Assessing Memory Using the WRAML3 in School Settings

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ASPP Fall Conference, 2022

Overview and Disclaimer

Wayne Adams is a co-author of the WRAML3 and as such receives royalties on the sales of test materials and scorings from Pearson.

Workshop Participant Agreement

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Assessment of Memory

Is it needed?

Common Referrals often involving Investigation of Memory Deficits

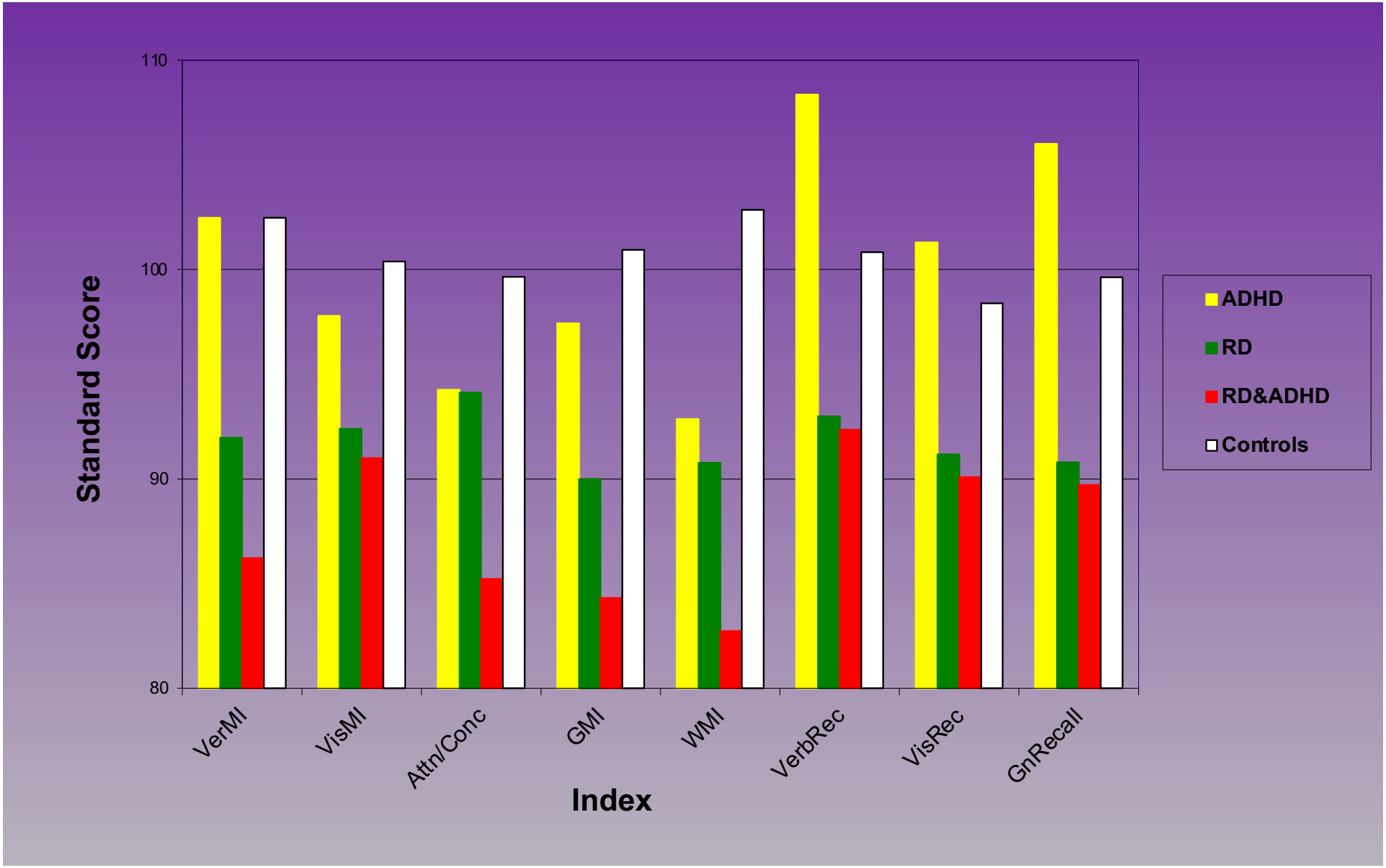
Children/Adolescents

- TBI
- Disease of the brain
- Substance abuse
- Hypoxia/anoxia
- Seizure Disorder
- Tumor
- Congenital and Genetic Disorders (FAS, Fragile X)
- Developmental disorders (ID, NF, LD, ADHD, etc.)

WRAML3 and WRAT5

WRAML3 Index	WRAT5			
	Word Reading	Spelling	Math Comp.	RC Sentence
GIMI	.50	.47	.37	.53
GDM	.40	.40	.39	.52
ACI	.51	.49	.33	.44
WMI	.62	.54	.50	.59

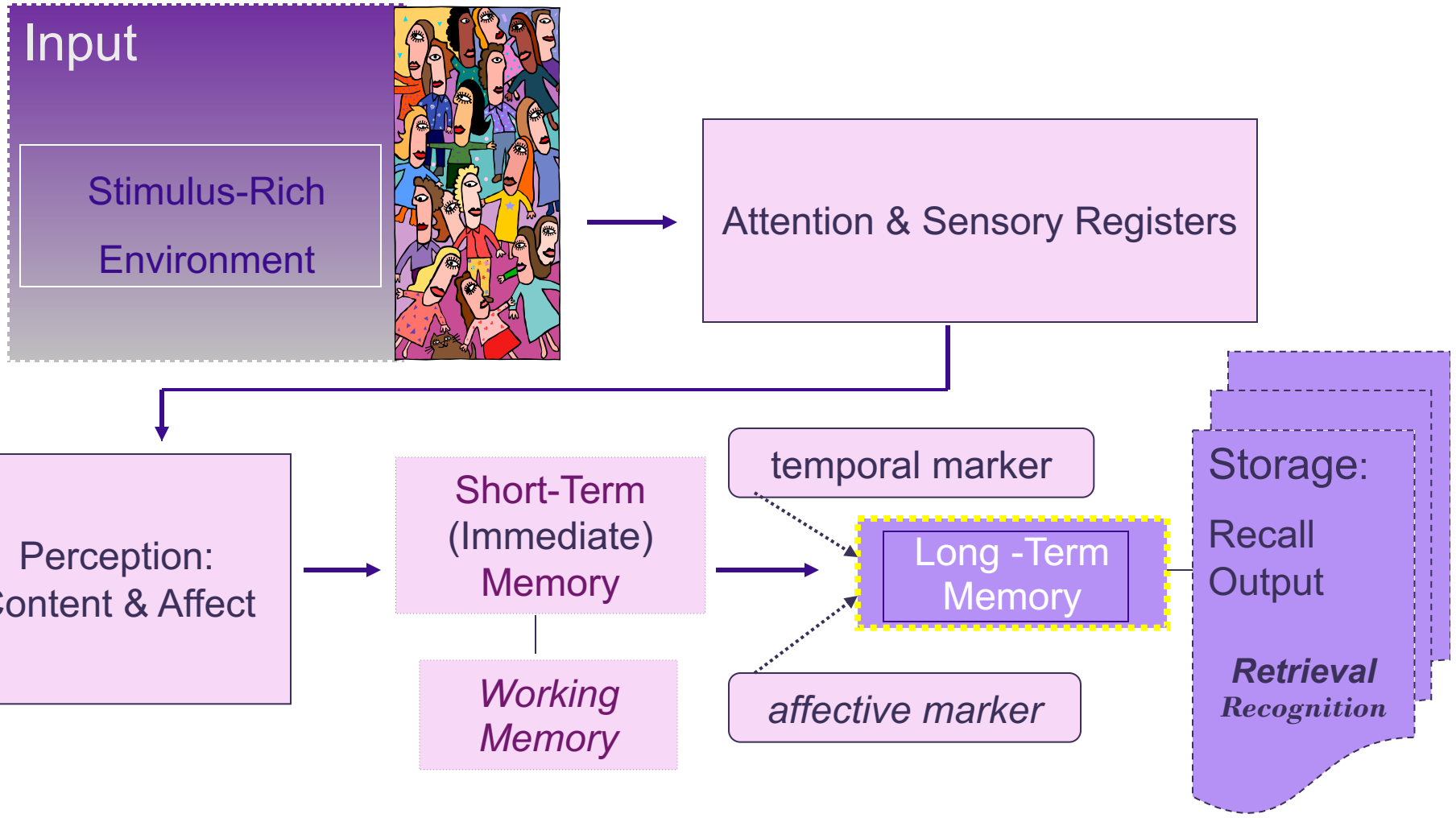
WRAML2 Index Scores for Children with ADHD, RD, and both RD & ADHD, compared to Matched Controls



Which picture do you recognize?

