

Virtual Reality Cognitive Performance Assessment Test (VRCPAT)

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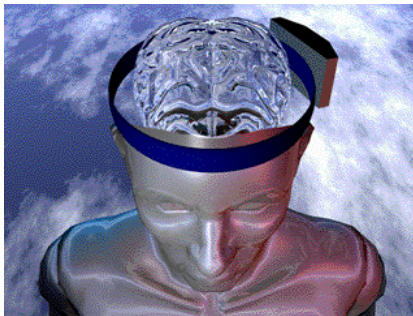
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VRPSYCH LAB
Virtual Reality Psychology & Social Interactions



NEUROPSYCHOLOGY



The Study of Brain/Behavior Relationships



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Virtual Reality Psychology & Social Interactions



NEUROPSYCHOLOGY

- Standardized tests used in a neuropsychological evaluation typically assess functioning in the following areas:
 - Attention
 - Executive functions
 - Language functions
 - Processing Speed
 - Learning and Memory
 - Visual-spatial functions
 - Sensory-Perceptual functions
 - Motor functions
- Academic skill development and emotional functioning are typically assessed as well.



WWI (Yerkes) Classify & Assign Recruits

- **Army Alpha** (literate)
 - arithmetical reasoning
 - practical judgment
 - synonym–antonym pairs
 - disarranged sentences
 - number series completion
 - Analogies & information
- **Army Beta** (illiterates)
 - Visual perceptual tests
 - Motor tests



Neuropsych Testing

Army
Alpha

DISARRANGED SENTENCES

Can these words be rearranged to form a sentence?
 envy bad malice traits are and true? or false?

NUMBER SERIES COMPLETION

Complete the series: 3 6 8 16 18 36

ANALOGIES

Which choice completes the analogy?
 tears—sorrow :: laughter— joy smile girls grin
 granary—wheat :: library— desk books paper librarian

INFORMATION

Choose the best alternative:
 The pancreas is in the abdomen head shoulder neck
 The Battle of Gettysburg was fought in 1863 1813 1778 1812

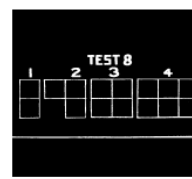
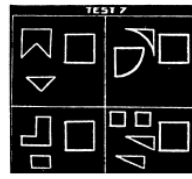
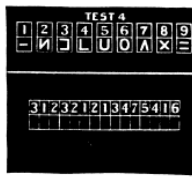
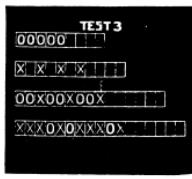
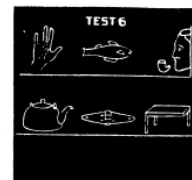
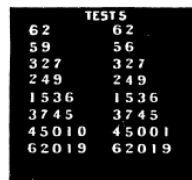
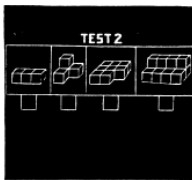
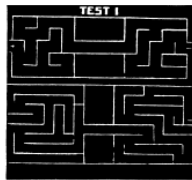
Note: Examinees received verbal instructions for each subtest.

FIGURE 1.1 Sample Items from the Army Alpha Examination
 Source: Reprinted from Yerkes, R. M. (Ed.), (1921). *Psychological examining in the United States Army. Memoirs of the National Academy of Sciences, Volume 15.* With permission from the National Academy of Sciences, Washington, DC.



Neuropsych Testing

Army
Beta



WAIS–III Subtests for IQ Scores

Verbal

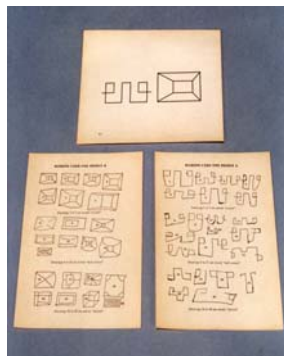
- Vocabulary
- Similarities
- Arithmetic
- Digit Span
- Information
- Comprehension

Performance

- Picture Completion
- Digit Symbol—Coding
- Block Design
- Matrix Reasoning
- Picture Arrangement



Neuropsych Tests: 1905



Binet (1905) Drawing a Design from Memory

“The subject is told that two designs will be shown to him, which he will be allowed to look at for ten seconds, and which he must then draw from memory.”



Neuropsych Tests: Now



Wechsler Memory Scale: Visual Reproduction Subtest

“The subject is told that two designs will be shown to him, which he will be allowed to look at for ten seconds, and which he must then draw from memory.”



