What Set of Cognitive Measures Constitutes an HCAP?

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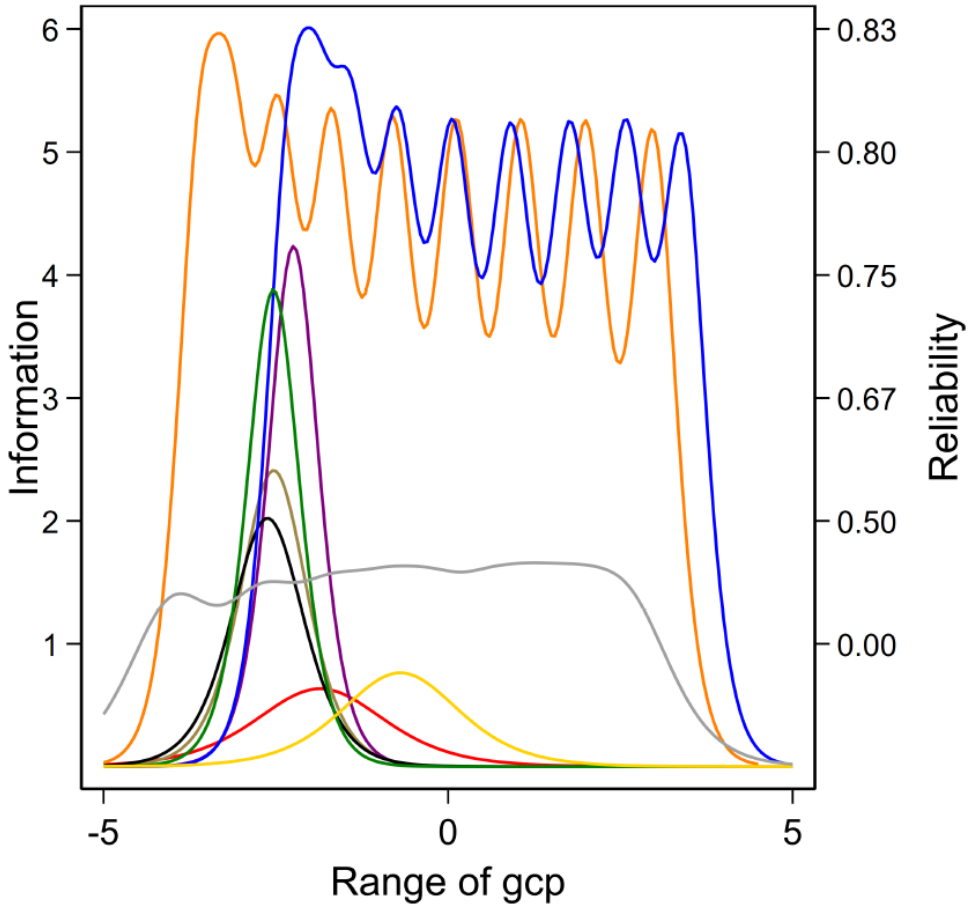
What is the goal of an HCAP?

- To better measure ~~cognitive impairment~~ cognitive performance continuously and dementia in population-representative samples to characterize risk factors for low cognitive performance and decline (Langa et al., 2020)
- Harmonized scores are not (necessarily) needed for dementia; what is needed is a similar recipe, including measurement of informant-reported functioning
  - But consistency begets confidence



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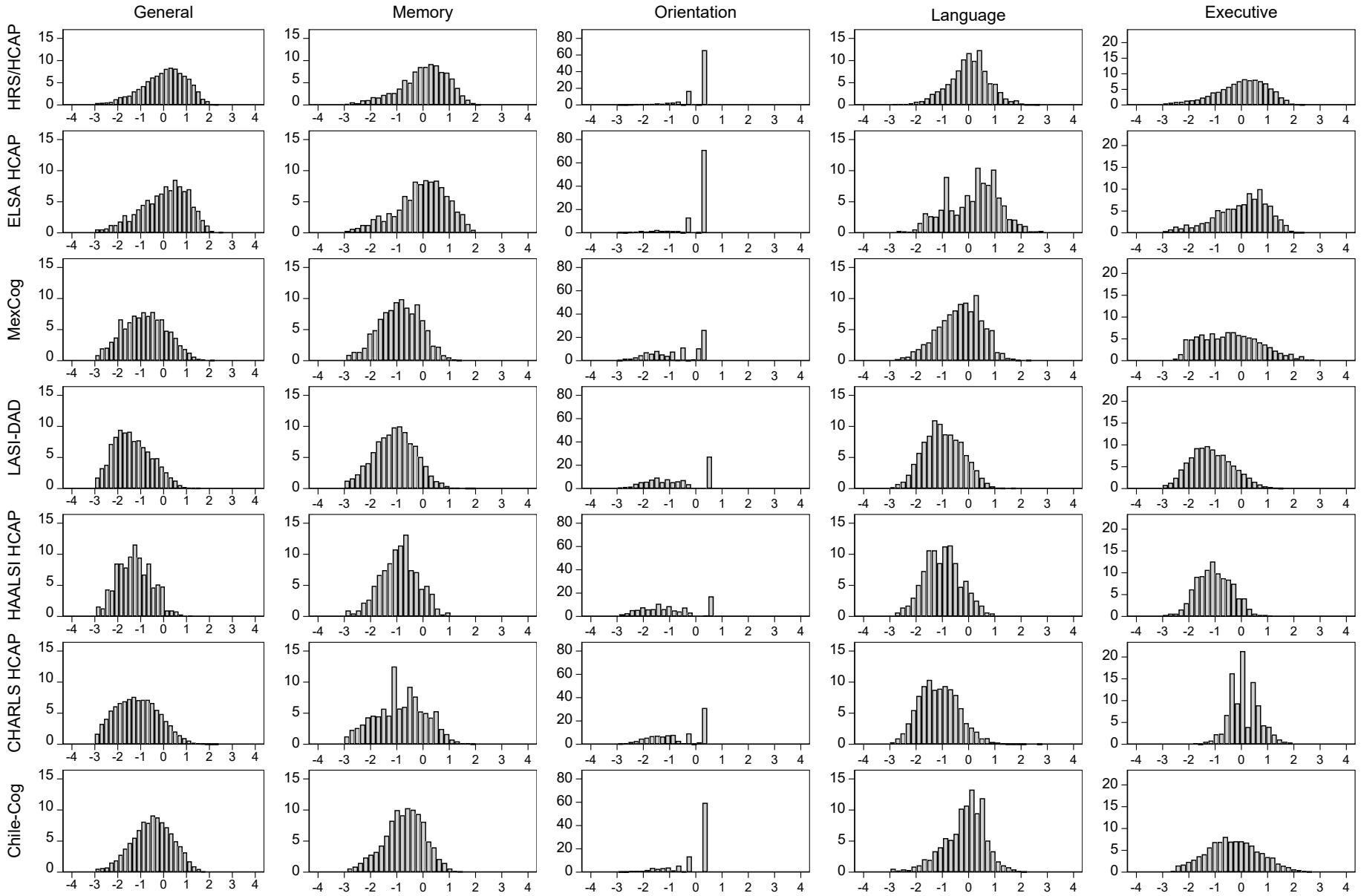
Outline

- How do we do cross-national harmonization?
  - *(3 options)*
- What cognitive tests can possibly be comparable cross-nationally? (e.g., linking items)
  - *(few)*
- Is this enough to comprise a respectable battery?
  - *(no)*
- To what degree should adaptation be allowed?
  - *(maybe some; needs consensus)*
- Is there a minimum number of linking items?
  - (no; item quality matters)
- What battery of tests should constitute an HCAP?

