National Neuropsychology Network

Bauer, Bilder, Drane, Holdnack, Loring, Sabsevitz, Wahlstrom

AACN Disruptive Technology Initiative
June 21st, 2018

UCLA Semel Institute
Tennenbaum Center for the Biology of Creativity

Journal of the International Neuropsychological Society (2011), **17**, 7–13.

doi:10.1017/S1355617710001396

SHORT REVIEW

Neuropsychology 3.0: Evidence-Based Science and Practice

Robert M. Bilder[1,2,3]
[1]Jane and Terry Semel Institute for Neuroscience & Human Behavior at UCLA, Los Angeles, California
[2]Department of Psychiatry & Biobehavioral Sciences, David Geffen School of Medicine at UCLA, Los Angeles, California
[3]Department of Psychology, UCLA College of Letters & Science, Los Angeles, California

(Received August 13, 2010; Final Revision October 16, 2010; Accepted October 18, 2010)

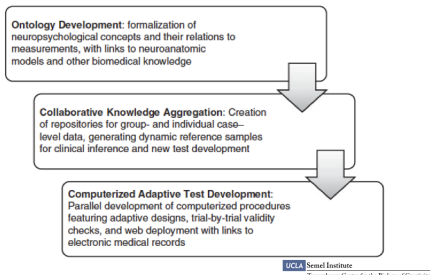
UCLA Semel Institute
Tennenbaum Center for the Biology of Creativity

The Future of NP Assessment?

- Scalable mobile assessments
  - Measure attention to visual, auditory, tactile stimuli; use augmented reality
  - Capture response times, GPS or gyro-captured motion in real world or test space
  - Use other peripheral devices to capture motion or physiological signals, HRV, more…
- IOT (internet of things)
  - Brain sensitive home – measure adl, memory, processing speed, sleep quality, diet
  - Brain sensitive car – measure sensorimotor control, stop signal, harzard avoidance
- Consider all possibilities for: acquisition, analysis, and interpretation of data

UCLA Semel Institute
Tennenbaum Center for the Biology of Creativity

Path to Development of Novel NP Paradigms



UCLA Semel Institute
Tennenbaum Center for the Biology of Creativity

Paradigm Shift from CTT to IRT-CAT

- Traditional Measurement
  - Fix items allow precision to vary
- IRT-Based CAT
  - Fix precision allow items to vary
  - 2x – 5x efficiency gain
- Change precision depending on application
  - Epidemiology – fewer items lower precision (se=.4)
  - Primary care screening – medium precision (se=.3)
  - RCTs – more items high precision (se=.2)

UCLA Semel Institute
Tennenbaum Center for the Biology of Creativity

Adaptive Testing for Clinical NP Assessment

- Prior probabilities of exam outcome (diagnoses, descriptives, recommendations) based on:
  - Referral Question
  - Demographics
  - History and Lab Results
- Stage 1: Select next procedure based on positive predictive power for each exam outcome
- Stage 2: Within procedure, select relevant precision and next item that maximizes information content
- Repeat until exit criteria are satisfied

UCLA Semel Institute
Tennenbaum Center for the Biology of Creativity

How do we get from here to there?

- Barriers
  - Legacy instruments … have a legacy
  - Inertia in the NP customer base:
    - concerns about validity of new methods
    - Prefer "tried and true" or familiar methods
  - CATs require large samples to calibrate items for IRT analysis
  - Evaluation of positive predictive power for different exam outcomes requires large samples
  - Assuming we can get enough data to generate a CAT approach to the NP exam, how would it be implemented?

National Neuropsychology Network

- National Data Archives (NDA) now aggregating item-level test data for NIH projects (autism, RDoC, ADNI), n's increasing (RDoC=12k total), BUT…
  - Patient selection follows grant inclusion/exclusion criteria – how representative?
  - Test selection follows grant protocols, usually selected experimental measures, often not tests most widely used in practice
- Meanwhile: ***Clinical NP exams = 500K/year (!)***
- Proposed:
  - National Neuropsychology Network: clinical sites sharing item-level data with NDA for open analysis, generation of back-compatible, efficient assessments, and forward-looking introduction of novel items to expand banks for existing and novel construct measurement

UCLA Semel Institute
Tennenbaum Center for the Biology of Creativity

How to launch the Neuropsychology Liberation Front?