Conceptual Model of Memory

Adapted from **Atkinson & Shiffrin, 1968**



Memory Testing
Historical Roots

Memory Testing
Historical Roots

Adult
vs.
Pediatric

Pediatric Memory Testing
WRAML Chronology

- **1990.** Wide Range Assessment of Memory and Learning (Adams & Sheslow)

- **2003.** Wide Range Assessment of Memory and Learning, 2nd Edition (Sheslow & Adams)

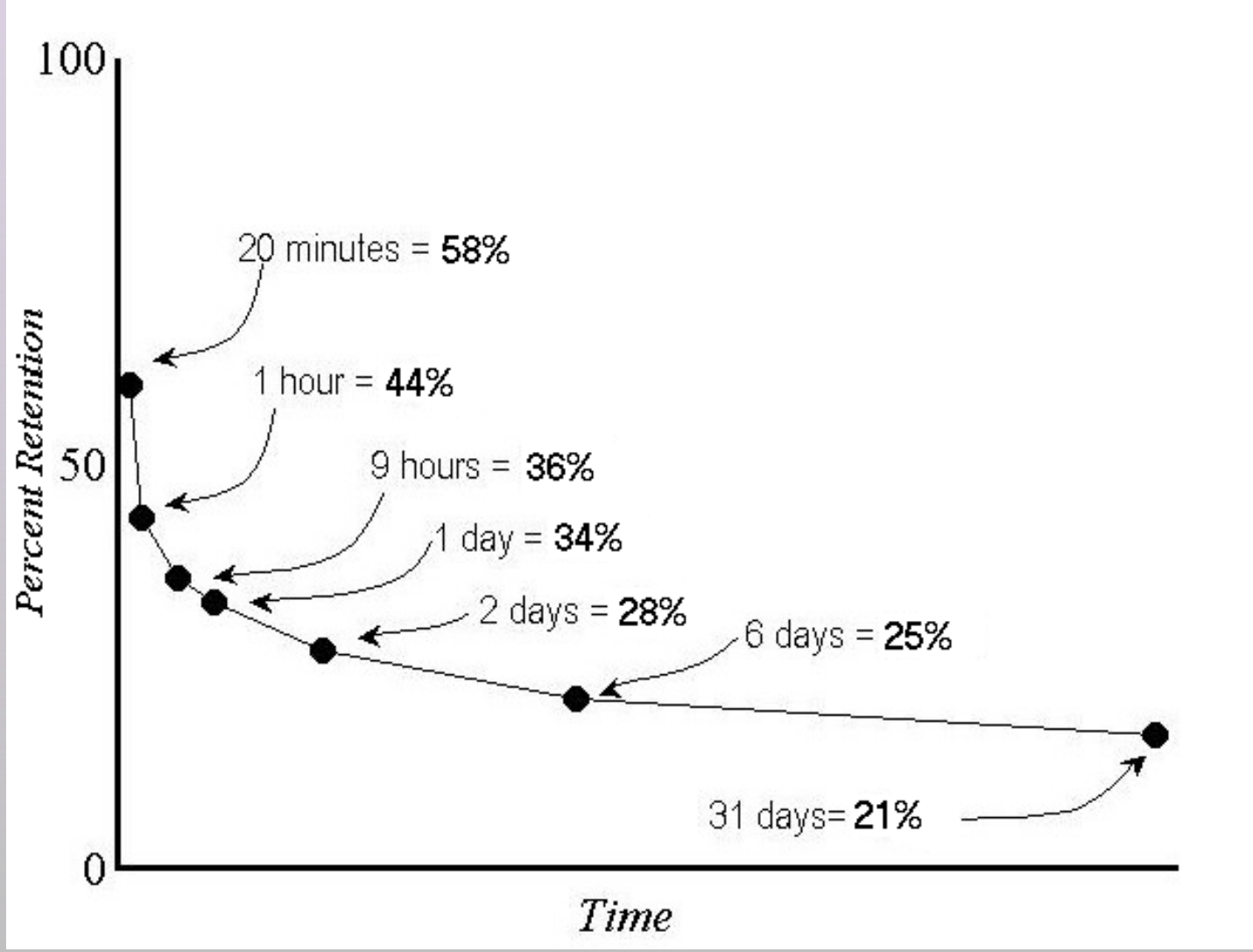
- ***2021.*** Wide Range Assessment of Memory and Learning, 3rd Edition (Adams & Sheslow)

Memory Testing
Historical Roots

Research

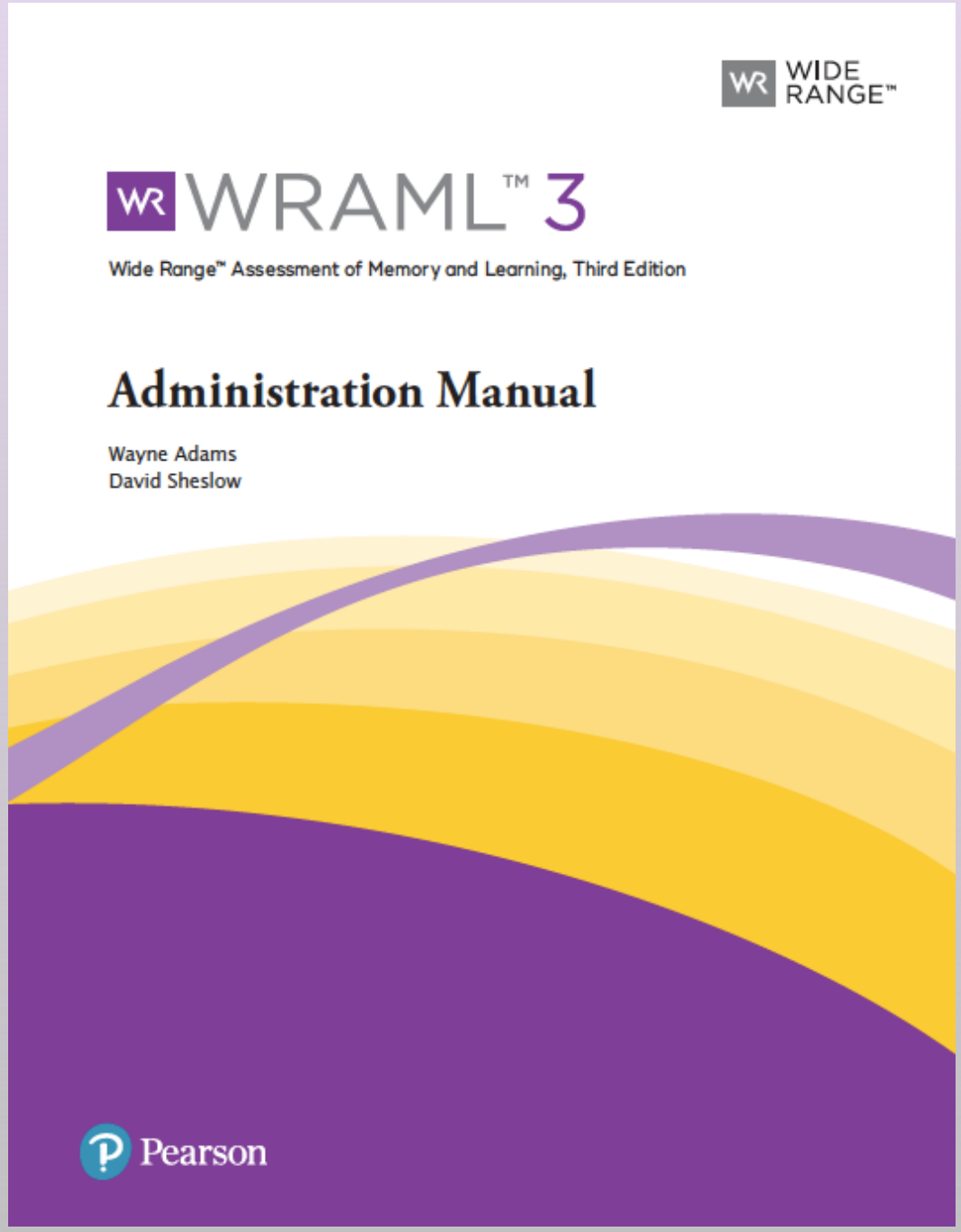
Memory: Historical Roots

Ebbinghaus's Forgetting Curve (1905)