What cross-nationally cocalibrated scores look like



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HCAP cognitive domains are measured with consistently high precision

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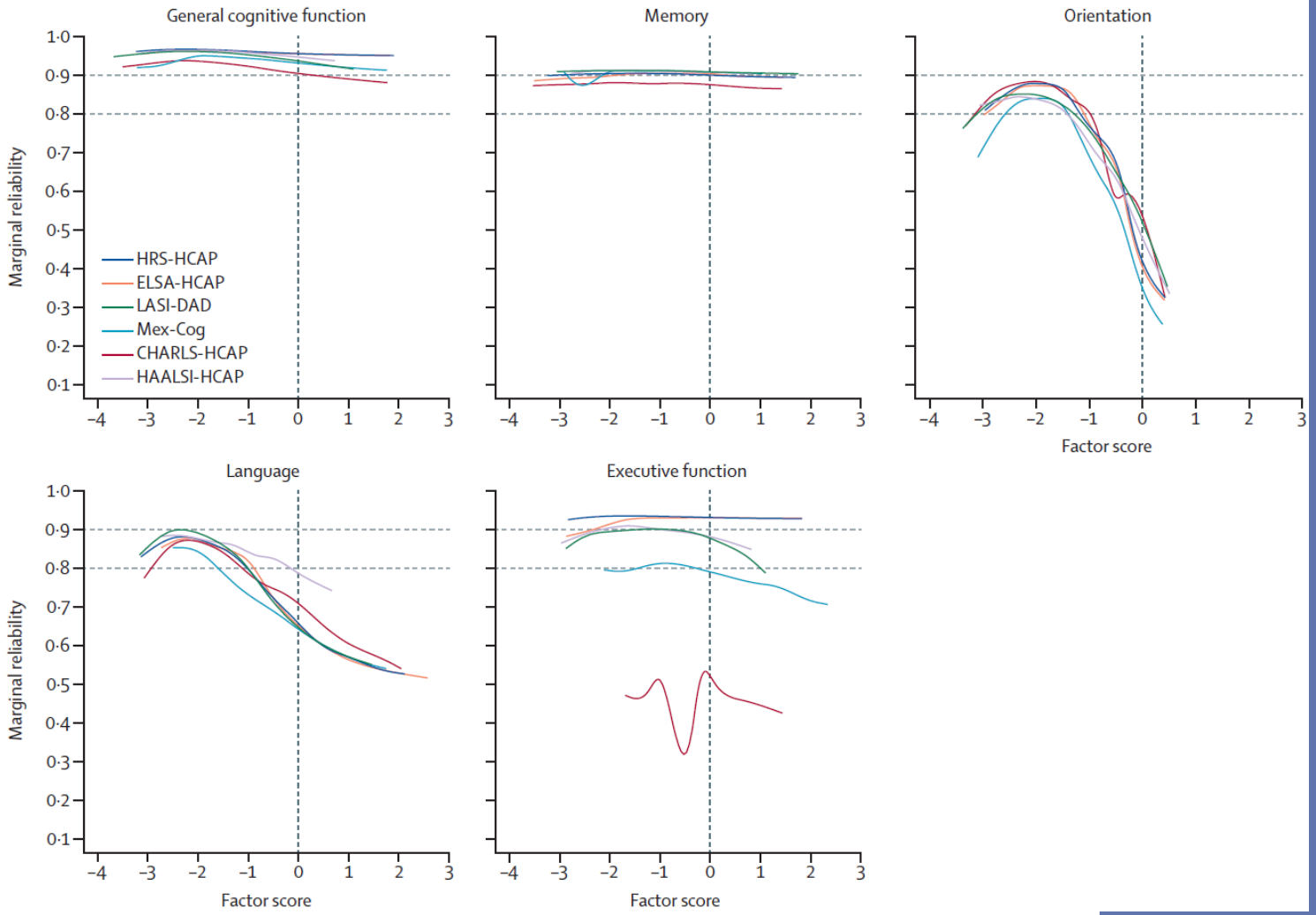
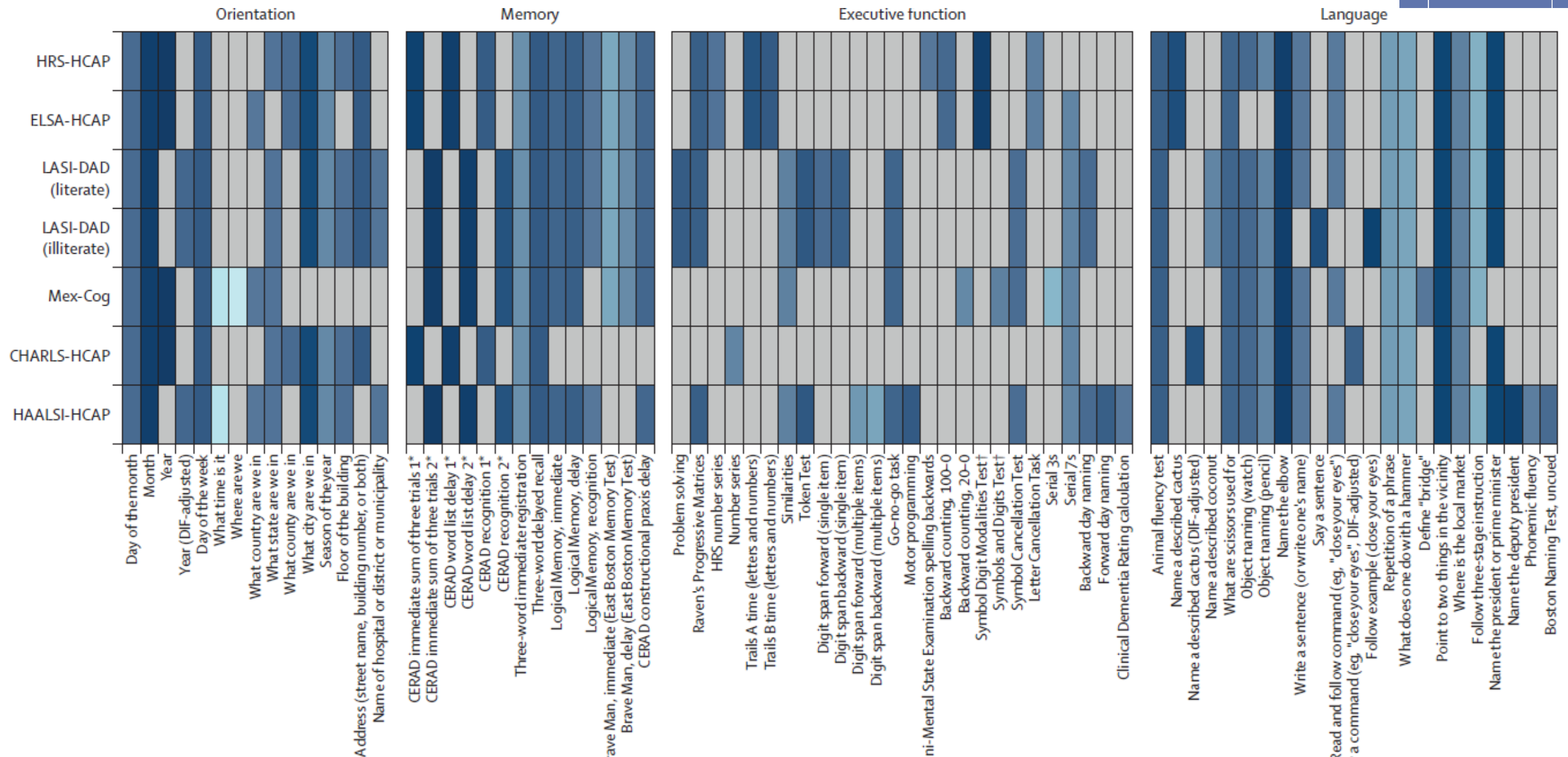
- Good for study power
- Consistency ensures comparable power to detect associations in each study
- Gaps in precision point us to areas for improvement
  - E.g., harder language items



Cognitive test items across published HCAPs, as of 2023



How to do cross-national harmonization?

