

Administration, Scoring, and
Basic Interpretation

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Memory and Learning

- ♦ Learning - process of acquiring new information.
- ♦ Memory - persistence of learning in a state that can be revealed at a later time" (Squire, 1987).
- ♦ WMS-IV measures ability to learn and remember information presented verbally and visually.

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Process of Learning and Remembering

Encoding	External information is transformed into mental representations or memories and stored in STM.
Consolidation	Information from immediate memory is solidified into long-term memory stores.
Retrieval	Information is brought into conscious awareness.

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WMS-IV and Long-term Memory

- ◆ Ability to store and retrieve bits of information or knowledge consciously - declarative memory (Squire & Butters, 1992).
- ◆ Ability to store and retrieve information that is situation and context specific - episodic memory.

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Test Structure and Scores
See Record Form

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WMS-IV: TWO Batteries

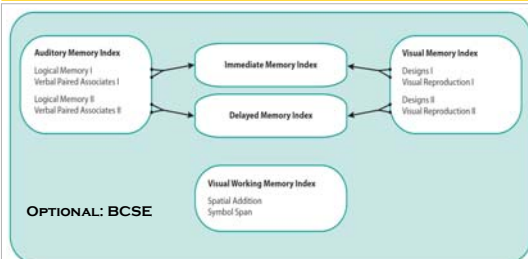
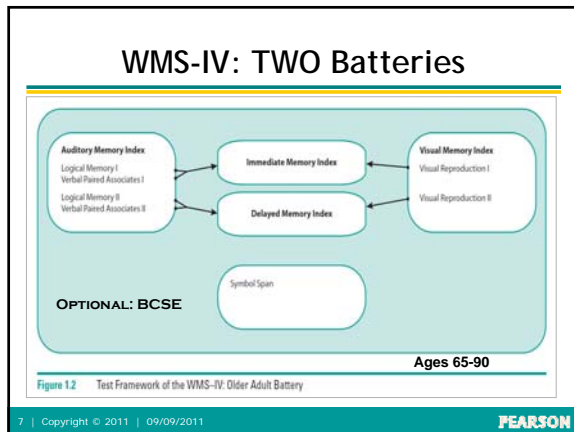


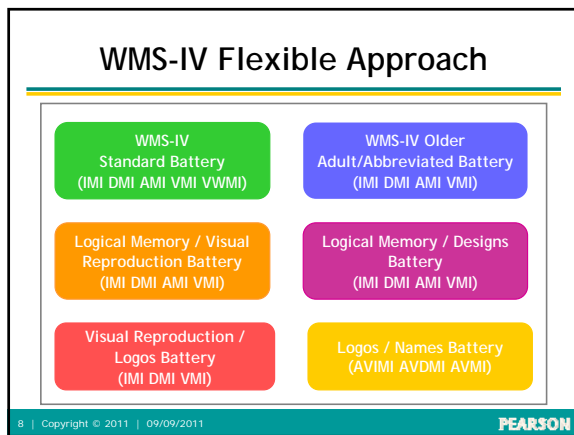
Figure 1.1 Test Framework of the WMS-IV: Adult Battery

Ages 16-69

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Index Structure of WMS-III / WMS-IV

WMS-III Index/Subtest	WMS-IV Index/Subtest
<i>Auditory Immediate</i>	<i>Auditory Memory</i>
Logical Memory I	Logical Memory I
Verbal Paired Associates I	Verbal Paired Associates I
<i>Auditory Delayed</i>	Logical Memory II
Logical Memory II	Verbal Paired Associates II
Verbal Paired Associates II	
<i>Auditory Recognition Delayed</i>	
Logical Memory II Recognition	
Verbal Paired Associates II Recognition	

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Index Structure of WMS-III / WMS-IV

WMS-III <i>Index/Subtest</i>	WMS-IV <i>Index/Subtest</i>
<i>Visual Immediate</i>	<i>Visual Memory</i>
Faces I	Designs I
Family Pictures I	Visual Reproduction I
<i>Visual Delayed</i>	Designs II
Faces II	Visual Reproduction II
Family Pictures II	<i>Visual Working Memory</i>
<i>Working Memory</i>	Spatial Addition
Letter-Number Sequencing	Symbol Span
Spatial Span	

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Index Structure of WMS-III / WMS-IV

WMS-III <i>Index/Subtest</i>	WMS-IV <i>Index/Subtest</i>
<i>Immediate Memory</i>	<i>Immediate Memory</i>
Logical Memory I	Logical Memory I
Verbal Paired Associates I	Verbal Paired Associates I
Faces I	Designs I
Family Pictures I	Visual Reproduction I
<i>General Memory</i>	<i>Delayed Memory</i>
Logical Memory II	Logical Memory II
Faces II	Verbal Paired Associates II
Verbal Paired Associates II	Visual Reproduction II
Family Pictures II	Designs II
Logical Memory II Recognition	
Verbal Paired Associates II Recognition	

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Brief Cognitive Status Exam

This *optional* subtest assesses a variety of cognitive functions. The examinee performs simple tasks in a number of different areas including

- ✓ orientation to time,
- ✓ mental control,
- ✓ clock drawing,
- ✓ incidental recall,
- ✓ automaticity and inhibitory control, and
- ✓ verbal production.