A Sampling of Research-based Memory Terms/Concepts also found on WRAML3

- **Primacy/Recency**
- **List Learning**
- **Learning Trials and Learning Curve**
- **Immediate vs. Delayed Recall**
- **Recall vs. Recognition**
- **Storage vs. retrieval**
- **Verbal vs. Visual**
- **Rote vs. Meaningful**
- **Developmental Trajectories**
- **Gist vs. Verbatim**


WIDE RANGE™
WRAML™ 3
Wide Range™ Assessment of Memory and Learning, Third Edition
Administration Manual
Wayne Adams
David Sheslow
Pearson

WRAML2 ➡ WRAML3

Changes

- Performance Validity measure
- Design Memory ⇨ Design Learning
- Delayed and Recognition Indexes (derived from 4 subtests each)
- Visual Working Memory replaces Symbolic Working subtest

WRAML2 ➡ WRAML3

- Changes
  - 2-subtest abbreviated option
  - Additional Process measures
  - Sound Symbol dropped
  - Miscellaneous updates/minor modifications

WRAML3

- Individually Administered
- Age Range: 5 – 90 years
- Standard, Screener and Brief Formats
- Administration Time:
  - 12 – 80 minutes

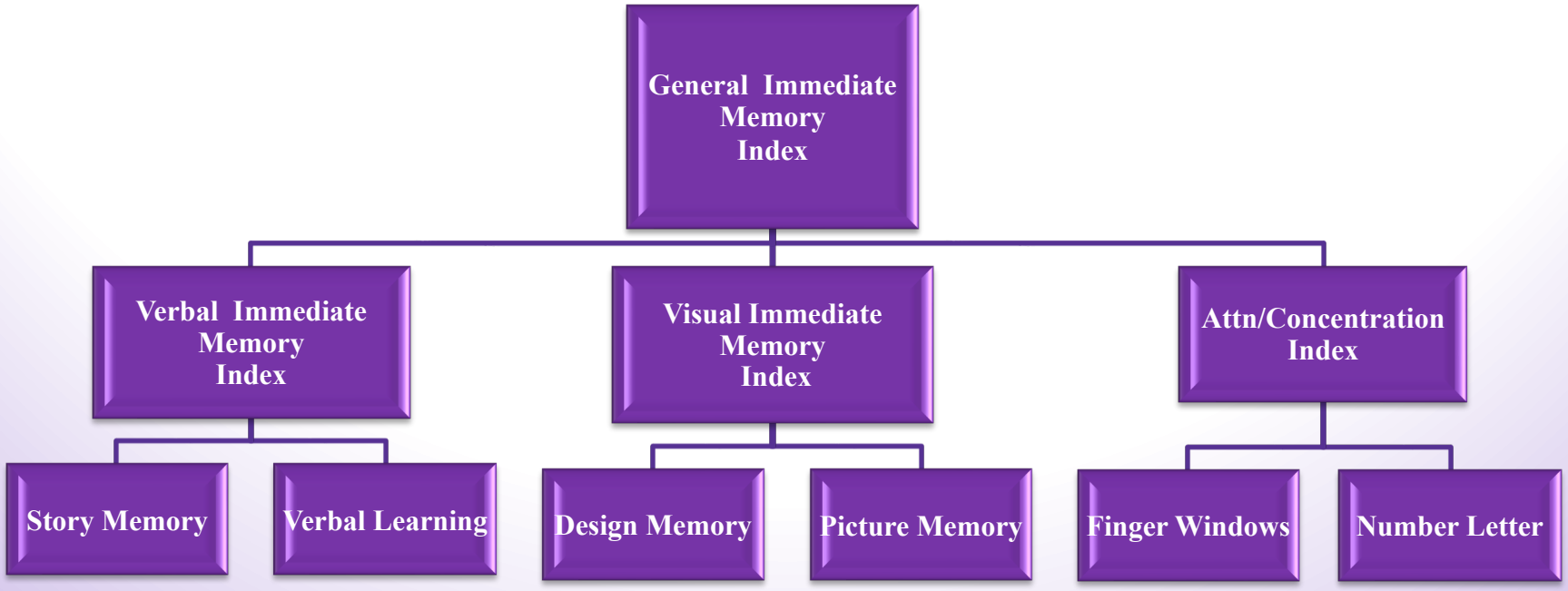
WRAML3 Components

- **Indexes**
  - **Immediate, Delayed, Recognition** (4 subtests each)
  - **Attention Concentration** (2 subtests)
  - **Working Memory (2 subtests)**
- **Subtests**
- **Process Analyses**

WRAML3 Structure

Immediate Recall ("Core")