1. Statistical cocalibration with item banking that leverages common and unique cognitive test items
2. Calibration samples
3. Linear Linking for Related Traits

Option 1: Statistical cocalibration with item banking that leverages common and unique cognitive test items

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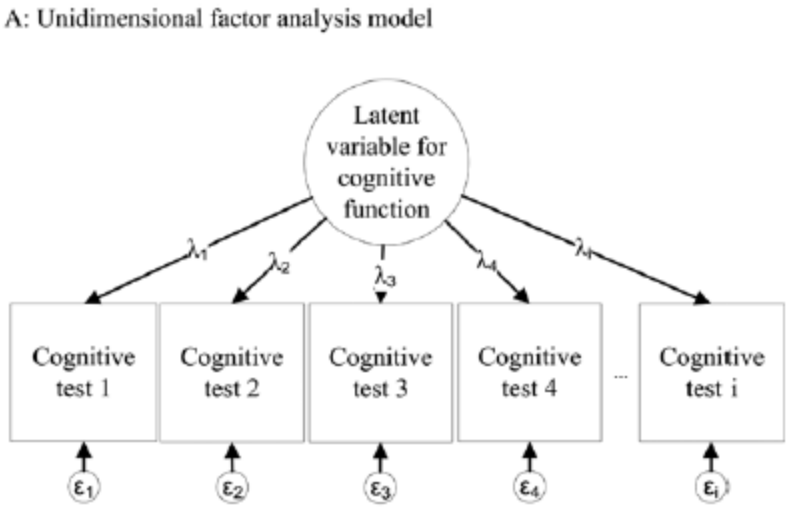
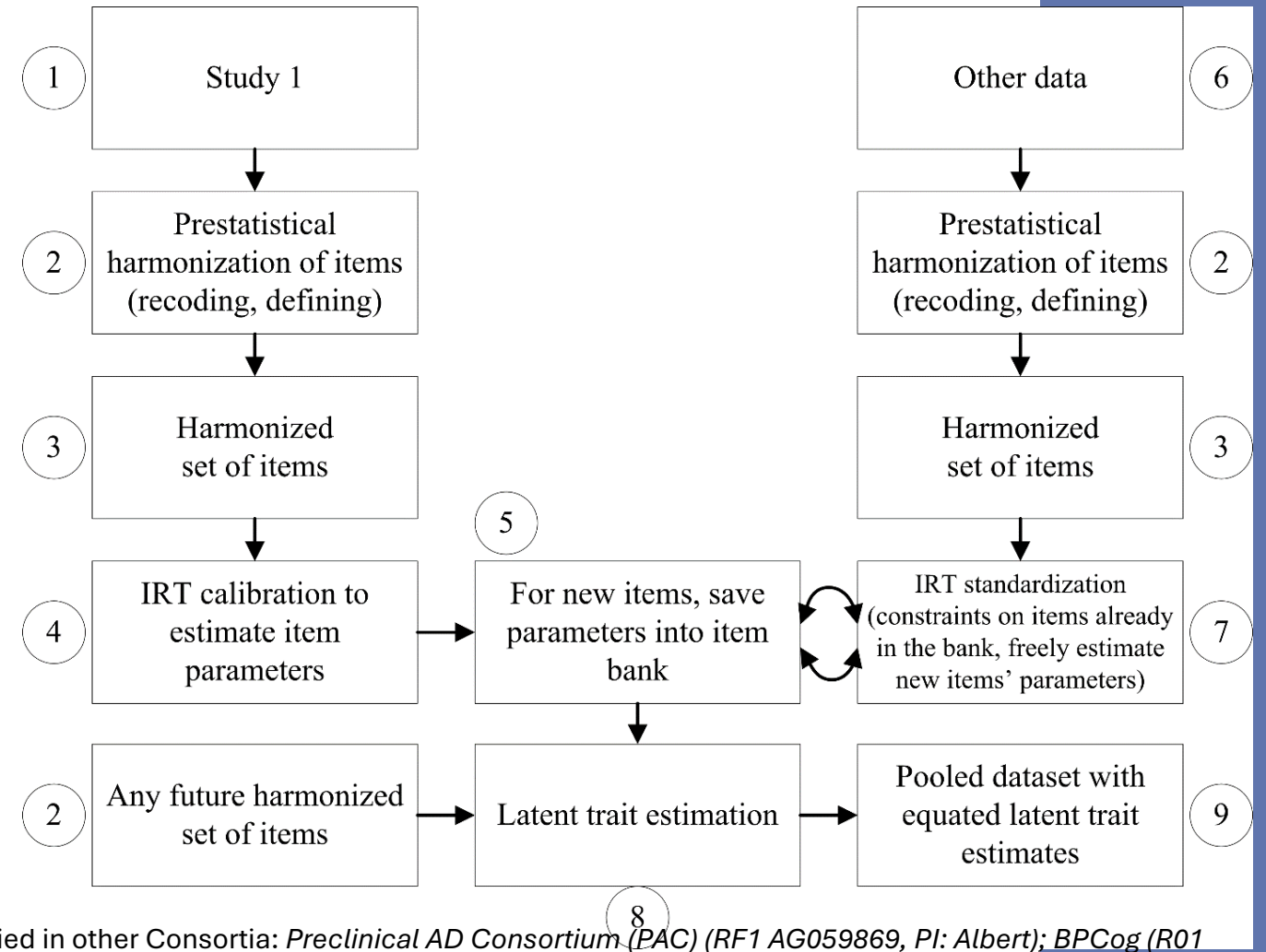
- Statistically harmonize across study samples
  - Readily scalable: We can add more to this pipeline as we receive them
  - PITCH project (R01, Jones) provided the foundation for this framework





PITCH project (R01, Jones) provided the foundation for this framework; being applied in other Consortia: *Preclinical AD Consortium (PAC) (RF1 AG059869, PI: Albert); BPCog (R01 NS102715, PI Levine); Stroke-Cog (RF1 AG068410, PI Levine); Collaborative Cohort of Cohorts for COVID-19 Research (C4R) (NHLBI-CONNECTS OT2HL156812, PI Oelsner); Dementia Risk Prediction Pooling Project (DRPP) (R33 NS120245, PI: Allen); EpilepsyCog (R01 AG074355, MPI Choi, Thacker)*