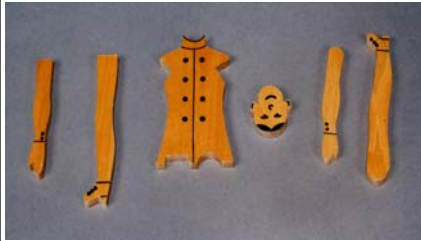
Neuropsych Tests: 1917



The Manikin Test: Developed by Pitner- Patterson, 1917



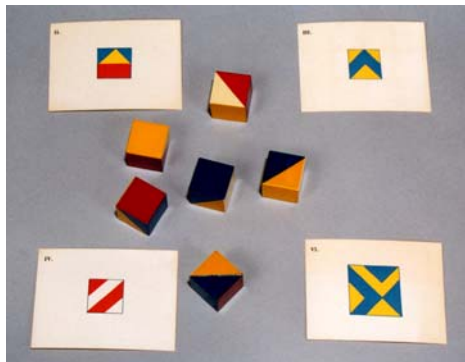
Neuropsych Tests: Now



Now the “Object Assembly”
Subtest on the WAIS, WISC



Neuropsych Tests: 1915



Kohs Blocks (1915)



Neuropsych Tests: Now



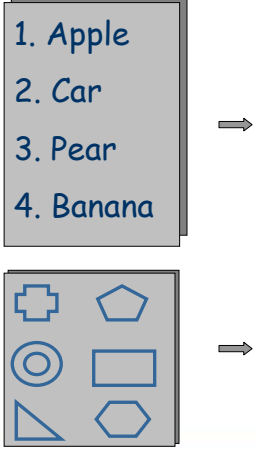
Now the “Block Design”
Subtest on the WAIS,
WISC, etc.



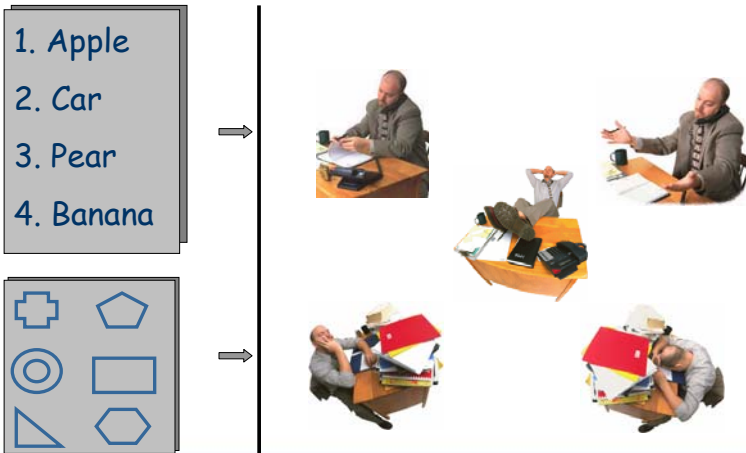
Ecological Validity: Relevance to Real World Functioning



Generalization of Ability



Generalization of Ability



*Are we still limited to using methods
developed 60-100 years ago!*



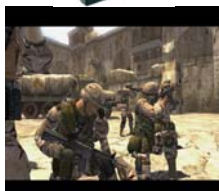
Virtual Reality Cognitive Performance Assessment Test (VRCPAT)

Developed from FSW and PTSD modules



Full Spectrum Warrior

X-Box Game Conversion for Iraq War PTSD clients!



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Full Spectrum VR Exposure Therapy for Iraq War PTSD



Funded by

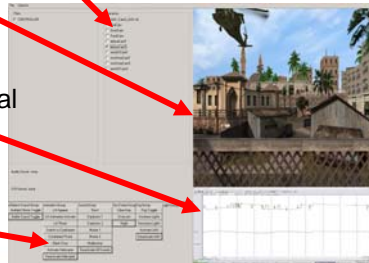
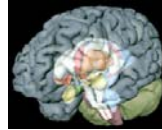


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“Wizard of OZ” Interface

- Scenario Settings
 - Location, Time of Day, Weather, etc.
- User Perspective
 - Alone, Patrol, HUMVEE, Helicopter, etc.
- Real-Time Psychophysiological Display
- TRIGGER Stimuli



Scent and Vibration



Envirodine Scent System

- Gunpowder
- Cordite
- Body Odor
- Garbage
- Burning Rubber
- Diesel Fuel
- Iraqi Spices

And Night Vision HMD Rig...