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Auditory Memory Index

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Logical Memory I

- This subtest assesses narrative memory under a free recall condition.
- Two short stories are presented orally.
- For older adults, one story is presented twice.
- The examinee is asked to retell each story from memory immediately after hearing it.

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Logical Memory II

The delayed condition assesses long-term narrative memory with free recall and recognition tasks.

- The examinee is asked to retell both stories from the immediate condition.
- Then the examinee is asked yes/no questions about both stories - Recognition.

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Verbal Paired Associates I

- ◆ This subtest assesses verbal memory for associated word pairs.
- ◆ The examiner reads 10 or 14 word pairs to the examinee. Then, the examiner reads the first word of each pair, and asks the examinee to provide the corresponding word.
- ◆ There are four trials of the same list in different orders.

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Verbal Paired Associates II

- ◆ The delayed condition assesses long-term recall for verbally paired information with cued recall and recognition tasks, and includes a free recall task.
- ◆ The examinee is orally presented with the first word of each pair learned in the immediate condition and asked to provide the corresponding word.

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Verbal Paired Associates II

- ◆ The examinee is then read a list of word pairs and asked to identify each as either one of the word pairs he or she was asked to remember or a new word pair.
- ◆ Finally, during the optional word recall task, the examinee is asked to say as many of the words from the pairs as he or she can recall.

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California Verbal Learning Test-II: Substitution

- ◆ CVLT-II Total Trials 1-5 can be substituted for VPA I
- ◆ CVLT-II Long Delay Free Recall can be substituted for VPA II

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Interpretive Considerations: LM and VPA

- ◆ Both measure aspects of semantic and auditory memory.
- ◆ Presentation of information is organized/ meaningful for LM and unorganized for VPA.
- ◆ VPA requires single word responses; LM requires longer, more cohesive responses.
- ◆ VPA is multi-trial learning measure. For Adult Battery, LM represents single-trial learning ability.

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Visual Memory Index

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Visual Reproduction I

- ◆ This subtest assesses memory for nonverbal visual stimuli.
- ◆ A series of five designs is shown, one at a time, for 10 seconds each.
- ◆ After each design is presented, the examinee is asked to draw the design from memory.

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Visual Reproduction: Scoring

- ◆ See Appendix B (Adm Manual) for scoring criteria for each item.
- ◆ Do not penalize or mistake poor motor control for memory or orientation issues.
- ◆ Use scoring template.

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Instructions Linking Immediate and Delayed Tasks

VR is first subtest administered.

Say, Later I will ask you to draw all of the designs again, so try to remember them.

If VR is not administered, present adapted statement after the first subtest you administer.

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Visual Reproduction II

The delayed condition assesses long-term visual- spatial memory with free recall and recognition tasks, and includes a direct copy task.

- First, the examinee is asked to draw the designs shown during the immediate condition. Designs are drawn from memory in any order.

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Visual Reproduction II

- Second, the examinee is asked to choose which of six designs on a page matches the original design shown during the immediate condition.
- Third, for an optional copy task, the examinee is asked to draw the designs while looking at them.

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Designs I

- ♦ This subtest assesses spatial memory for unfamiliar visual material.
- ♦ The examiner shows examinee a grid with 4-8 designs on a page for 10 seconds, and then removes the page from examinee's view.
- ♦ The examinee then selects the designs from a set of cards and places the cards in a grid in the same place as previously shown.

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Designs II

- ◆ The delayed condition assesses long-term spatial and visual memory with free recall and recognition tasks.
- ◆ First, the examinee is asked to recreate the pages shown in the immediate condition with the cards and grid.

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Designs II

- ◆ Then he or she is shown a series of grids and asked to select the two designs that are correct and in the same place as on the pages shown in the immediate condition.

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Interpretive Considerations: VR and DE

- ◆ Both measure aspects of visual details and spatial memory.
- ◆ Response process for VR includes more visual-construction and fine motor abilities than DE.