- Collaborative data aggregation at the item level across clinics, nationwide
- Need to provide shared access to item-level data in a way that provides appropriate:
  - Privacy
  - Data security
  - Practicality for busy clinicians and staff
- Solutions:
  - Leverage current methods for data collection (e.g., Pearson Q-Interactive)
  - Develop novel software for point of testing data acquisition
  - Use existing privacy/security protocols developed by NIH for data archives (GUID)
  - Proposal: Submitted February 2018, initial review says… ?
- GOAL: simultaneously make life *easier* for clinicians AND share data to support assessments of the future.

UCLA Semel Institute
Tennenbaum Center for the Biology of Creativity

The Towers of Babel, London, Hanoi...: Which instruments should be included?

- Daunting challenge: how to accommodate the broad range of tests used?
- Surprise: despite flexible approaches to NP there is considerable homogeneity of actual tests used
- Rabin et al (2016) survey – 80% of exams covered by:
  - Wechsler Adult Intelligence Scale, 4th Edition (WAIS-IV)
  - Wechsler Memory Scale, 4th Edition (WMS-IV)
  - California Verbal Learning Test, 2nd Edition (CVLT-2)
  - Delis-Kaplan Executive Function System (D-KEFS)
    - Trail Making, Verbal Fluency, Design Fluency, Color Word Interference Test
  - OTHERS: Rey Auditory Verbal Learning Test [RAVLT], Hopkins Verbal Learning Test [HVLT], Rey Osterrieth Complex Figure Test (ROCFT), Wide Range Assessment of Memory & Learning, 2nd edition (WRAML-2), Brief Visuospatial Memory Test, Revised (BVMT-R), Wisconsin Card Sorting Test (WCST); Boston Naming Test; Mini Mental State Exam (MMSE), Montreal Cognitive Assessment (MoCA)

UCLA Semel Institute
Tennenbaum Center for the Biology of Creativity

Proposed Sites for R01MH118514

- University of Florida, c/o Russell Bauer, ABPP-CN
- Medical College of Wisconsin, c/o David Sabsevitz, ABPP-CN
- Emory, c/o Daniel Drane, ABPP-CN, David Loring, ABPP-CN
- UCLA, c/o Robert Bilder, ABPP-CN
- UCLA – coordinating, statistical expertise including:
  - Steve Reise: head of quantitative area, UCLA Psychology; Catherine Sugar, head of Semel Institute Biostatistics Core
- Pearson – collaborative deposition of Q-interactive results into NIMH Data Archive for shared use by NP community
  - James Holdnack (senior scientist), Dustin Wahlstrom (project owner, Q-i)

UCLA Semel Institute
Tennenbaum Center for the Biology of Creativity

Table 2. Tests Most Frequently Administered by NNN Sites

Battery or Domain	Test	Total x 4 years	QI	Battery or Domain	Test	Total x 4 years	QI
WAIS-IV	Digit Span	14900	*	General	MOCA	4000	
WAIS-IV	Coding	11140	*	Symptom	Beck Depression Inventory	3700	
WMS-IV	Logical Memory	10300	*	WMS-IV	Verbal Paired Associates	3620	*
WAIS-IV	Block Design	10200	*	Memory	Hopkins Verbal Learning Test	3520	
Language	Boston Naming Test	10200		WAIS-IV	Letter-Number Sequencing	3420	*
WMS-IV	Visual Reproduction	10020	*	Memory	Brief Vis Memory Test-Revised	2920	
Executive	Wisconsin Card Sorting Test	9320		Visuospatial	Facial Recognition Test	2600	
WAIS-IV	Symbol Search	8140	*	General	Mini-Mental State Exam	2000	
WAIS-IV	Similarities	8100	*	Language	WMS-III Mental Control	2000	
WAIS-IV	Matrix Reasoning	7940	*	Language	Test of Memory Malingering	1916	
WAIS-IV	Information	7620	*	Memory	Rey Auditory Verbal Learning Test	1900	
Memory	Rey Complex Figure Test	6420		PVT	Green's Word Memory Test	1640	
D-KEFS	Verbal Fluency Test	6220	*	D-KEFS	Design Fluency Test	1600	*
WAIS-IV	Arithmetic	6140	*	Exec	EXIT25	1600	
WAIS-IV	Vocabulary	6060	*	Symptom	Beck Anxiety Inventory	1500	
D-KEFS	Color-Word Interference Test	5720	*	WAIS-IV	Picture Completion	1440	*
Motor	Grooved Pegboard Test	5500		PVT	Medical Symptom Validity Test	1400	
D-KEFS	Trail Making Test	5420	*	Executive	Symbol Digit Modalities Test	1320	
General	ACS-Test of Premorbid Function	4820	*	WMS-IV	Design Memory	1180	*
Memory	California Verbal Learning Test	4820	*	Achievement	Woodcock Johnson-subtests	1060	
WAIS-IV	Visual Puzzles	4720	*	General	NIH Toolbox	1000	
Motor	Finger Tapping Test	4500		Language	Emory Semantic Fluency Paradigm	800	
Visuospatial	Judgment of Line Orientation	4120		Language	Columbia Auditory Naming Test	800	
				General	RBANS	800	

