

The NIH Toolbox: The Development of a Measure of Episodic Memory/Learning

Patricia Bauer¹, Sureyya Dikmen², Robert Heaton³, Dan Mungas⁴, Jerry Slotkin⁵, Richard Gershon⁵

1. Emory University; 2. University of Washington; 3. University of California - San Diego; 4. University of California - Davis; 5. Northwestern University

ABSTRACT

Objective:

Develop a measure of memory and learning for the NIH Toolbox that is applicable across the age span of 3 to 85, easy to use, and in the public domain. Based on extensive review of the literature, the Imitation Based Assessment of Memory (IBAM), an experimental procedure used in studying episodic memory in infants and young children, was chosen for development. The NIH Toolbox seeks to assemble brief, comprehensive assessment tools that will be useful in particular in measuring outcomes in epidemiologic studies and clinical trials across the lifespan.

Methods:

The IBAM involves computerized presentation of a sequence of pictures in a fixed order, and the subject is asked to reproduce the order over three learning trials. The score is the number of adjacent pairs correctly reproduced. Number of pictures in the sequence reflects the difficulty level of the task, and varies by age. Several waves of pre-testing involving 270 subjects have been performed to derive the number of steps necessary for different age bands, number of learning trials necessary, test-retest reliability, and relationship to "gold standard" measures of episodic memory. Preliminary data are encouraging in indicating that the IBAM is usable across the target age span, is reliable, and relates well to gold standards in the field.

Conclusions:

Based on pilot and pre-testing performed to date, IBAM appears to be a promising measure of episodic memory. Validation will be performed on an additional 600 subjects, and SOME of the results will be available for presentation at INS meeting.

Imitation Based Assessment of Memory 15-step sequence



Pictures are displayed one at a time until the entire sequence is represented. Pictures then appear in the center of the screen, in random order, and subjects are required to place them in the correct order.

Subjects:	158 normal subjects age 20-60 were examined, of which 52 were re-examined 2 weeks later
IBAM	Imitation Based Assessment of Memory (IBAM) is a measure being developed for the NIH Toolbox involving computerized presentation of a 15-step sequence of pictures in a fixed order. The subject is asked to reproduce the order of the pictures after each of three learning trials. The score is the number of adjacent pairs of pictures correctly reproduced over 3 trials. For this age group 15 step sequence was used.
Validation Measures:	Rey Auditory Verbal Learning Test (RAVLT) is a list of 15 unrelated words presented in a fixed order over 3 learning trials. The subject is asked to repeat the list in any order after each presentation. The score is the number of correct words recalled. Was used to test convergent validity.
	Brief Visuospatial Memory Test-Revised (BVMT-R) is a 3-trial measure of visual-spatial memory/learning requiring reproduction of geometric forms. The score is the number of figures correctly reproduced. Was used to test convergent validity.
	Vocabulary This is a measure of receptive vocabulary, similar in format to the Peabody Picture Vocabulary Test-Fourth Edition, is CAT-administered and provides a measure of general verbal ability. Was used to test divergent validity.
	Reading This is a CAT-administered measure of reading recognition, in which the subject reads aloud singly presented letters and words. It is similar to the Wide Range Achievement Test-Fourth Edition. Was used to test divergent validity.
Data Analyses	Test-retest correlations for the IBAM and for the gold standard measures of memory were calculated to examine reproducibility. Correlations with RAVLT and BVMT-R were calculated to determine convergent validity. Correlations with Vocabulary and Reading were calculated to determine divergent validity. To examine effects of age and gender, the scores on the three memory measures were transformed into z scores and group differences examined using one-way ANOVAs.