Option 2: Calibration samples

- Underutilized alternative for HCAPs (so far), but has been used successfully in core HRS
  - Randomize test administration to a different mode or swap tests
  - Do so either in the entire study sample or a subsample, or leverage an innovation sample (e.g., LASI-DAD)
- Viable option if there are no linking items

Option 3: Linear Linking for Related Traits

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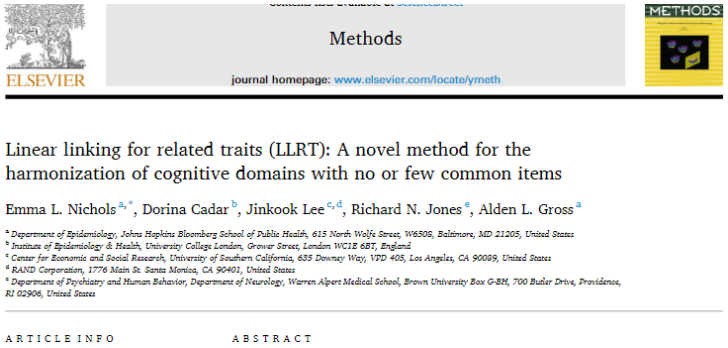
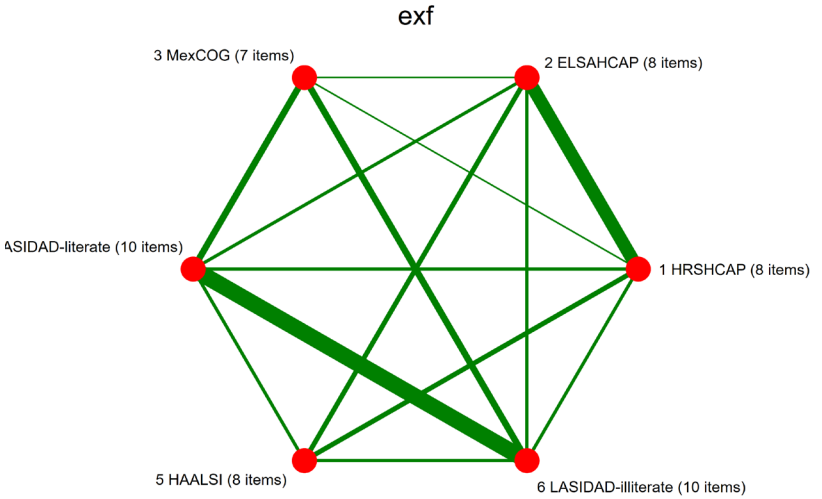
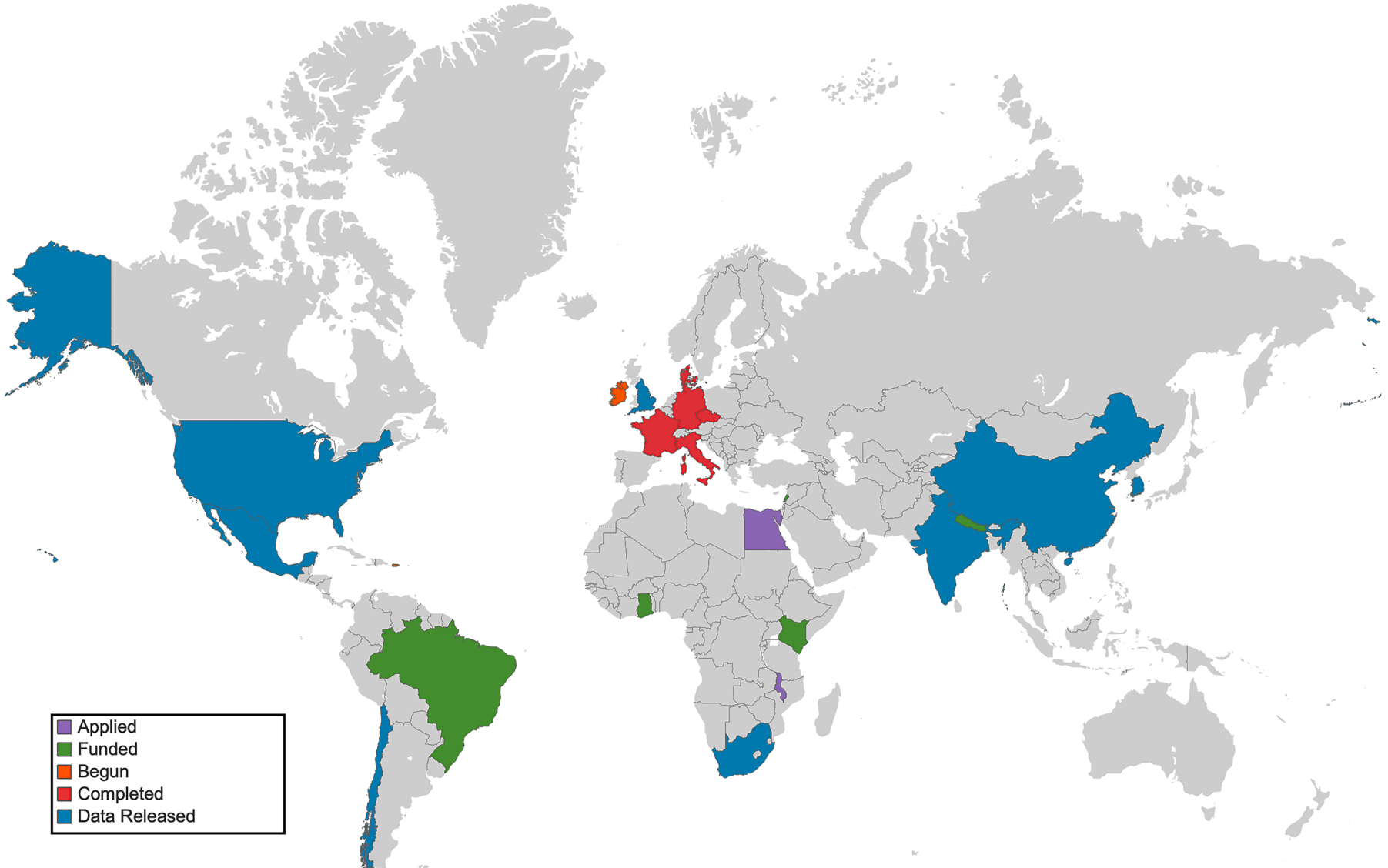
- If we cannot leverage common items within a domain (e.g., executive functioning), instead we can instead leverage information from a related latent construct (e.g., general cognitive performance)
- **Major Assumption:** Scaling differences between HCAPs on general cognitive functioning are comparable to the differences that would be observed on the cognitive subdomain





So, we prefer comparable tests. What cognitive tests can possibly be comparable cross-nationally?