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Interpretive Considerations: VR and DE

- ◆ DE has greater recognition memory component than VR which uses a free recall response format.
- ◆ DE evaluates spatial memory explicitly; VR does not.
- ◆ Stimuli for VR are easier to name than stimuli on DE. This may facilitate memory by using verbal cues.

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Visual Working Memory Index

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Spatial Addition (Ages 16-69)

- ◆ Spatial Addition replaces Spatial Span.
- ◆ Assesses visual-spatial working memory using a visual addition task.
- ◆ Examiner shows the examinee, sequentially, two grids with blue and red circles. [5 sec.]
- ◆ Then, examiner asks examinee to add or subtract the location of the circles based on a set of rules.

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Symbol Span

- ◆ This subtest assesses visual working memory using novel visual stimuli.
- ◆ The examinee is briefly shown a series of abstract symbols on a page and then asked to select the symbols from an array of symbols, in the same order they were presented on the previous page.

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Interpretive Considerations: SA and SSP

- ◆ SA taps spatial location memory and the ability to compare spatial images.
- ◆ SSP is highly focused on recall of visual details and the sequence of the images must also be maintained in memory.
- ◆ SA uses a free recall format.
- ◆ SSP uses a recognition memory format.

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Scores

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Types of Scores

- ◆ Primary Subtest Scaled Scores (mean=10, sd = 3; range 1 - 19)
- ◆ Index Scores (mean=100, sd = 15; range 40 - 160)
- ◆ Process Scores (Scaled Score or Cumulative Percentage)
- ◆ Contrast Scaled Scores

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Contrast Scores - Note!

The basis of the comparison for contrast scores is other people of similar performance levels on the initial/control skill, not age-based peers.

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Contrast Score Overview

- ◆ Scored on 1-19 Scaled Score Metric.
- ◆ Does not replace normative scores.
- ◆ Answers specific hypothesis about an examinee's performance relative to his/her performance on other measures.

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Contrast Score Overview

- ◆ Normative score asks: Is this person's delayed memory impaired?
- ◆ Contrast score asks: Is this person's delayed memory impaired given his/her initial encoding ability?

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Contrast Score Interpretation

High scores (13 and above) indicate better than expected performance on the dependent variable given performance on the control variable.

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Contrast Score Interpretation

Low scores (7 and below) indicate poorer than expected performance on the dependent score given performance on the control score.

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Contrast Score Interpretation

Scores in the average range (8-12) indicate no difference in performance between the control and dependent measures.

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Contrast Scores: Example

Normative Scores

- Joe obtained a 6 on VR I and a 6 on VR II
- Interpret VR I and VR II as impaired in comparison to his same age peers

Simple Difference Discrepancy Analysis

- $VR I (6) - VR II (6) = 0$
- Difference is not statistically significant

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Contrast Scores: Example

Final Interpretation Using Simple Difference

- Both VR I and VR II are impaired but are not significantly different from one another

Suggested Intervention

- Target interventions toward both encoding and retrieval deficits

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Contrast Scores: Example

Normative Scores

- Joe obtained a 6 on VR I and a 6 on VR II

Contrast Score

- VR I vs. VR II Contrast Scaled Score is 8

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Contrast Scores: Example

Final Interpretation Using Contrast Scaled Score

- In relation to his peers, both immediate and delayed memory are impaired.
- Contrast score shows that VR Delayed is actually within average range (SS=8) when adjusted for his immediate ability.

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Contrast Scores: Example

Final Interpretation Using Contrast Scaled Score

- His delayed memory performance is being impacted by his immediate memory ability.
- Thus, his critical memory problem may be in initial encoding ability.

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Contrast Scores: Example

Suggested Intervention

- ◆ Target intervention toward encoding difficulties.

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Interpretation

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Interpreting WMS-IV Data

1. Auditory Memory
 - Index Score
 - Subtest Scores
 - Process Scores
 - Forgetting and Retrieval

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Interpreting WMS-IV Data

2. Visual Memory
 - Index Score
 - Subtest Scores
 - Process Scores
 - Forgetting and Retrieval

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Interpreting WMS-IV Data

3. Modality Specific Memory Ss and Ws
4. Visual Working Memory
5. Visual Memory Abilities Compared to Visual Working Memory Abilities
6. Immediate and Delayed Memory (Retention of Information)

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See Sample Interpretive Report

Sofia Estrange
Age 40 years 3 months

Data from WMS-IV Administration and Scoring Manual

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Summary of Needs

- Sofia displayed a notable amount of forgetting between the immediate and delayed tasks of the WMS-IV.
- Her delayed memory is much lower than expected given her level of initial encoding.
- Sofia may benefit from using associative linkages when encoding information. By linking new information to what has been previously learned, she may be able to gain a more global understanding of the information and improve recall.