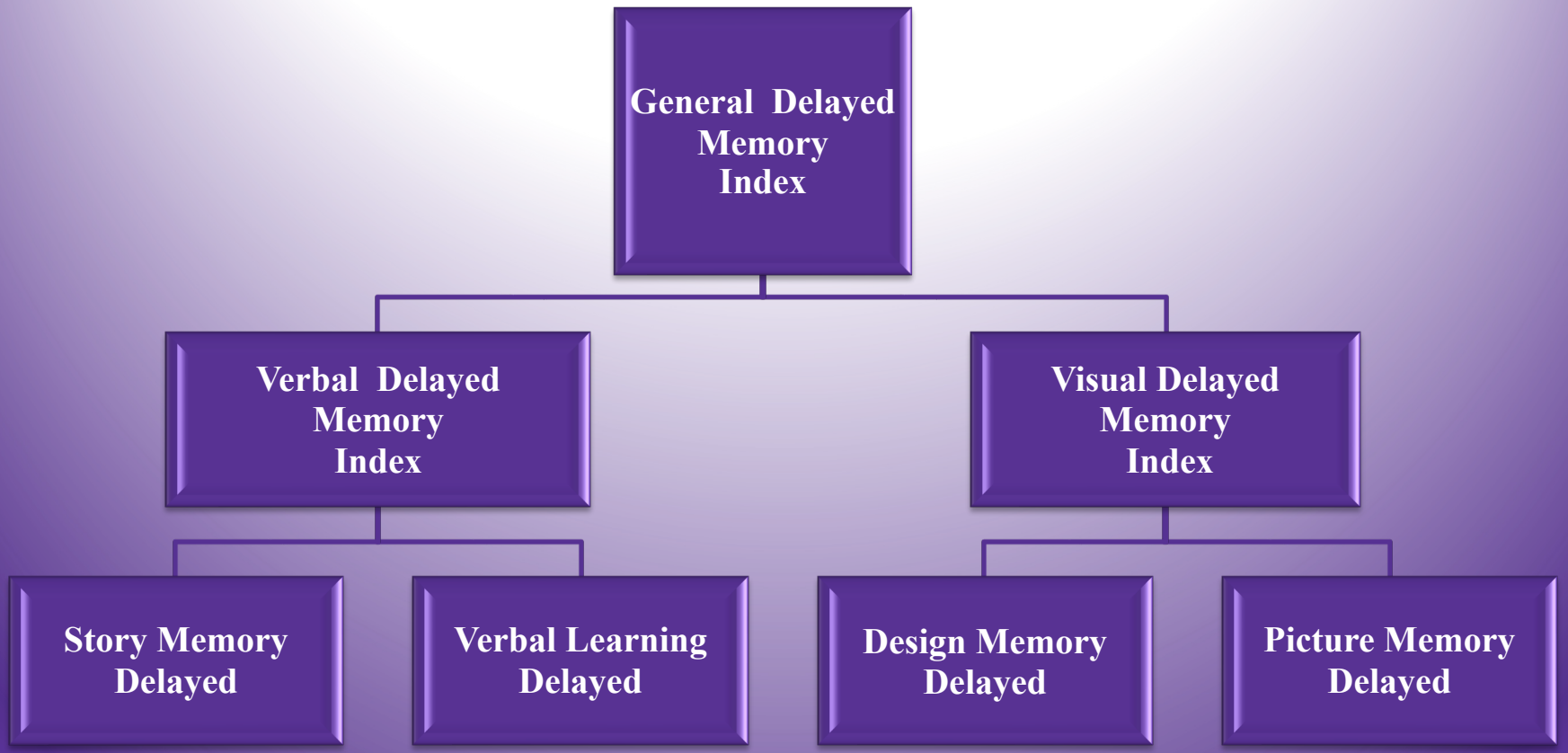
Indexes and Subtests



WRAML3 Structure

Delayed Recall

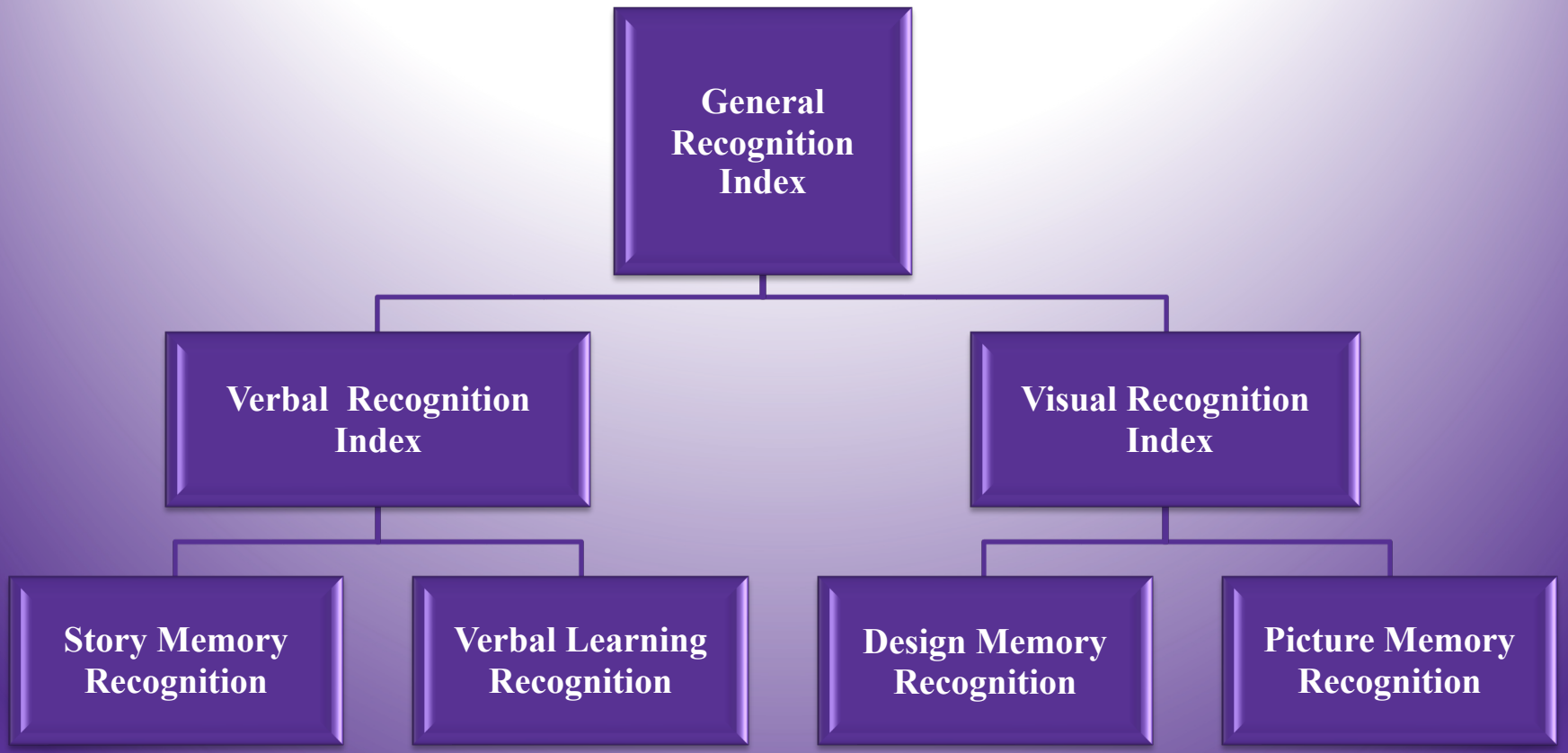
Indexes and Subtests



WRAML3 Structure

Recognition

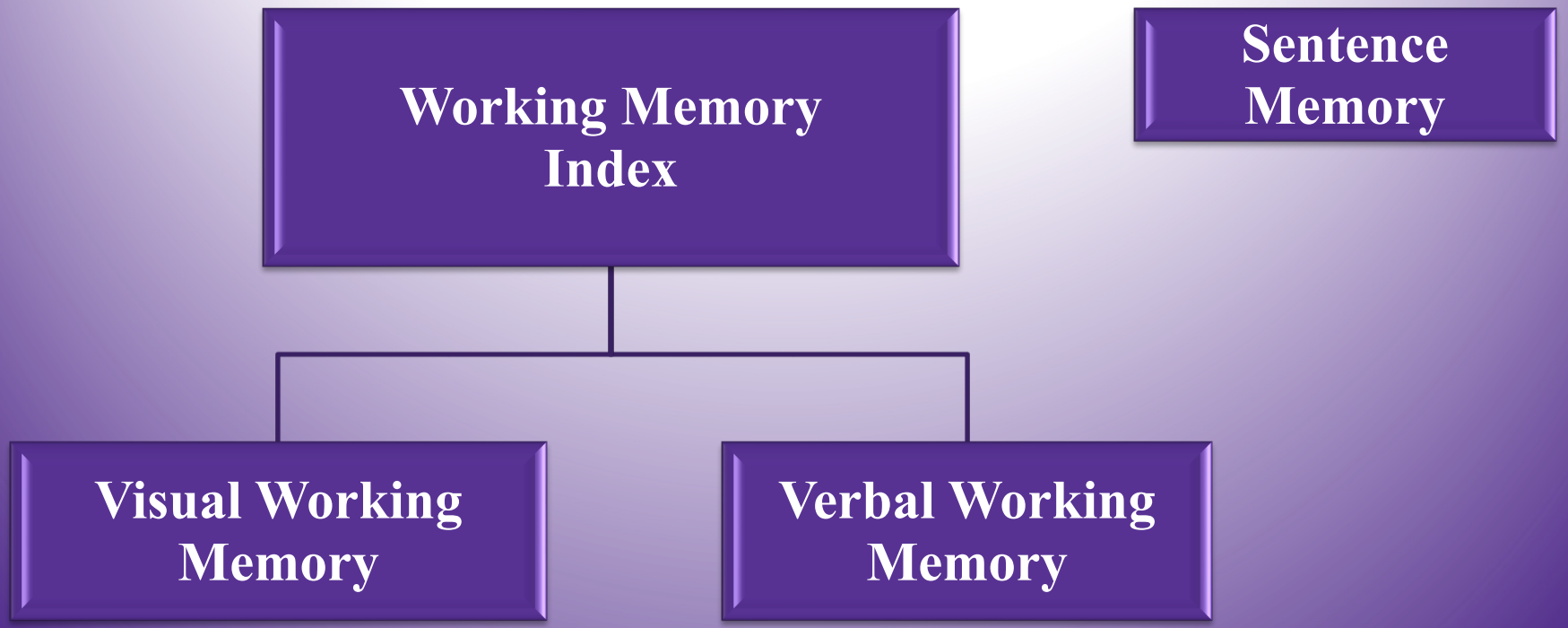
Indexes and Subtests



WRAML3 Structure

Other

Indexes and Subtests



WRAML3
Scores Available

Age-Based Norms

- **Standard Scores**
  - (Indexes, M=100, sd=15)
- **Scaled Scores**
  - (Subtests, M= 10, sd=3)
- **Percentiles** (for Indexes)
- **Age Equivalents** (5:3 – 22:6 yrs.)

WRAML3
Other Data Available

- Confidence Intervals
- Index Discrepancy Data (both statistical significance and base rate data)

WRAML3

Other Data Available (con't)

- Process Analyses (with quantitative values)
- Age-based descriptive statistics and clinical base rates (prevalence) with provided.

- Hand scoring, Q-Global scoring, and Interpretive Report each available

WRAML3
Record Forms

Record Form *(aka Examiner Form)*

Recall Response Booklet (Immediate and Delayed)

- Picture Memory
- Design Learning

Recognition Response Booklet

- Picture Memory
- Story Memory
- Design Learning
- Verbal Learning

Becoming Familiar with the WRAML3

A clinical “walk through”

Illustrative Case: Sam

8 year 5-month-old male, who is starting 3rd grade.

Was involved in a MVA and sustained fractured femur, some cuts and bruises.
Possible 5 -10 min. loss of consciousness

1-mo post-injury

2 wks. w/ visiting teacher

Should Sam return to school?