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Original HCAP Battery

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17 tests in original battery ~ 45 test items

Key Challenge:

- *Not all HCAPs administered the same items, due to language, cultural factors, literacy/numeracy, etc.*

Table 2. HRS HCAP tests

a Respondent test	Cognitive domains[1] assessed
MMSE	O, MemIE, MemDE, Vis, AS, LF
HRS-TICS (3 items: Object naming; Naming President)	MemIE
CERAD Word List Learning and Recall – Immediate	MemIE
Semantic Fluency (Animal Naming Test)	LF
Letter Cancellation Test	AS
Timed Backward Counting Task (from MIDUS)	AS
Community Screening Instrument for Dementia (CSI-D; 4 items)	O, EF, LF
CERAD Word List Recall – Delayed	MemDE
Story recall – Immediate	MemIE
CERAD Word List – Recognition	MemR
CERAD Constructional Praxis – Immediate	Vis
SDMT	EF, AS
CERAD Constructional Praxis – Delayed	MemDE
Story recall – delayed	MemDE
Story recall – recognition	MemR
HRS Number Series	EF
Raven's Standard Progressive Matrices	EF
Trail Making Test (Part A and Part B)	EF, AS

Original HCAP Battery

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Most common tests items across 8 completed HCAPs

Domain & Item	# studies
Orientation	
Day of month	8
Month	8
Day of the week	8
Season of year	7
Memory	
Three word immediate registration	8
Three word delayed recall	8
CERAD immediate sum of 3 trials	8
CERAD word list delay	8
CERAD recognition	8
Logical Memory immediate	7
Logical Memory delay	7
CERAD constructional praxis delay	7
Executive functioning	
Serial 7s	7

Domain & Item	# studies
Language	
Animal fluency	8
What are scissors used for?	7
Object naming (watch)	7
Object naming (pencil)	7
Name the elbow	8
Write a sentence (or write one's name)	8
Read and follow command (Close your eyes)	7
Repetition of a phrase	7
What does one do with a hammer	7
Point to 2 things in the vicinity	7
Where is the local market?	7
Visuospatial	
Constructional praxis, immediate	7

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USA
Mexico
Chile
England
Kenya
South Africa
China
India

What do we lose?

- Nearly all tests of executive functioning
- Nearly all tests of visuospatial functioning (minimal to begin with)
- Potentially valuable tests that measure a cognitive domain from an emic approach within a context

- What domains are preserved?
  - Memory
  - Language – driven by fluency

How much of a problem is it to not have a common battery across HCAPs?

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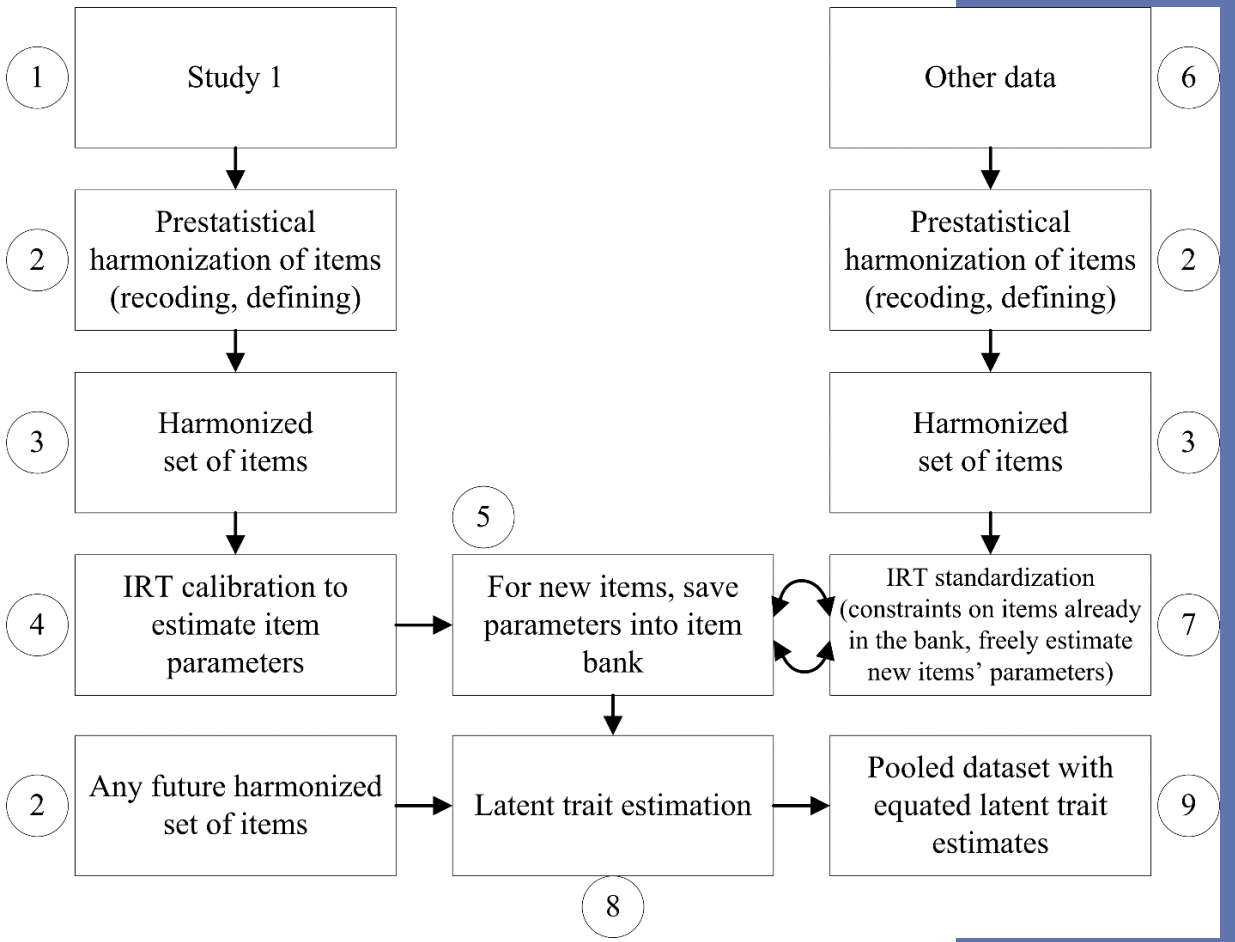
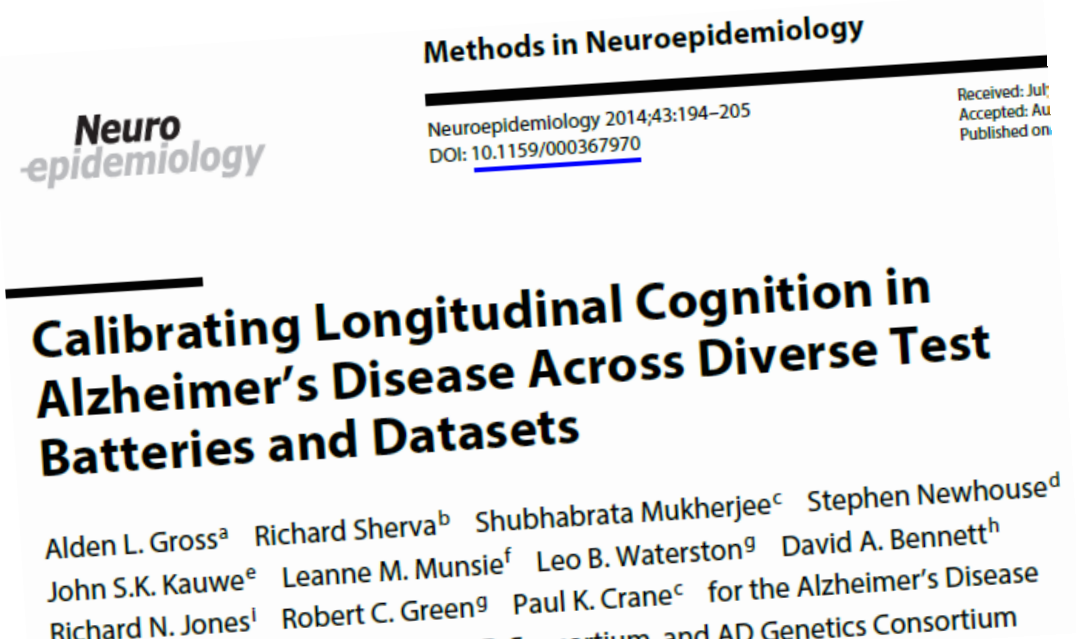
- Our cocalibration approach does not strictly require ***all*** tests to be common
- But how much variation should be allowed?
- Should an "HCAP-light" be allowed? We begin to lose precision of estimated cognition, which affects quality of data and cross-national comparability
- We probably want to have standards, or else every cognitive battery would be branded "HCAP"



How much variation should be allowed?

