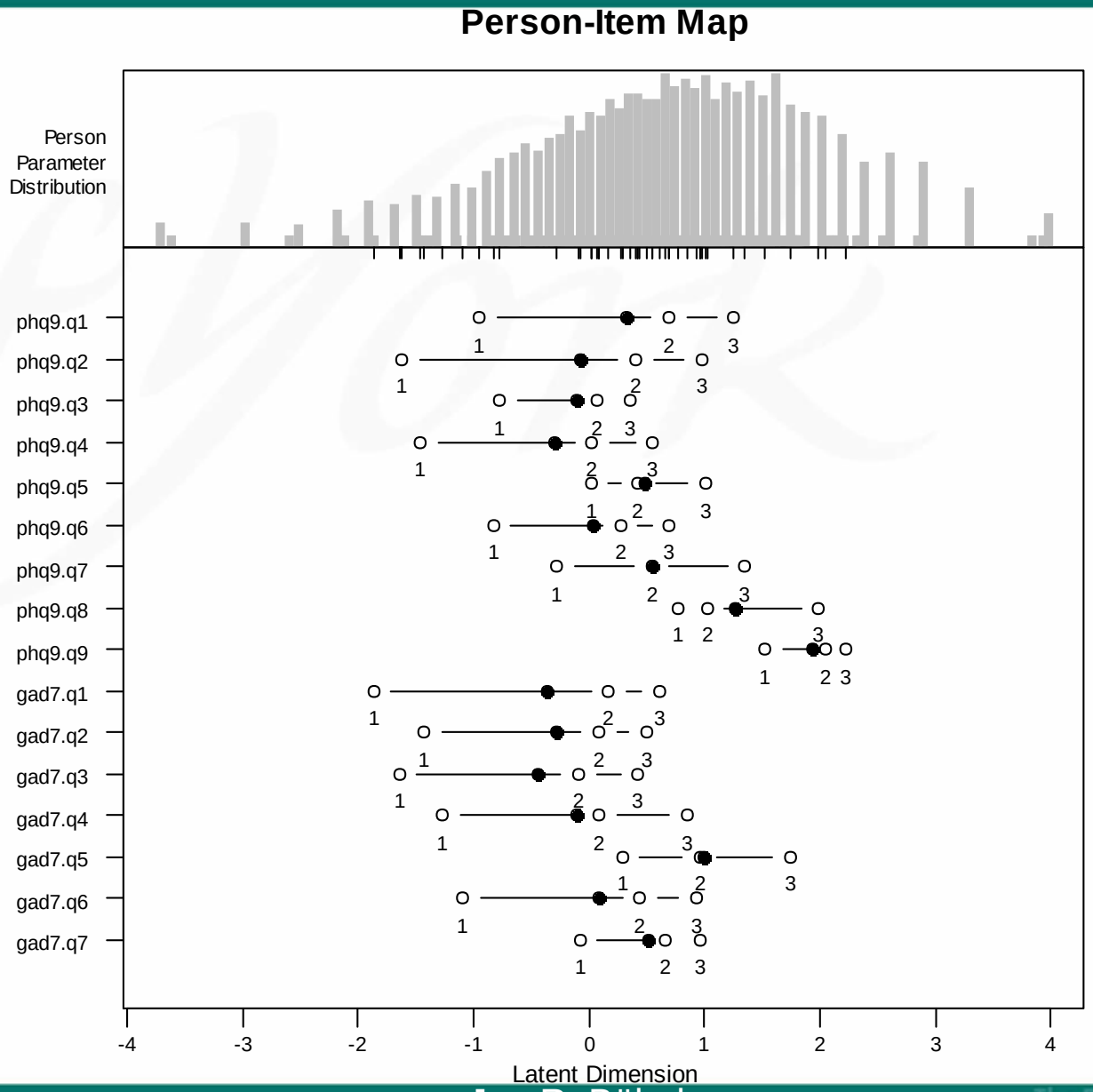
Single Scale Analyses: PHQ-9 & GAD-7

- Expectation of person fit vs. empirical

$X^2_{(df=1)}$ =	PHQ alone (Outfit / Infit)	GAD alone (Outfit / Infit)
1.00 (1-*D* = .317)	.305 / .331	.286 / .283
1.30 (1-*D* = .254)	.175 / .195	.166 / .185
2.71 (1-*D* = .100)	.016 / .012	.010 / .011
3.84 (1-*D* = .050)	.002 / .000	.002 / .001

MULTIPLE INSTRUMENTS SINGLE DIMENSION

Unidimensional Rasch Model



Unidimensional Rasch Model

- Item fit statistics for both instruments together

	OUTFIT	INFIT
phq9_q1	.913	.908
phq9_q2	.721	.749
phq9_q3	1.211	1.142
phq9_q4	.971	.983
phq9_q5	1.222	1.165
phq9_q6	.922	.924
phq9_q7	.925	.938
phq9_q8	1.021	1.026
phq9_q9	1.090	1.142
gad7_q1	.898	.925
gad7_q2	.742	.778
gad7_q3	.730	.770
gad7_q4	.765	.788
gad7_q5	.985	.995
gad7_q6	1.096	1.065
gad7_q7	1.156	1.130