SAM

WISC-V FSIQ =105

VCI = 111; VSI = 103;

FRI = 95; WMI = 102; PSI = 89

WRAT-5

WRdg = 109; Spell = 104;

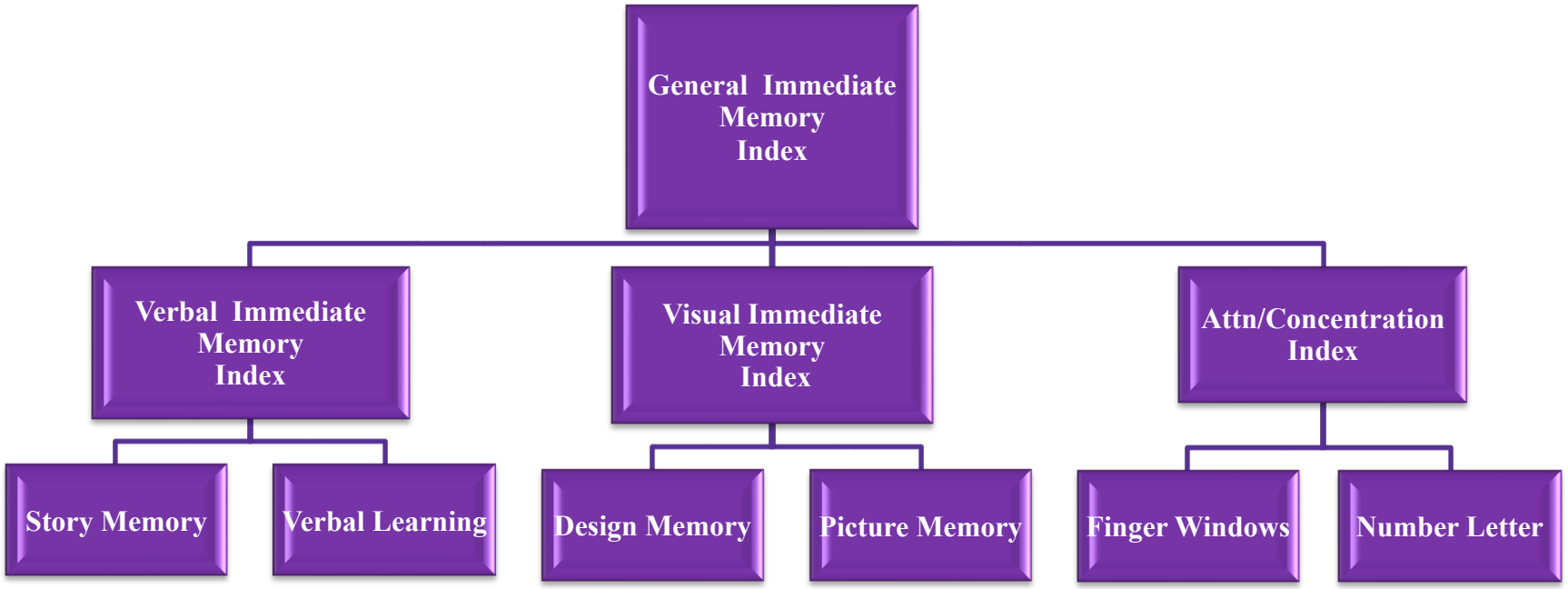
MathComp = 111; SenRdg = 101

Teacher: “nice, quiet, struggles w/ reading ‘a bit,’ occasional frustration

WRAML3 Structure

Immediate Recall ("Core")

Indexes and Subtests



Visual Memory Index

2 subtests

Picture Memory (Immediate)

- 4 Stimulus Scenes (laminated cards):
  teaching scene plus 3 additional scenes
- Different scenes for 5-9 yrs. than 10-yrs. and older (except for teaching
  picture)
- A Scene Review component added

Example:
Picture Memory presentation

Sample Item (2nd item for 5 – 9 year olds). [Teaching item preceded.]

“Now I will show you another picture, but I am not allowed to give any more help. Look carefully at the picture because I’ll ask you to remember what has been changed, moved, or added.”

Here’s the picture again. Take a look to see how well you were able to find things that were changed, moved, or added.

Process Scores: scores from tasks that help the examiner know the process(es) how the examinee achieved the result

Picture Memory

There is one process measure associated with the subtest:

Commission Errors

Picture Memory Process Measure

Commission Errors

Age	5 yrs	7 yrs	10 yrs	14 yrs	18 yrs
M Total Commission Errors	4.8	3.3	2.6	2.4	2.0

Picture Memory Delayed Recall
(20-30 min. delay)

"A little while ago I showed you a picture where some things were changed, moved, or added. When I say *begin,* put an *X* on all the things you can remember that were changed, moved, or added."

(2nd time response scene shown)

Picture Memory Recognition

(assumes Delayed Recall administered)

SAM

Picture Memory ss = 13

SAM

Picture Memory ss = 13

Total

Commission Errors: 14

(base rate < 5%)

SAM

Picture Memory ss = 13

PM Delayed ss = 11

PM Recognition ss = 10

Verbal Memory Index (VerMI)

"Core" (immediate)

- Story Memory subtest

Verbal Immediate Memory Index

Story Memory

Two Stories read to examinee

A & B to 5 – 9-year olds

C & D to 10 years and older

WRAML3 Story Memory A: Record Form

UPPERCASE: response must be exact (Verbatim)
lowercase: response may be general (Gist)

			Immediate	Delayed
Story Details	V	G	Score	Score
1. PAUL/PAUL'S				
2. BIRTHDAY				
3. SEVENTH				
4. fun				
5. PARTY				
6. CHOCOLATE				
7. cake				
8. presents				
9. Dad				
10. GREEN				
11. BICYCLE/BIKE				
Details 1–11 Total				

			Immediate	Delayed
Story Details	V	G	Score	Score
12. happy				
13. sad				
14. watching				
15. Mom				
16. box				
17. jumped				
18. puppy				
19. LICK				
20. face				
21. bicycle/bike rides with dog				
Details 12–21 Total				
Details 1–11 Total				
Story A Total Raw Score				

Process Scores: scores from tasks that help the examiner know the process(es) how the examinee achieved the result

Story Memory

Gist and Verbatim score comparison

Individual Story scaled score comparison (Story 1 vs 2 performance)

Story Memory

Supplemental Subtest

SM Delayed Recall

WRAML3 Story Memory A: Record Form

UPPERCASE: response must be exact (Verbatim)
lowercase: response may be general (Gist)

			Immediate	Delayed
Story Details	V	G	Score	Score
1. PAUL/PAUL'S				
2. BIRTHDAY				
3. SEVENTH				
4. fun				
5. PARTY				
6. CHOCOLATE				
7. cake				
8. presents				
9. Dad				
10. GREEN				
11. BICYCLE/BIKE				
Details 1–11 Total				

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19. LICK				
20. face				
21. bicycle/bike rides with dog				
Details 12–21 Total				
Details 1–11 Total				
Story A Total Raw Score				

Story Memory

Supplemental Subtest

SM Recognition

SAM: WRAML3 Results

- Story Memory ss = 10
- Story Memory Recall ss = 6
- Story Memory Recognition ss = 8

Possible interpretation?