RESULTS

Test Retest Correlations

	IBAM	RAVLT	BVMT-R
IBAM	.73		
RAVLT		.67	
BVMT-R			.73

Test-retest correlations:

IBAM Test-retest correlation is comparable to gold standard measures of memory

Convergent Validity

IBAM-RAVLT	.52
IBAM-BVMT-R	.58
RAVLT-BVMT-R	.47

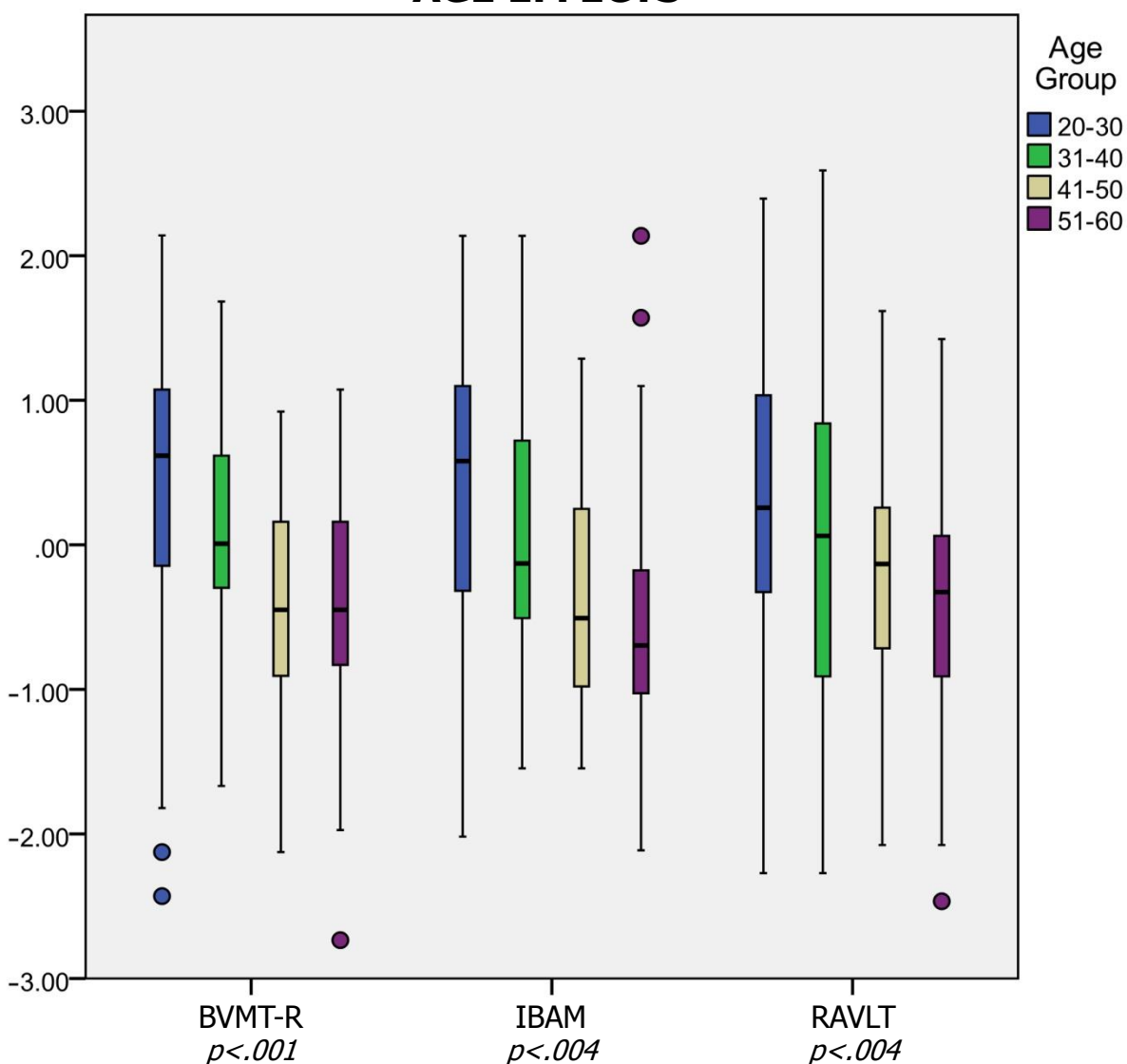
IBAM captures similar constructs as other well established measures of memory.