Virtual Reality Cognitive Performance Assessment Test (VRCPAT)



VRCPAT

- VRCPAT
 - Recycle graphic assets
 - FSW
 - Subsequent VR training tools (e.g. PTSD module)
 - Develop a comprehensive, standardized, norm-based VR cognitive performance assessment test battery
 - Compare data with traditional neurocognitive assessment battery



Procedure

- **Neuropsychological battery**
 - Pencil/paper tests: including Self-reports and Demographics
- **Virtual Reality (VRCPAT)**
 - Learning Phase: Trials 1–3 (Similar to HVLIT & BVMT-R)
 - VR Acclimation Phase
 - VRCPAT Immersion Phase
 - Capture images of 10 items (from Acquisition Phase: Trials 1-3)
 - 2 images at each of the 5 Zones
 - Time limit = 1 min. for each Zone
 - Actual immersion is around 15 min.



Participants

- Sample:
 - 30 healthy subjects (50% female)
 - Recruited from undergraduate and graduate schools.
- Comparable in age, education, ethnicity, sex, self-reported symptoms of depression
- Age Range:
 - 21 to 36 (mean = 24.97, SD = 3.78)
- Education Range:
 - 13 to 20 years (mean = 16.13, SD = 1.69)
- Inclusion/Exclusion Criteria:
 - Excluded persons with significant psychiatric history
 - Excluded persons with significant neurologic history
- USC's Institutional Review Board




Neuropsychological Battery

Learning	- HVLT Trials 1–3 - BVMT-R Trials 1–3
Memory	- HVLT Retention and Recognition - BVMT-R Retention and Recognition
Executive Functions	- TMT B - Stroop Interference
Attentional Processing	- WAIS-III Digit Span Forward - WAIS-III Digit Span Backward
Processing Speed	- TMT A - Digit Coding
Verbal Fluency	- Category Fluency - Letter Fluency



Learning Phase

1. intact wooden barrel with US Army stencil
2. man with blue shirt (white stripes)
3. tanned Caucasian American soldier with moustache
4. camel with an M brand on rear left side
5. large red shipping container numbered 7668
6. sealed wooden crate with Iraqi flag on side corner 
7. injured brown and white dog on its side
8. blue car with bullet holes in the windshield
9. sign above door with English words "Internet Homeland"
10. Robed man holding cell phone by graffiti image of Saddam on wall



Learning Phase: Free Recall

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.



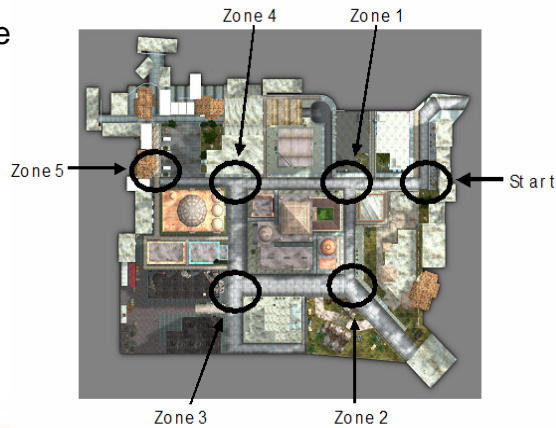
VR Acclimation

- Demonstrate and Explain:
 - Head Mounted Display, earphones, and controller
 - Adjustments are made for a proper fit.
- Acclimatation:
 - Participant navigates the Virtual Environment
- *Once instructions are clear, participant begins scenario*

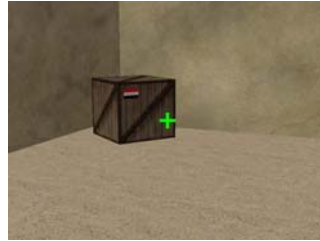


VRCPAT Immersion Phase

- Capture images of 10 items
 - from Acquisition Phase
 - Trials 1-3
- 2 images at each of 5 Zones
- Time limit = 1 min. for each Zone
- Actual immersion is around 15 min.



Zone Targets



- Targets:
 - Injured brown and white dog on its side
 - Sealed wooden crate with Iraqi flag on side corner



Zone Distractors



- Distractors:
 - Blue car **WITHOUT** bullet holes in the windshield
 - Man with **RED** (instead of blue) shirt (white stripes)
 - Caucasian American soldier **WITHOUT** moustache



Post-exposure Procedure

- **Item Recall:**
 - Participant asked to recall the 10 items
 - Participant asked to name the Zone in which each item was found
- **Item Recognition:**
 - Participant asked to recognize the 10 items from a series of targets and distractors
- Complete Beck Depression Inventory and Post-exposure Checklist.