SAM

to be continued…

WRAML3

Visual Memory Index

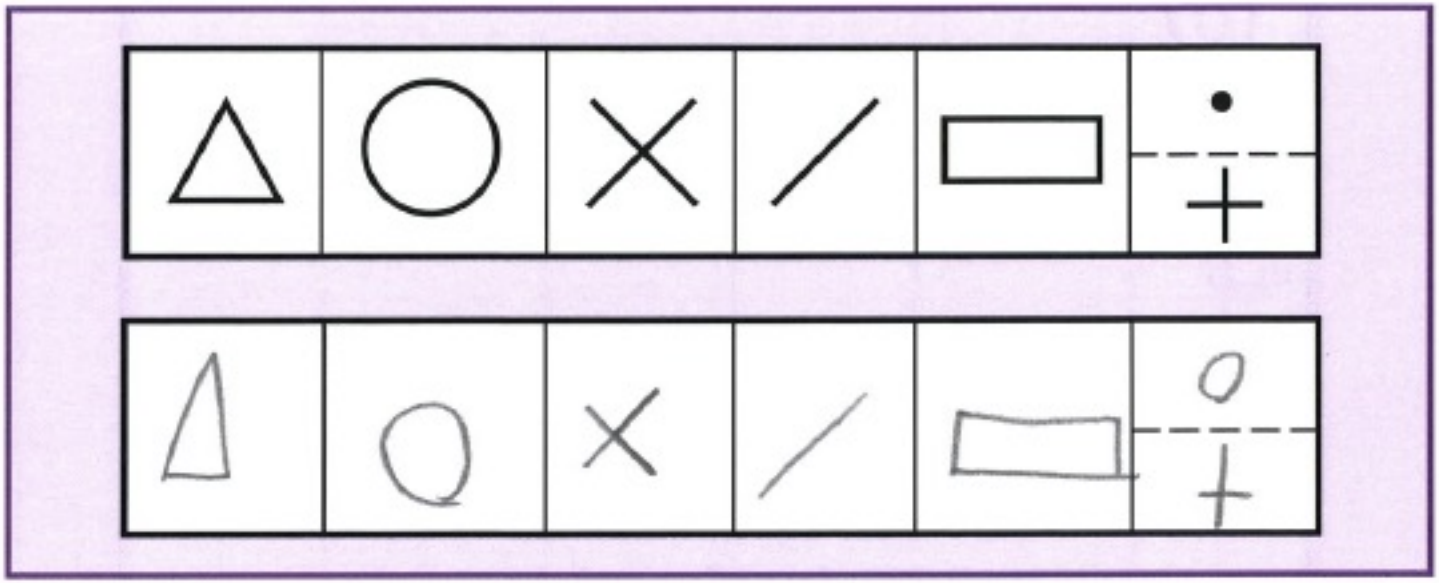
Subtest 2

Design Learning subtest

- Start with Practice Item when necessary

  This minimizes impact of perceptual motor weakness by child providing scoring criteria

DL “Practice Item”

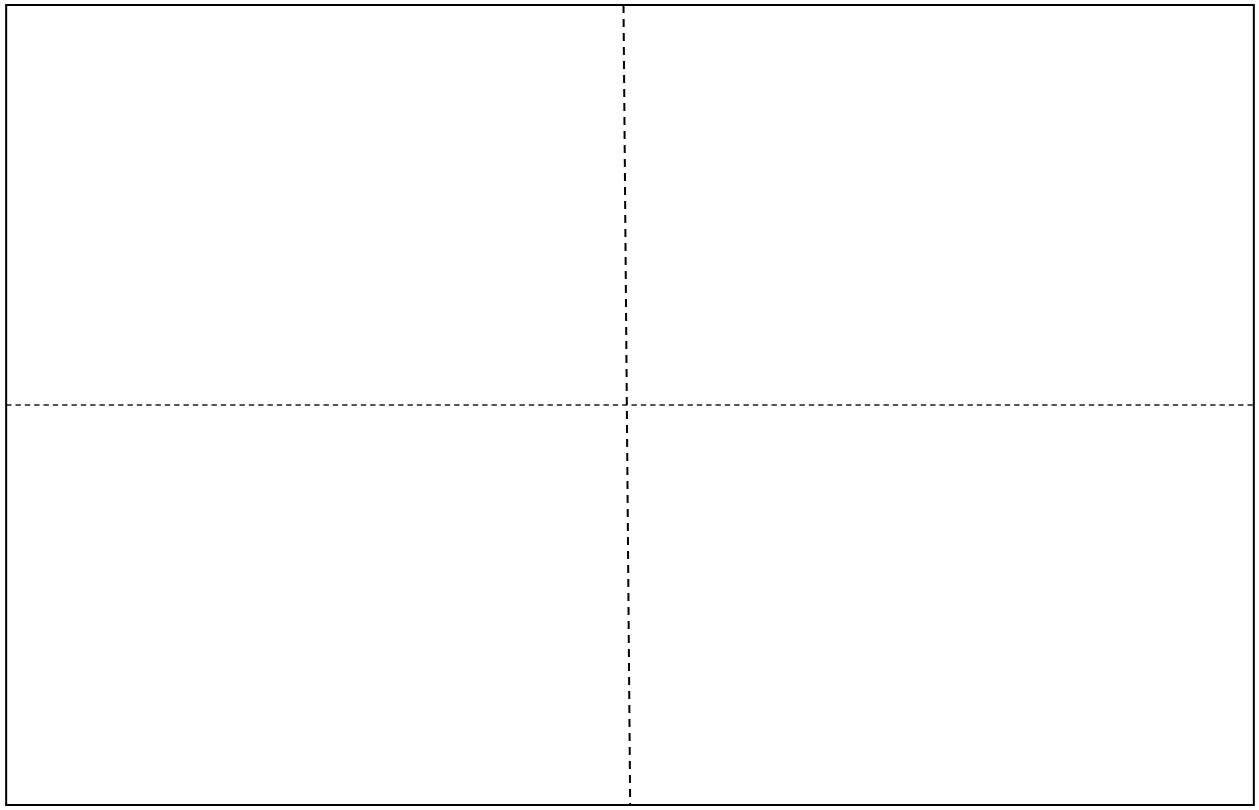


Design Learning subtest

- Drawing task
  - 1 card, 4 learning trials
  - Look 10 sec., Delay 10 sec., draw

Create 5 “cards” like the following

(*4 quadrants made by dotted lines*)



Design Learning directions

I’m going to show you a card with lots of shapes on it. Most people will not remember all of them. Look at the whole card and try to remember as many shapes and their locations as you can. Take a picture of it in your mind.

Now draw what you saw just where you saw it even if you can't remember everything. [*Notice that the dotted lines are drawn for you***.] [***Draw all the shapes even if you drew them before***.]**

I'm now going to show you the same card again. See what you can remember this time. Remember to look at the whole card. [Draw all the shapes even if you drew them before.]

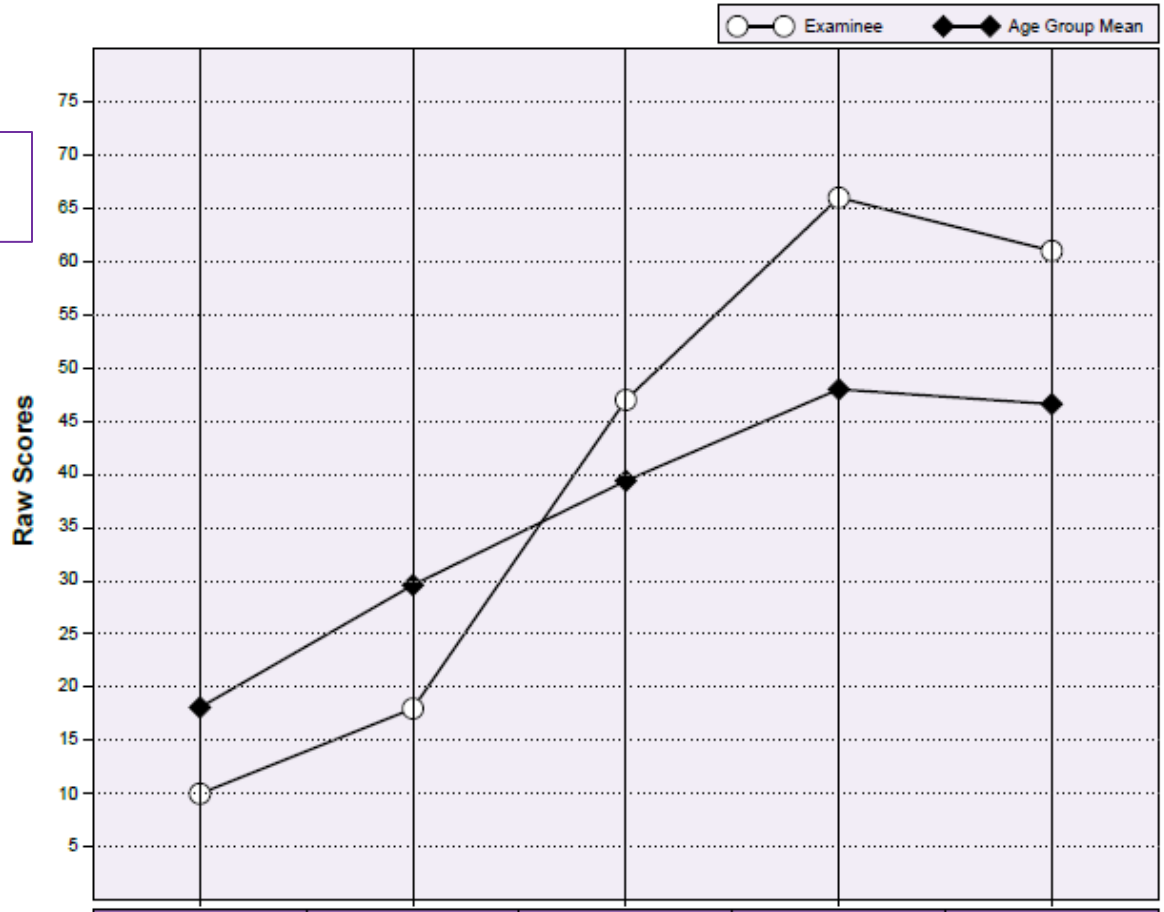
Design Learning subtest

Process Measures (immediate only)