Cocalibration can “work” as long as there’s at least 1 common linking item



Test name	ADNI	MAP	ROS	NACC	Cache	Tarenflurbil	Semagacestat	AddNeuroMed	ACT
MMSE	X	X	X	X	X	X	X	X	X*
Boston Naming Test	30-item	15-item	15-item	30-item	30-item			15-item	15-item
Semantic fluency	A, V	A	A	A, V	A	A		A	A
Digit Span Test	X	X	X	X	X	X			
Logical Memory I & II, Wechsler Memory Scale	X	X	X	X					X
Trail Making Test	X			X	X				X
Word list learning (CERAD battery)		X	X		X			X	
Symbol-Digit Modalities Test		X	X						
Controlled Oral Word Association Test					X	X			
Constructional Praxis					X			X	X
Digit Symbol Substitution, Wechsler Memory Scale-Revised	X			X					
ADAS-Cog	X					X	X	X	
Auditory Verbal Learning Test	X					X			
Line Orientation		X	X						
Number comparisons		X	X						
Digit ordering		X	X						
East Boston Story Test		X	X						
Ravens Progressive matrices		X	X						
Alphabet span			X						
Hopkins Verbal Learning Test					X				
Shipley					X				
Paired Associates						X			X
Digit cancellation						X			
Object recognition								X	
Word list learning									X
WAIS Information									X
WAIS Comprehension									X
Mattis Dementia Rating Scale									X
Total number of cognitive tests	9	12	13	7	10	8	2	7	11
Total number of cognitive test in	13	18	19	11	12	12	2	7	16
Cronbach's alpha by dataset	0.90	0.94	0.95	0.89	0.84	0.89	0.67	0.85	0.84

What is a minimum number of linking items?

It depends on the number and quality of linking items

Scenario number	Orientation to day	Orientation to month	Orientation to year	Orientation to date	President	Vice-President	Backwards counting	Verbal naming - *scissors*	Verbal naming - *cactus*	Serial 7s	Immediate 10-word recall	Delayed 10-word recall	8-word recall, 3 trials*	Delayed 8-word recall	Visual scanning	Figure copy	Figure recall	Condition description
1	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	1. All items are linking items.
2	L	L	L	G1	G1	G1	G1	G1	G1	G1	G1	G1	G2	G2	G2	G2	G2	2. Three core linking items: *conservative linking scenario*.
3	L	L	L	G1	G1	G1	G1	G1	G1	G1	L	G1	G2	G2	G2	G2	G2	3. Four linking items: *liberal linking scenario*.
4	L	L	L	L	L	L	L	L	L	L	L	--	--	--	--	--	--	4. G1 (HRS) items only (all are linking items).
5	--	--	--	--	--	--	--	--	--	--	--	L	L	L	L	L	L	5. G2 (MHAS) items only (all are linking items).
6	L	G1	G1	G1	G1	G1	G1	G1	G1	G1	G1	G1	G2	G2	G2	G2	G2	6. Only one linking item, dichotomous and low difficulty.
7	G1	G1	G1	G1	G1	G1	G1	G1	G1	G1	L	G1	G2	G2	G2	G2	G2	7. Only one linking item, polytomous with thresholds of a range of difficulty.
8	G2	G2	G2	G1	G1	G1	G1	G1	G1	G1	L	G1	G2	G2	G2	G2	G2	8. Only one linking item, polytomous with thresholds of a range of difficulty, core items not used in group 1.
9	L†	L‡	L	G1	G1	G1	G1	G1	G1	G1	G1	G1	G2	G2	G2	G2	G2	9. Three core linking items with shifted difficulty.
10	L†'	L‡'	L	G1	G1	G1	G1	G1	G1	G1	G1	G1	G2	G2	G2	G2	G2	10. Three core linking items with shifted difficulty and boosted discrimination.

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Diagnosis, Assessment & Disease Monitoring

RESEARCH ARTICLE

Harmonization of cognitive screening tools for dementia across diverse samples: A simulation study

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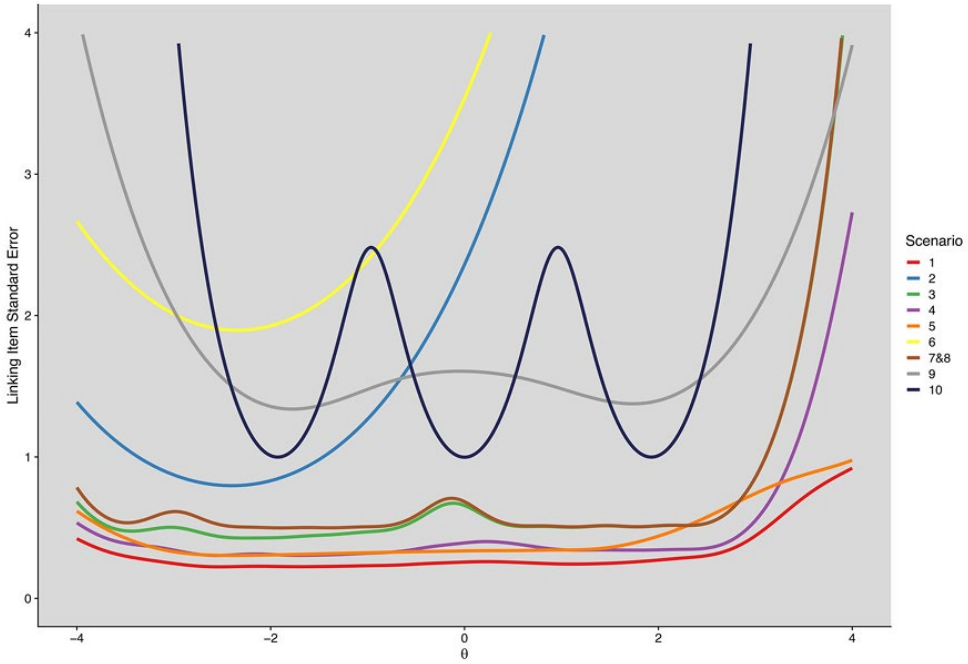
2023