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Recommendations

- Encourage Sofia to use external memory sources such as lists, date books, calendars, and pocket-size recorders for information that must be remembered.
- Teach Sofia “self-cueing” strategies may help facilitate her retrieval of information.

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Technical Properties

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Standardization Sample

- 16-90 years, n = 1400 total
 • 100 per age band (14 age bands)
 Based on 2005 US Census
 Exclusionary Criteria
 Stratified proportionately
- Age
 - Gender
 - Race/Ethnicity (White, African American, Hispanic, Asian, and Other)
 - Education level
 - Geographic region

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Reliability

Index	Average r (Ages 16-69)	Average r (Ages 65-90)
Auditory Memory	.95	.95
Visual Memory	.96	.97
Visual Working Memory	.93	
Immediate Memory	.95	.95
Delayed Memory	.94	.92

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Construct Validity

Table 4.4 Normative Sample Goodness-of-Fit Statistics for Confirmatory Factor Analysis

Model	Goodness-of-Fit Index				
	χ^2	df	AGFI	RMSEA	TLI
Adult					
Ages 16-24 (n = 300)					
Model 1	2.62	8	.992	.000	1.000
Model 2	1.50	6	.994	.000	1.000
Ages 25-44 (n = 300)					
Model 1	12.68	8	.963	.044	0.977
Model 2	9.85	6	.960	.046	0.975
Ages 45-69 (n = 300)					
Model 1	12.05	8	.966	.041	0.977
Model 2	10.65	6	.958	.051	0.965
Overall 16-69 (n = 900)					
Model 1	18.54	8	.982	.038	0.982
Model 2	17.11	6	.977	.045	0.975

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Studies of Concurrent Validity

- ◆ WMS-III
- ◆ WMS-III Abbreviated
- ◆ CVLT-II
- ◆ Children's Memory Scale
- ◆ WAIS-IV
- ◆ WAIS-III
- ◆ WISC-IV
- ◆ RBANS
- ◆ DKEFS
- ◆ WIAT-II
- ◆ ILS
- ◆ ABAS-II
- ◆ Brown ADD Scales
- ◆ BDI-II
- ◆ BDI-Fast Screen

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WAIS-IV and WMS-IV

Co-normed

- Allows more accurate estimation of correlations between measures

Important to consider context

- WMS-IV evaluates memory within a context (e.g., Visual, Auditory)

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Correlation Between WAIS-IV and WMS-IV Indexes

	Verbal Comp	Perceptual Reasoning	Working Memory	Process Speed	Full Scale	GAI
Auditory Index	.53	.44	.50	.40	.57	.54
Visual Index	.44	.62	.47	.45	.61	.58
Visual Working Memory	.53	.66	.62	.51	.71	.66
Immediate Index	.57	.61	.57	.51	.70	.66
Delayed Index	.51	.55	.51	.44	.61	.58

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Clinical Studies

- Alzheimer's Disease
- Mild Cognitive Impairment
- Major Depression
- Traumatic Brain Injury
- Right and Left Temporal Lobectomy
- Schizophrenia
- ADHD
- Reading Disorder
- Mathematics Disorder
- Autism
- Asperger's
- Intellectual Disability

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Mild Cognitive Impairment

WMS-IV Index	Clinical Mean	Control Mean	Mean Diff.	<i>p</i> value	Effect Size
AMI	89.9	105.6	15.65	<.01	1.05
VMI	89.3	102.1	12.84	<.01	0.89
VWMI	91.6	107.2	15.54	<.01	1.22
IMI	90.8	105.8	15.00	<.01	1.09
DMI	87.5	103.5	16.00	<.01	1.01

n = 50 (ages 55-84)

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Probable Dementia of the Alzheimer's Type

WMS-IV Index	Clinical Mean	Control Mean	Mean Diff.	<i>p</i> value	Effect Size
AMI	68.5	107.1	38.60	<.01	2.24
VMI	69.7	102.5	32.85	<.01	2.00
IMI	71.7	107.4	35.71	<.01	2.16
DMI	63.6	104.6	40.98	<.01	2.39

n = 48 (ages 65-89)

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Intellectual Disability- Mild Severity

WMS-IV Index	Clinical Mean	Control Mean	Mean Diff.	p value	Effect Size
AMI	64.4	98.3	33.84	<.01	2.47
VMI	68.9	97.6	28.66	<.01	2.40
VWMI	63.0	96.6	33.53	<.01	2.96
IMI	63.1	97.2	34.13	<.01	3.27
DMI	63.1	97.9	34.83	<.01	3.13

n = 32 (ages 16-58)

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