VRCPAT: Construct Validity

- **Convergent Principle:**
 - measures of constructs that are *related* to each other should be *strongly* correlated
- **Discriminant Principle**
 - measures of *different* constructs should *not* correlate highly with each other



Convergent Validity: Correlations between NP test scores and VRCPAT Total Memory Score

	r(x,y)	r ²	T	p
Learning				
HVLT Trials 1-3	0.58	0.34	3.78	<.01
BVMT-R Trials 1-3	0.75	0.56	6.01	<.01
Memory				
HVLT Retention	0.50	0.25	3.05	<.01
BVMT-R Retention	0.40	0.16	2.29	<.01

Note: For all analyses, N equals 30. HVLT = Hopkins Verbal Learning Test; BVMT R = Brief Visuospatial Memory Test – Revised.



Theory

Convergent Validity

Neuropsychological tests (HVLT; BVMT) reflect a memory construct

Memory construct

Verbal Learning

Verbal Memory

Visual Learning

Visual Memory

Observation

VRCPAT & NP Test Correlations

Learning

HVLT Trials 1-3	0.58
BVMT-R Trials 1-3	0.75

Memory

HVLT Retention	0.50
BVMT-R Retention	0.40

the correlations provide evidence that the items all converge on the same construct



Table 4: Discriminant Validity: Correlations between NP test scores & VRCPAT

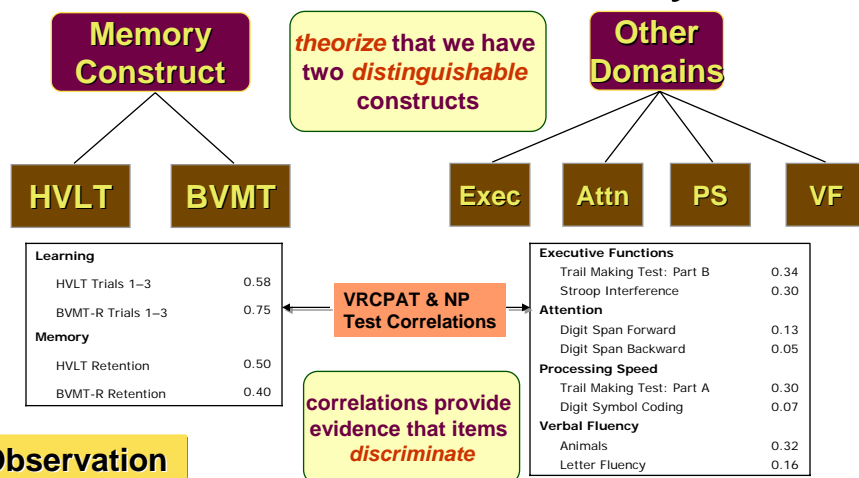
	r(x,y)	r ²	t	p
Executive Functions				
Trail Making Test: Part B	0.34	0.12	1.94	ns
Stroop Interference	0.30	0.09	1.66	ns
Attention				
Digit Span Forward	0.13	0.02	0.68	ns
Digit Span Backward	0.05	0.00	0.29	ns
Processing Speed				
Trail Making Test: Part A	0.30	0.09	1.67	ns
Digit Symbol Coding	0.07	0.01	0.39	ns
Verbal Fluency				
Animals	0.32	0.10	1.79	ns
Letter Fluency	0.16	0.03	0.86	ns

Note: For all analyses, N equals 30.



Theory

Discriminant Validity



Observation



Conclusions

Convergent Validity

- VRCPAT correlated significantly with traditional neuropsychological Learning and Memory composites.

Discriminant Validity

- No significant correlations existed between VRCPAT measures and non-memory composites:
 - Executive Functions
 - Attention
 - Processing Speed
 - Verbal Fluency.



Conclusions

Findings suggest that the VRCPAT measures a capacity. . .

- Consistent
 - with traditional measures of learning and memory
 - Convergent Validity
- Inconsistent
 - with potential confounds
 - Discriminant Validity
- Conclusions
 - VRCPAT has adequate construct validity
 - provides a unique opportunity to reliably and efficiently study memory function within an ecologically valid environment.