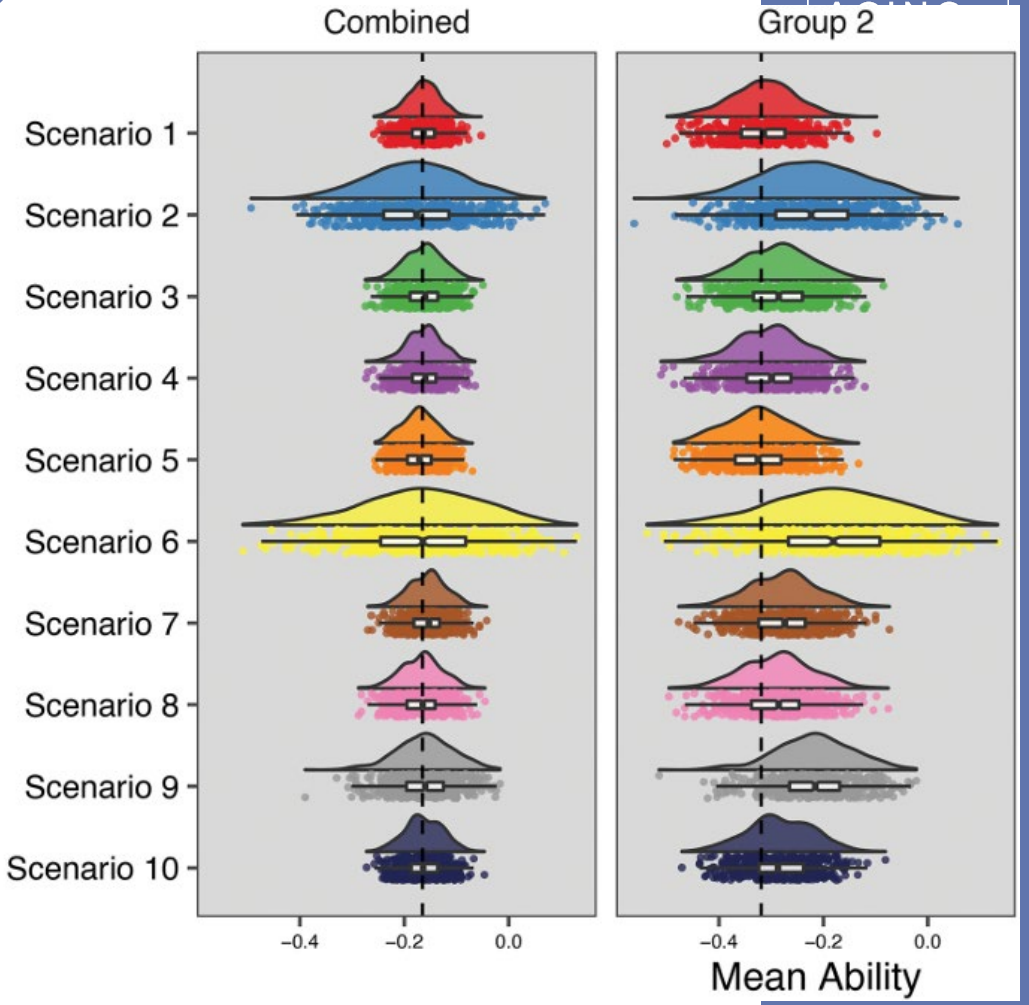
Number and quality of linking items

Have at least 1 polytomous linking item (Scenario 7), and *additionally* some easy binary items helps (Scenario 3)

HCAPs need such a scenario for each cognitive domain

- Memory
- Executive
- Language
- Visuospatial?
- Orientation?





What battery of tests should constitute an HCAP?

- We have suggestions for each domain
  - Importance, feasibility, time to complete, amenable to ppt
- Yellow highlighting indicates a polytomous test, which is preferred over easy/binary tests
- **General notion:** As long as a study administers a core set of cognitive tests, plus other tests desirable to that study, then it's an HCAP as long as the total cognitive battery is at least an hour on average
  - HRS/ELSA would want tests that tap numeracy, literacy
  - All studies should want tests that allow linking between HCAP and Core interview

Core set of HCAP items for Memory

- **CERAD word list learning** – immediate, 15-20 minute delayed recall, and recognition
- Three-word immediate registration and delayed recall
- **Logical memory** – immediate, delay, and recognition
- **East Boston Memory Test** (e.g., Brave Man) – immediate and delayed recall]
- **Constructional praxis**, delayed recall (visual memory)

- Score stories using both exact and gist recall

Core set of HCAP items for Executive Functioning

- Trail-Making, using circles and squares
- Ravens progressive matrices
- Go-No-Go
- Symbol Cancellation Test
- Similarities
- Token Test
- Digit Span Forward
- Digit Span Backward
- Backward Day naming
- Judgment and Problem-solving (e.g., lost child)

Cost for tests like Ravens is an issue

Core set of HCAP items for Language

- Animal fluency
- What do you use to cut paper (scissors)?
- Confrontational object naming (watch)
- Confrontational object naming (pencil)
- What is this? (Elbow)
- What does one do with a hammer?
- Define Bridge.
- Point to 2 things in the vicinity (e.g., window and door; ceiling and sky)
- Follow 3-stage instruction

Consider also phonemic fluency (FAS), more challenging confrontational naming tests

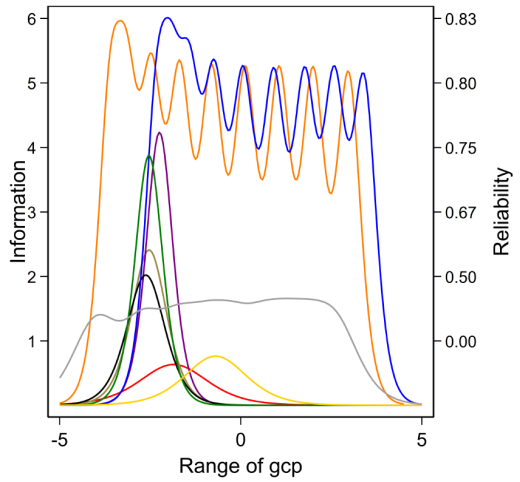
Core set of HCAP items for Visuospatial functioning

- CERAD constructional praxis

- More is needed here if we want this domain to be measured with precision
  - WAIS visual puzzles
  - Card rotations, e.g., mental orientation

Core set of HCAP items for Orientation

- Day of month
- Month
- Year
- Day of the week
- Where are we
- Season of year



- Orientation is included because of history with the MMSE
- Questions serve to ease ppt into the interview
- Provides measurement only at the severe range of ability