Note. QI: * test administered on Q-interactive platform. The rest will be administered via a new, tablet-based/web-based point-of-testing data acquisition program.

Structured Clinical Protocol/ Common Data Elements

- Clinical measures will include structured demographic, diagnostic, and dimensional ratings of key symptoms using instruments proposed as common data elements by the NIMH Research Panel (Barch et al., 2016):
  - Structured History Protocol for Neuropsychology (SHiP-NP)
  - Patient Reported Outcome Measures (Self-Reports)
    - DSM-5 Self-Rated Level 1 Cross-Cutting Symptoms Measure - Adult
    - Patient Reported Outcomes Measurement Information System (PROMIS) Adult Depression Computerized Adaptive Test (CAT)
    - PROMIS Adult Anxiety CAT
    - World Health Organization Disability Assessment Schedule 2.0 (WHODAS 2.0)
  - DSM-5 Clinician-Rated Dimensions of Psychosis Symptom Severity
  - NINDS CDEs, Neuro-QOL, NIDA Substance Abuse HER Data Elements, NIH Toolbox

UCLA Semel Institute
Tennenbaum Center for the Biology of Creativity

Deliverables: Data

- Collect data on 10,000 cases over 4 years and deposit all item-level data in RDoCdb (enrollment targets are 325 cases per site/year, yielding ~1300 cases/year for the network, or ~5200 cases over the 4-year period of data collection).
- Inclusion/Exclusion criteria:
  - Broad: representative of clinical NP services nationally
  - dementia and degenerative conditions, epilepsies (including psychogenic non-epileptic seizures [PNES]), movement disorders, and other complex neuropsychiatric disorders
  - In all these syndromes, depression, anxiety, or psychotic symptoms are either directly part of the differential diagnosis (e.g., "dementia vs depression") or the psychiatric symptoms may be critical moderators of cognitive impairment

UCLA Semel Institute
Tennenbaum Center for the Biology of Creativity

Table 3. Estimated Clinic Flow for Major Diagnostic Groups

Condition/Diagnostic Group	Emory	MCW	UCLA	UF	Total Per Year	Total x 4 years
Dementia, MCI, Memory Loss	250	400	280	225	1,155	4,620
Epilepsy	175	75	120	75	445	1,780
Transplant Service, Brief Inpatient Evals	5	10	50	100	165	660
Movement Disorders, Surgical, DBS	150	20	50	250	470	1,880
ADHD/Learning Disability	0	150	50	75	275	1,100
Traumatic Brain Injury	20	750	50	100	920	3,680
Neoplasm, Stroke	50	150	50	50	300	1,200
Primary Psychiatric	55	0	50	25	130	520
TOTAL	705	1,555	700	900	3,860	15,440

Deliverables: Results

- Evidence-based battery selection – this includes adaptive test selection within batteries of tests, to determine which test in the battery provides the highest predictive power for selected differential diagnostic applications, given prior test results
- Computerized adaptive tests – including adaptive item selection within tests, given prior item results, to provide measurement of specific traits with prescribed levels of precision
- Fixed short-forms of tests that increase efficiency of testing even when adaptive testing is not practical
- Analyses will examine test operating characteristics, sensitivity, specificity, positive and negative predictive power of both original and new measures to aid in differential diagnosis of neurocognitive disorders and major psychiatric syndromes
- Establish a testbed for evidence, enabling future measures to be examined directly for equivalence or superiority

UCLA Semel Institute
Tennenbaum Center for the Biology of Creativity

UCLA Semel Institute
Tennenbaum Center for the Biology of Creativity

Many thanks!

rbilder@mednet.ucla.edu

http://www.semel.ucla.edu/creativity
http://healthy.ucla.edu