Harmonizing Measurements Across Studies of Dementia and Cognitive Aging

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Why harmonize measurements

- Meta analysis
- Integrative analysis
- Cross-study, including cross-national comparison
- Inform measurement science

Psychometric Engineering
(Thissen 2001)

https://en.wikipedia.org/wiki/File:Manhattan_Bridge_Construction_1909.jpg

Psychometric Engineering

Psychometrics is a field of study concerned with the theory and technique of psychological measurement. (https://en.wikipedia.org/wiki/Psychometrics)

Engineering is the application of mathematics, empirical evidence and scientific, economic, social, and practical knowledge in order to invent, innovate, design, build, maintain, research, and improve structures, machines, tools, systems, components, materials, processes and organizations. The term Engineering is derived from the Latin *ingenium*, meaning "cleverness" and *ingeniare*, meaning "to contrive, devise". (https://en.wikipedia.org/wiki/Engineering)

Thissen, Psychometrika 2001:4(66):473-86

RFA-AG-15-015

Enhancing Cross-National Research within the Health and Retirement Study Family of Studies

For the purposes of this FOA, the specific measures are cognition and dementia assessment ...

Enhancing the comparability of these measures will support cross-national behavioral and social research in aging ...

Responsive applications will propose ... calibration to gold standard measures; or methods to increase item, measure, or construct comparability.

PITCH Project

Psychometric Integrative Technology for Cognitive Health Research

Aims:

1. Harmonize cognitive assessments in HRS and ISS*
2. Evaluate validity of harmonized cognitive assessments
3. Evaluate the validity of brief candidate measures for future inclusion

* ISS - International Sister Studies

PITCH Project Team

Brown University
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- Douglas Tommet, MS

University of Washington
- Paul K Crane, MD MPH
- Laura E Gibbons, PhD
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- M Maria Glymour, ScD
- Carole Dufouil, PhD (Inserm)

Columbia University
- Jennifer Manly, PhD

Friday Harbor Psychometrics Workshop
Conference on Advanced Psychometric Methods in Cognitive Aging Research; R13-AG030995 (Mungas PI)
2008 - 2018
http://alzheimer.ucdavis.edu/fhpsych/

Linking and harmonizing tests

- 10+ years of experience, various domains, mostly cognition
- Leveraging ***item response theory (IRT)*** methods
- Much of this work emanated from Friday Harbor Psychometrics workshops

Soc Psychiatry Psychiatr Epidemiol (2004) 39 : 828–835 DOI 10.1007/s00127-004-0815-8

ORIGINAL PAPER

Richard N. Jones · Stephanie J. Fonda

Use of an IRT-based latent variable model to link different forms of the CES-D from the Health and Retirement Study

Soc Psychiatry Psychiatr Epidemiol (2004) 39 : 828–835 DOI 10.1007/s00127-004-0815-8

ORIGINAL PAPER

Richard N.

Use of

of the

Methods in Neuroepidemiology

Neuro
epidemiology

Neuroepidemiology 2014;43:194–205
DOI: 10.1159/000367970

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Calibrating Longitudinal Cognition in Alzheimer's Disease Across Diverse Test Batteries and Datasets

Alden L. Gross[a] Richard Sherva[b] Shubhabrata Mukherjee[c] Stephen Newhouse[d] John S.K. Kauwe[e] Leanne M. Munsie[f] Leo B. Waterston[g] David A. Bennett[h] Richard N. Jones[i] Robert C. Green[g] Paul K. Crane[c] for the Alzheimer's Disease Neuroimaging Initiative, GENAROAD Consortium, and AD Genetics Consortium

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Richard N. Jones · Robert C. Green · Paul K. Crane · for the Alzheimer's Disease Neuroimaging Initiative, GENAROAD Consortium, and AD Genetics Consortium

ORIGINAL ARTICLE

Application of Latent Variable Methods to the Study of Cognitive Decline When Tests Change over Time

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Background: The way a construct is measured can differ across cohort study visits, complicating longitudinal comparisons. We demonstrated the use of factor analysis to link differing cognitive test batteries over visits to common metrics representing general cognitive performance, memory, executive functioning, and language.