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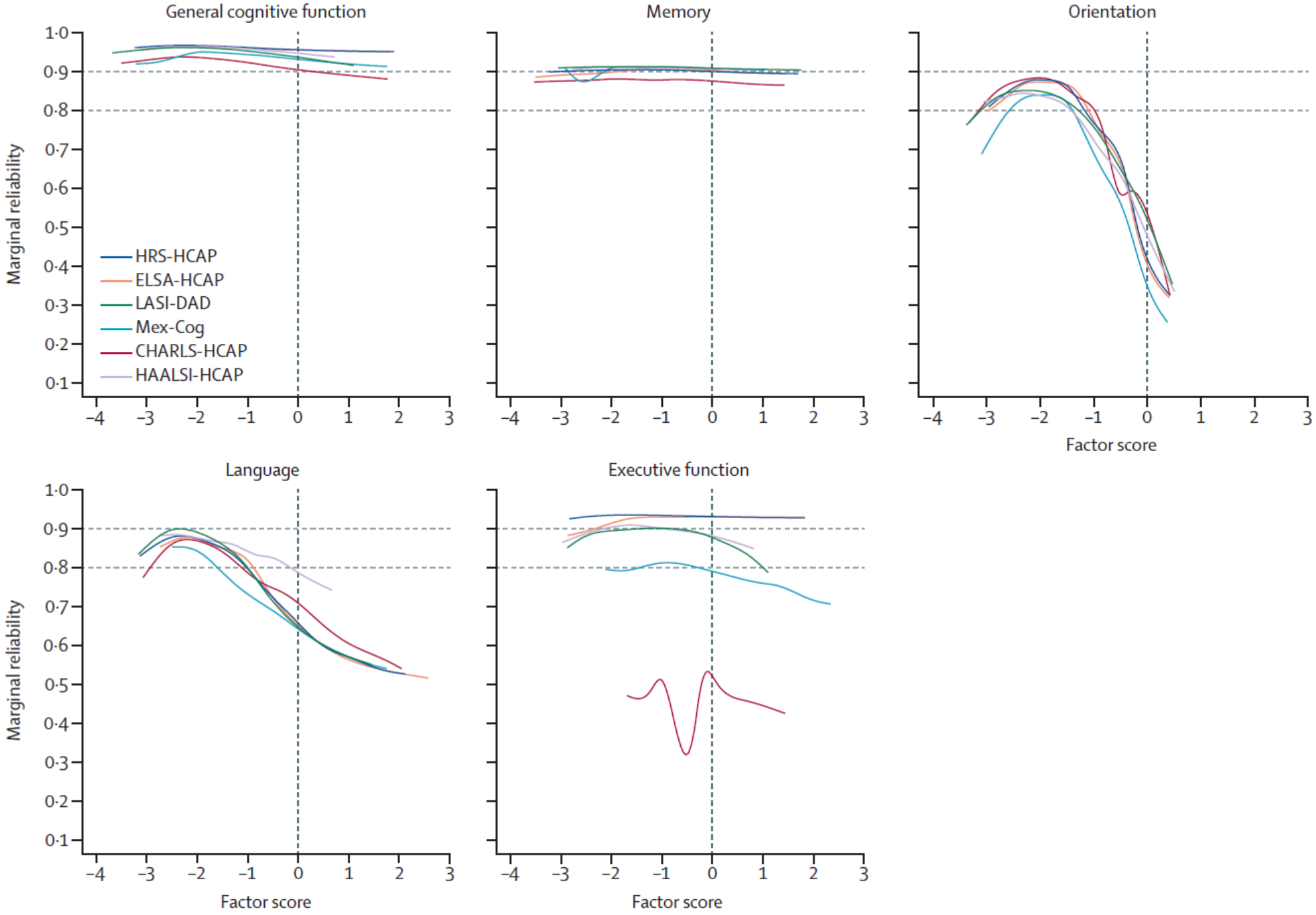

Conclusions

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  - To better measure cognitive performance continuously and dementia in population-representative samples to characterize risk factors for low cognitive performance and decline (Langa et al., 2020)
- How do we do cross-national harmonization?
  - *(3 options)*
- What cognitive tests can possibly be comparable cross-nationally? (e.g., linking items)
  - *(few)*
- Is this enough to comprise a respectable battery?
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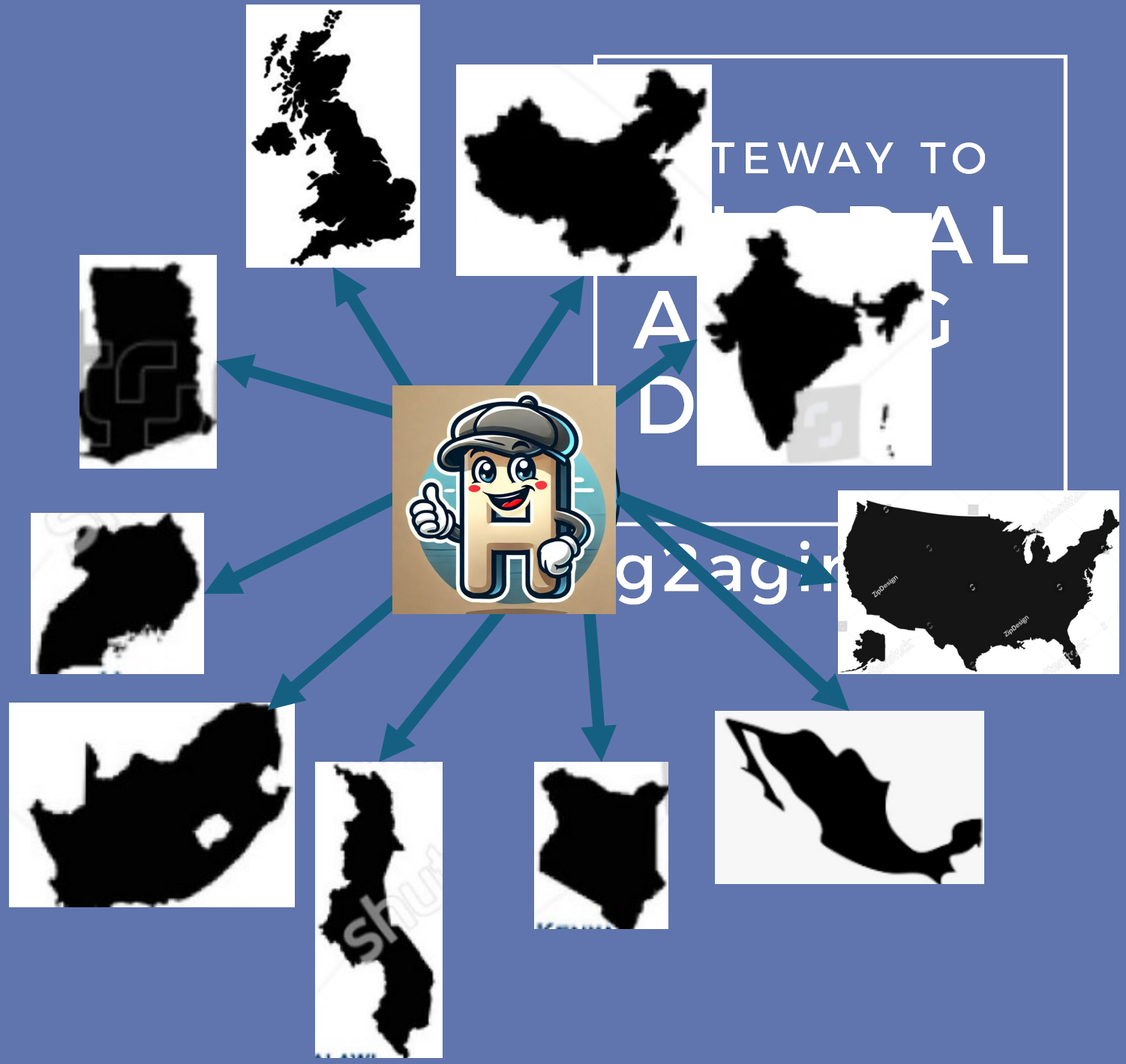
- Is there a minimum number of linking items?
  - (no; item quality matters)
- What battery of tests should constitute an HCAP?
  - We offered some ideas

Conclusions

- Perhaps even the “required” tests might be optional, if they truly will not work in a context
  - E.g., *symbol digit* in Nepal; *orientation to time* in Nepal or Africa
- Ultimately, test items described in a manual are necessary but insufficient: training and **guidance for interviewers** is paramount to ensure comparability of encouragement to participants and **scoring/coding** of responses

Thank you!



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