- Trials 1 – 4 and Delay Comparison graph

Process Scores – Design Learning over Trials

SAM



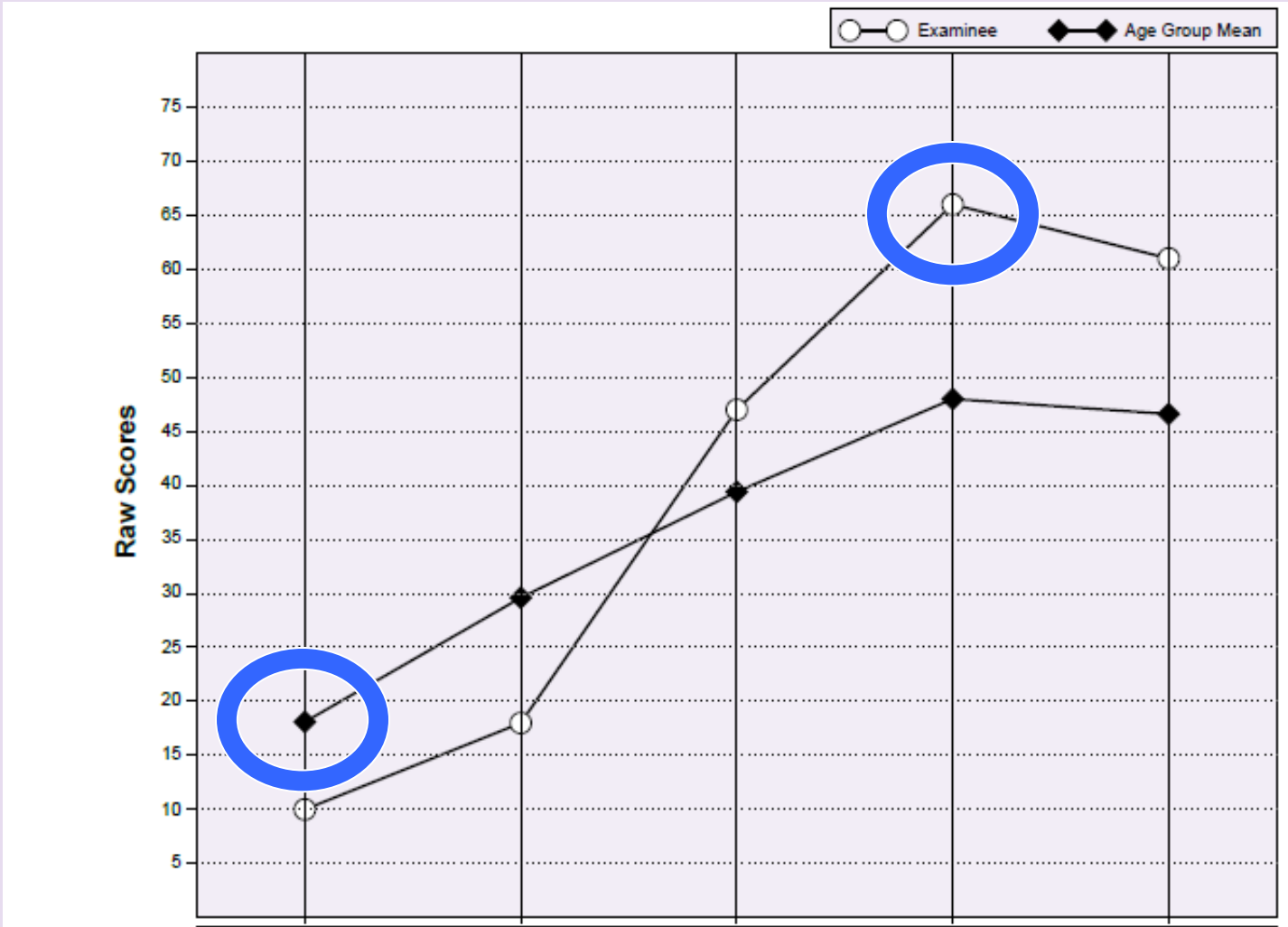
	Trial 1	Trial 2	Trial 3	Trial 4	Delayed
Raw Score	10	18	47	66	61
Mean (*SD*)	18.1 (8.5)	29.6 (11.1)	39.4 (13.5)	48.0 (12.8)	46.6 (13.8)

Design Learning subtest

Process Measures (immediate only)

- Trials 1 – 4 and Delay
  Comparison graph
- Slope *(Trial 4 vs. Trial 1)*

Process Score – Slope



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Mean (*SD*)	18.1 (8.5)	29.6 (11.1)	39.4 (13.5)	48.0 (12.8)	46.6 (13.8)

Design Learning subtest

Process Measures (immediate only)

- Trials 1 – 4 and Delay Comparison graph
- Slope *(Trial 4 vs. Trial 1)*
- Quadrant Analysis

Process Score

DL Quadrant Analysis

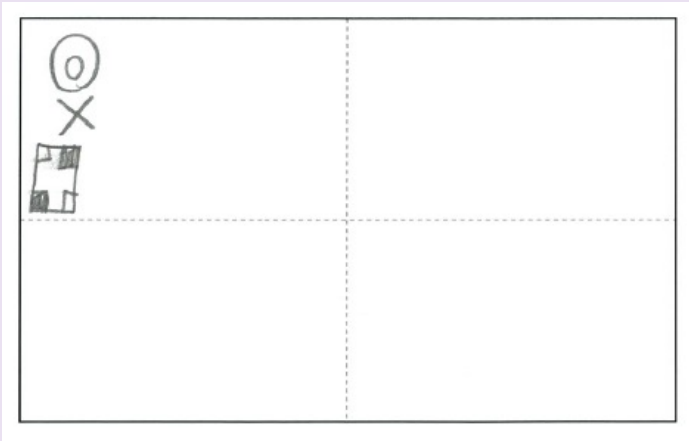
shapes/quadrant (max. 4 pts / shape x 4 = 16)

…sum the raw score points for each design in the quadrant across *all* four immediate recall learning trials.

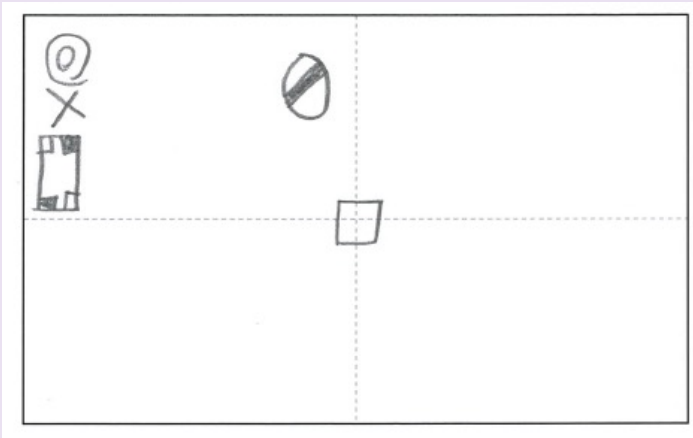
A score for each quadrant is computed and compared to age adjusted raw score norms to obtain base rate.