Methods: We used data from three visits (over 26 years) of the Atherosclerosis Risk in Communities Neurocognitive Study (N = 14,252). We allowed individual tests to contribute information differentially by race, an important factor to consider in cognitive aging. Using gen-

standard error = 0.015, vs. −0.041 standard deviation units/year, standard error = 0.014), which is consistent with the notion that factor scores more explicitly address error in measuring assessed traits than averages of standardized tests.

Conclusions: Factor analysis facilitates use of all available data when measures change over time, and further, it allows objective evaluation and correction for differential item functioning.

(*Epidemiology* 2015;26: 878–887)

Soc Psychiatry Psychiatr Epidemiol (2004) 39 : 828–835 DOI 10.1007/s00127-004-0815-8

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Richard N. J

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ELSEVIER

Journal of Clinical Epidemiology ■ (2008) ■

Journal of
Clinical
Epidemiology

Item response theory facilitated cocalibrating cognitive tests and reduced bias in estimated rates of decline

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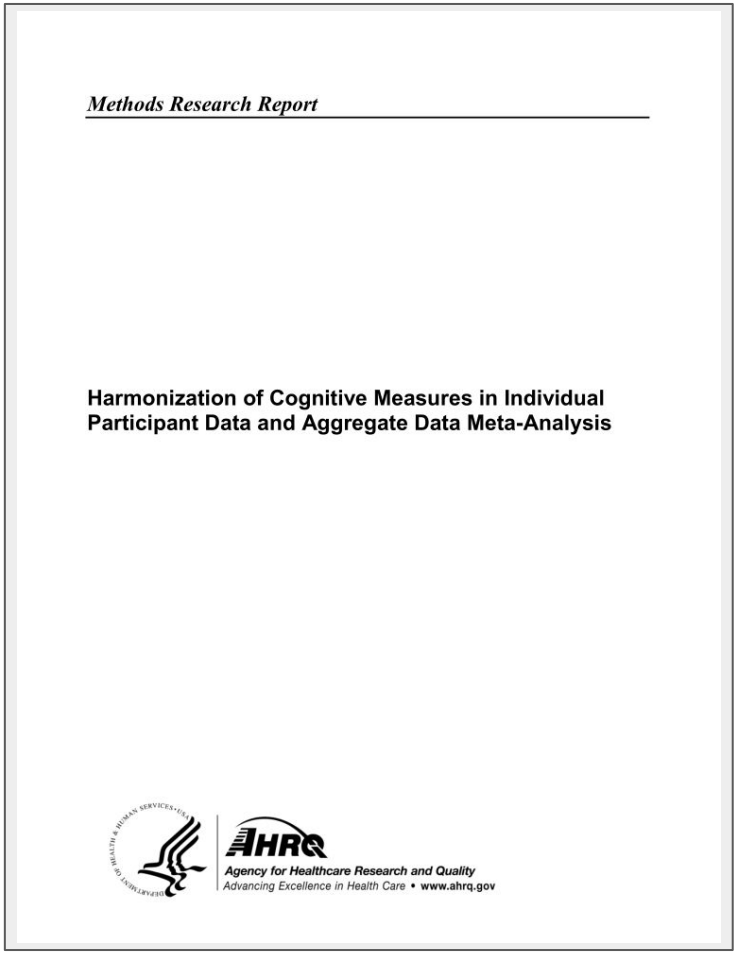
What is ***Item Response Theory***

- A general approach to data analysis relating responses to underlying traits
- Many related statistical models
- Broadly contained within general latent variable framework
- Developed in fields of Educational and Psychological Assessment mostly 1930-1970’s
- Continually refined methods
- Broad applications in social and health sciences
- Procedures available in many general purpose statistical software packages

Our approach

1. Pre-statistical harmonization
2. Statistical harmonization
3. Validation
4. Dissemination
5. Recommendations



Pre-statistical harmonization

1. Identify & obtain data
2. Classify items according to measurement
    a. Domain
    b. Modality (performance, self-rated, informant-rated, expert rating)
    c. Response type
    d. Scrutinize quality of translation
3. Identify referent population and sample(s)
4. Anticipate validation needs
    a. Harmonization of independent and potential outcome variables:
        i. Age
        ii. Sex
        iii. Education
        iv. Diagnostic group
        v. race, ethnicity