Unidimensional Rasch Model

$X^2_{(df=1)}$ =	PHQ (Outfit / Infit)	GAD (Outfit / Infit)	GAD & PHQ (Outfit / Infit)
1.00 (1-D = .317)	.305 / .331	.286 / .283	.357 / .389
1.30 (1-D = .254)	.175 / .195	.166 / .185	.189 / .206
2.71 (1-D = .100)	.016 / .012	.010 / .011	.006 / .004
3.84 (1-D = .050)	.002 / .000	.002 / .001	.001 / .000

ASSESSMENT OF CHANGE

Change Evaluation in IAPT

- In the IAPT documentation we find the following criteria to mark a "reliable" improvement/deterioration:
  - PHQ: 6 score points between assessments
  - GAD: 4 score points between assessments

- Given the reliability of the instrument...
  - ...only in 2.5% of test score differences
  - we would see one more positive (more negative)

Clark & Oates (2014). *Improving Access to Psychological Therapies: Measuring improvement and recovery adult services - Version 2*. NHS England. Retrieved from http://www.iapt.nhs.uk/silo/files/measuring-recovery-2014.pdf
Jacobson, N. S., & Truax, P. (1991). *Journal of Consulting and Clinical Psychology*, *59*, 12–19.

Change on Score Level

PHQ-9

	N	Percent
Reliable deterioration	276	4.42
No change	2859	45.79
Reliably improved	3109	49.79

GAD-7

	N	Percent
Reliable deterioration	211	3.38
No change	2202	35.27
Reliably improved	3831	61.35

Together

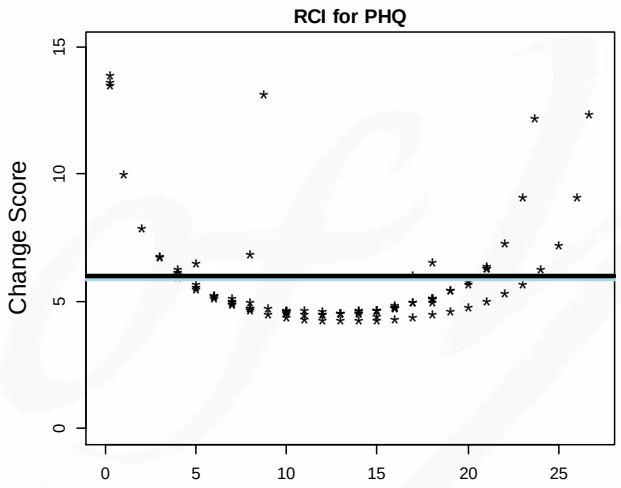
	N	Percent
No change	2111	33.81
Reliably improved	4133	66.19

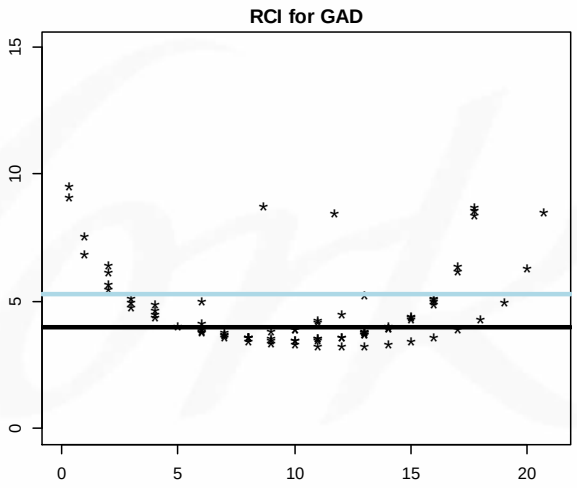
IRT/Rasch Perspective

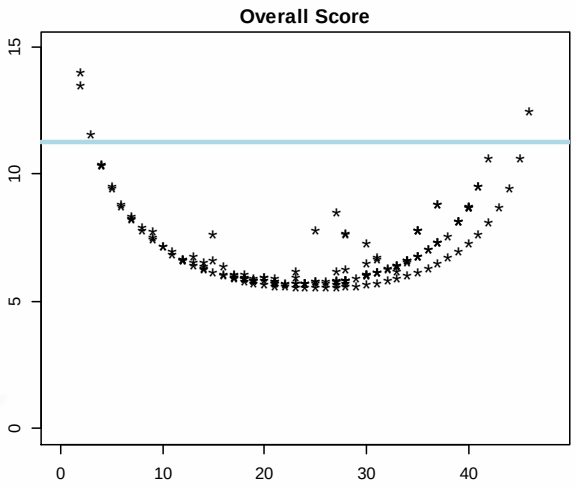
- Reise and Haviland suggested:
  - use theta estimate from "pre-"assessment
  - build (95%-)CI with conditional SE
  - classify change based on this more individual information