Divergent Validity

IBAM-Vocabulary	.051
IBAM-Reading	.275

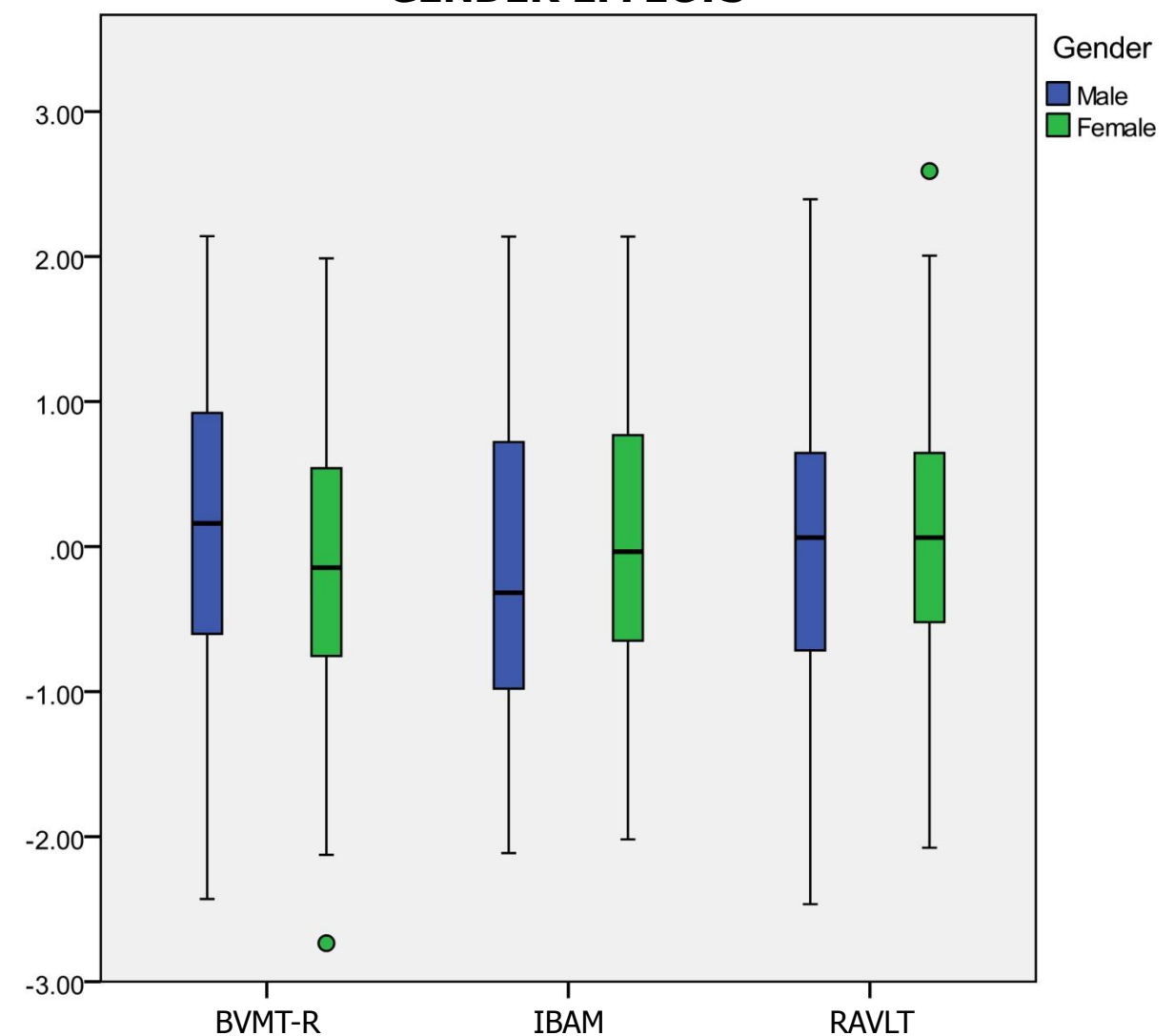
The relationships of IBAM to measures of crystallized intelligence are low, as expected

AGE EFFECTS



Z-Scores by Age Group for BVMT-R, IBAM, and RAVLT

GENDER EFFECTS



Z-Scores by Gender for BVMT-R, IBAM, RAVLT

CONCLUSIONS: IBAM is a promising measure of episodic memory/learning. Its test-retest reliability is comparable to those of the gold standards, and it shows good convergent and divergent validity. It also shows age effects even within a relatively narrow age range. IBAM may obviate language barriers, has 3 alternate forms, and will be in the public domain.