Comparable measures across HRS and Sister Studies																	
	HRS	CHARLS	CRELES	ELSA	BELASSI-L	HAALSI	IFLS	JSTAR	KLoSA	LASI	MHAS	NICOLA	SAGE	SHARE	THSLS	TILDA
Verbal Memory - 10 words immediate recall	C	C	?	C	?	?	?	C		C	?	?	?	C	?	?
Verbal Memory - 10 words delayed recall	C	C	?	C	?	?	?	C		C	?	?	?	C	?	?
Orientation - date naming- month	C	C	?	C	?	?	?	C	C	C	?	?	?	C	?	?
Orientation - date naming- day of month	C	C	?	C	?	?	?	C	C	C	?	?	?	C	?	?
Orientation - date naming- year	C	C	?	C	?	?	?	C	C	C	?	?	?	C	?	?
Orientation - date naming- day of week	C	C	?	C	?	?	?	C	C	C	?	?	?	C	?	?
Orientation - season		C	?		?	?	?		C		?	?	?		?	?
Orientation - person			?		?	?	?				?	?	?		?	?
Orientation - place			?		?	?	?	C	C		?	?	?		?	?
Verbal Fluency - animals naming			?	C	?	?	?			C	?	?	?	C	?	?
Numeracy and numberic ability - counting backward	C		?		?	?	?			C	?	?	?		?	?
Numeracy and numberic ability - Serial 7 (subtract 7)	C	C	?		?	?	?	C	C	C	?	?	?	C	?	?
Numeracy and numberic ability - Computation items			?		?	?	?				?	?	?		?	?
Visuoconstruction - draw picture		C	?		?	?	?		C		?	?	?		?	?
Vocabulary			?		?	?	?				?	?	?		?	?

Notes:

Data in columns HRS, CHARLS, ELSA, JSTAR, KLOSA, LASI, SHARE from RAND (http://www.g2aging.org/?section=topic&topicid=10)

See text for explanation of study acronyms.

comparable measure -	C
partially comparable measure -	
no comparable measure -	
unknown -	?

--- Studies with public data available ---

CHARLS - China Health, Aging, and Retirement Longitudinal Study

CLSA - Canadian Longitudinal Study on Aging

CRELES - Costa Rican Longevity and Healthy Aging Study

ELSA - English Longitudinal Study of Ageing

MHAS - Mexican Health and Ageing Study

~~IFLS - Indonesia Family Life Survey~~ *cognition only on 7-24yo participants*

JSTAR - Japanese Study on Aging and Retirement

KLoSA - Korean Longitudinal Study on Aging

LASI - Longitudinal Aging Study in India

NZHART - New Zealand Health and Aging Research Team

SAGE - Study on Global Ageing and Adult Health

SHARE - Survey of Health, Ageing, and Retirement in Europe

TILDA - The Irish Longitudinal Study on Ageing

--- Studies in development ---

ELSI - Estudo Longitudinal da Saúde e Bem-Estar dos Idosos Brasileiros [The Brazilian Longitudinal Study of Aging (ELSI-BRASIL)]

HAALSI - The Health and Aging in Africa in three INDEPTH Communities

NICOLA - Northern Ireland Cohort for the Longitudinal Study of Ageing

THSLS - The Scottish Longitudinal Survey of Ageing

Statistical harmonization

IRT linking based on common item design

HRS-ISS must have at least some cognitive assessment items in common with HRS.

Issues to address:

- Dimensionality
- Precision differences across study

Validation

External criterion validity

- Correlate with age
- Correlate with educational attainment (?)
- Differences across diagnostic groups (if available)
- Score harmonized assessment in studies with larger neuropsyc batteries
    - Repeat tests of external validation
        - Age
        - Diagnoses
        - Biomarkers for disorders related to impaired cognition

Dissemination

There already exists a well-established platform for sharing harmonized data from HRS-ISS: g2aging.com

We will prepare dissemination materials that are similar to be distributed on that platform.

Recommendations

How sensitive a measurement is the HRS cognitive assessment

To what purposes is it useful? What are its limits?

How can we improve upon it while minimizing participant burden?

https://en.wikipedia.org/wiki/File:Manhattan_Bridge_Construction_1909.jpg