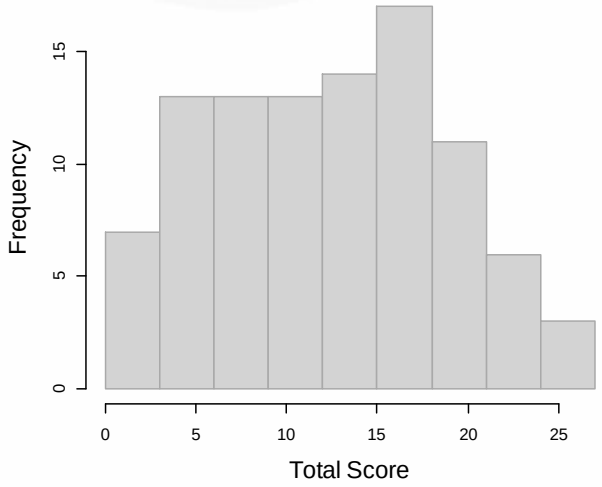
Reise & Haviland (2005). *Journal of Personality Assessment*, *84*, 228–238.
Brouwer, Meijer & Zevalkink (2013). *Psychotherapy Research*, http://doi.org/10.1080/10503307.2013.794400

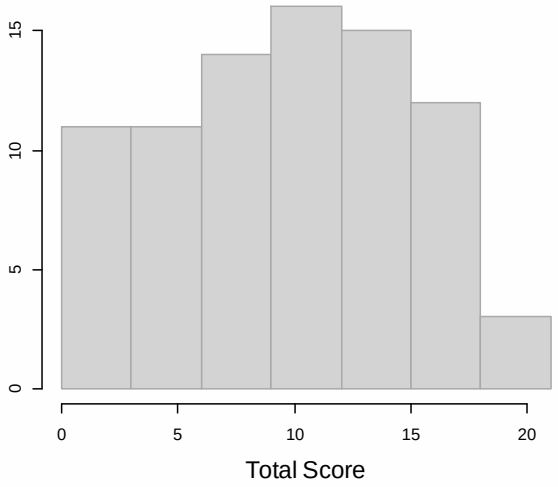
Reliability- vs Information-Based Assessment

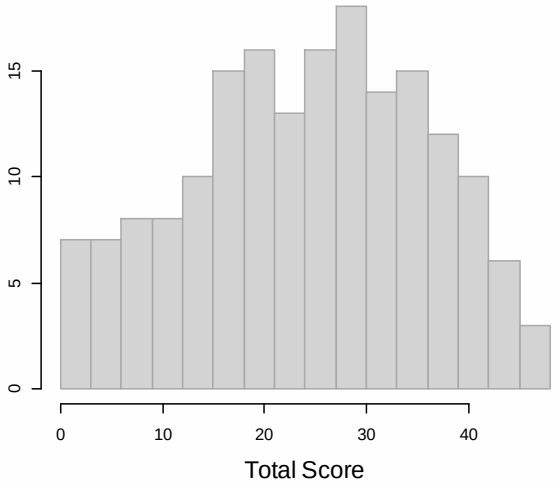












Reliability- vs Information-Based Assessment

	Reliability-based		Information-based	
PHQ-9				
	N	**Percent**	**N**	**Percent**
Reliable deterioration	122	2.3	226	4.3
No change	2846	53.8	2081	39.4
Reliably improved	2319	43.9	2980	56.4
GAD-7				
	N	**Percent**	**N**	**Percent**
Reliable deterioration	192	3.6	228	4.3
No change	2337	44.2	2106	39.8
Reliably improved	2758	52.2	2953	55.9
Together				
	N	**Percent**	**N**	**Percent**
Reliable deterioration	-	-	288	5.4
No change	-	-	1541	29.1
Reliably improved	-	-	3458	65.4

Reliability- vs Information-Based Assessment

		PHQ Trait-based		
		Deterioration	**No Change**	**Improvement**
PHQ Score-based	**Deterioration**	0.98	0.02	0.00
	No Change	0.04	**0.73**	**0.23**
	Improvement	0.00	0.00	1.00

		PHQ Trait-based		
		Deterioration	**No Change**	**Improvement**
PHQ Score-based	**Deterioration**	0.98	0.02	0.00
	No Change	0.02	0.89	0.09
	Improvement	0.00	0.00	1.00

DISCUSSION

Summary of Results

- Both instruments might fit the Rasch Model
  - also if used as an item pool
- Both instruments cover the spectrum present in the sample
- Both instruments show relevant differences between reliability- and information-based change assessment
  - in terms of "numbers classified"
  - in terms of relevant trait range

Thanks to...

...Jaime Delgadillo (NHS Trust Leeds & University of York)

...Rob Meijer (Groningen) & Jan Štochl (York)

...Tim Croudace (Dundee)

...Mental Health and Addiction Research Group (Simon Gilbody)