DL Trials 1- 4

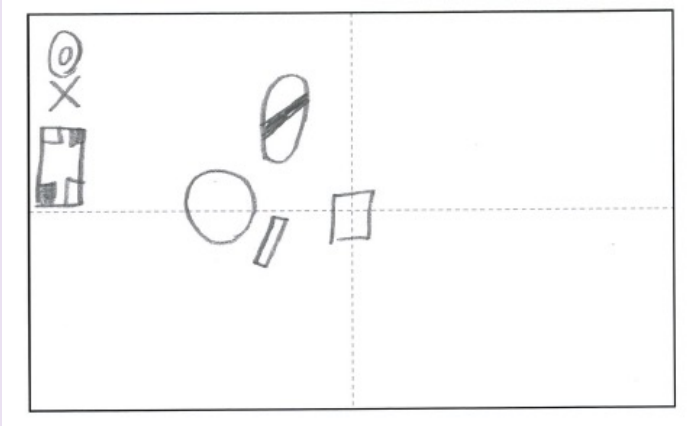
T1



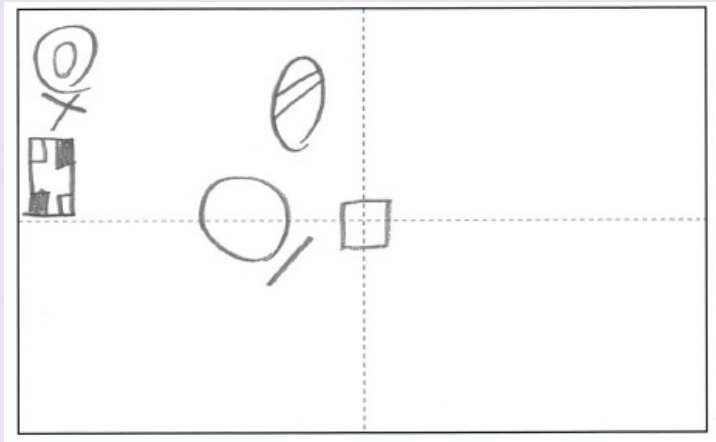
T2



T3



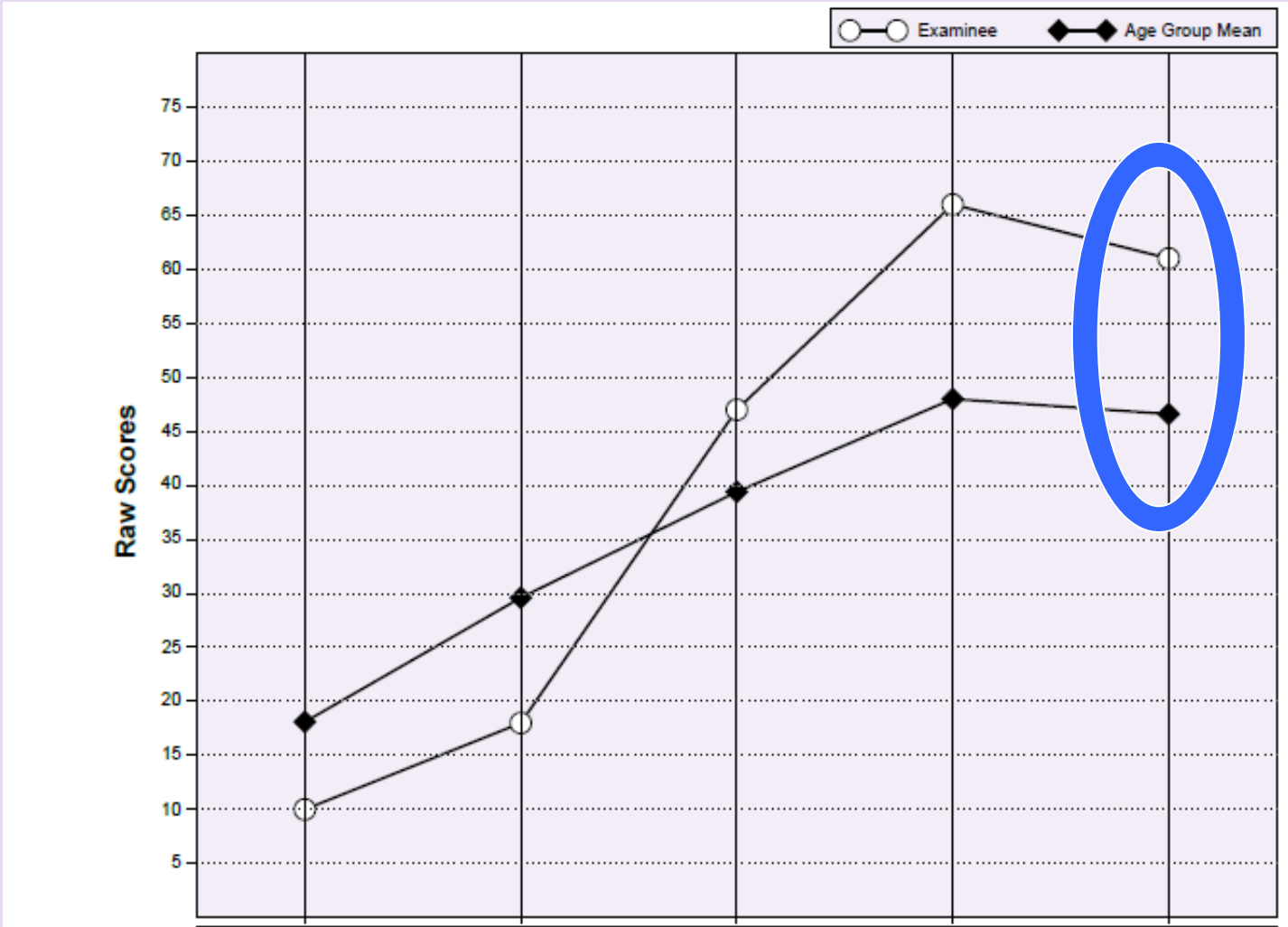
T4



Design Learning subtest

DL Delayed Recall

Process Score – Slope



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Mean (*SD*)	18.1 (8.5)	29.6 (11.1)	39.4 (13.5)	48.0 (12.8)	46.6 (13.8)

DL Recognition

Sam

Design Learning Results Summary

- DL Immediate: ss = 11
  - Trials raw scores: 10,18, 47, 66 _ 61
  - Slope: ns
  - Quadrant Analysis: ns
- DL Delayed: ss = 14
- DL Recognition: ss = 11

WRAML3 VisMI Results (ss)

SAM

Picture Memory Immed. = 13

Delay = 11

Recognition = 10

Design Learning Immed. = 11

Delay = 14

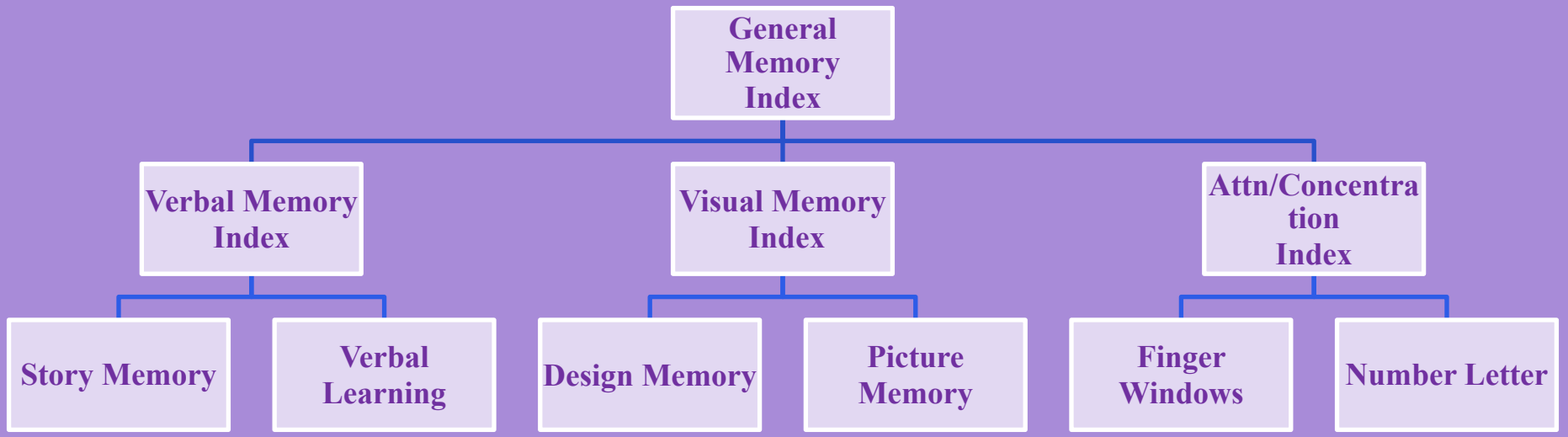
Recognition = 11

Reasonable Interpretation?

Time for memory consolidation!

Break!

WRAML3 Structure
Indexes and Subtests



Verbal Learning Index

1. Story Memory subtest

2. Verbal Learning subtest

Verbal Learning (immediate recall)

- List-learning task
  (13 words, 5 – 9 yrs; 16 words, ≥ 10 yrs)
- Common nouns
- Four learning trials

Process Measures

Verbal Learning (Immediate only)

- Intrusion errors

Verbal Learning

- **Intrusion Errors**

Age	5 yrs	7 yrs	11 yrs	15 yrs	21 yrs
M Total Intrusions	1.7	1.5	1.5	1.1	1.7

Process Measures

Verbal Learning (Immediate only)

- Intrusion errors
- Repetition errors

Process Measures

Verbal Learning (Immediate only)

- Intrusion errors
- Repetition errors
- Primacy – Recency

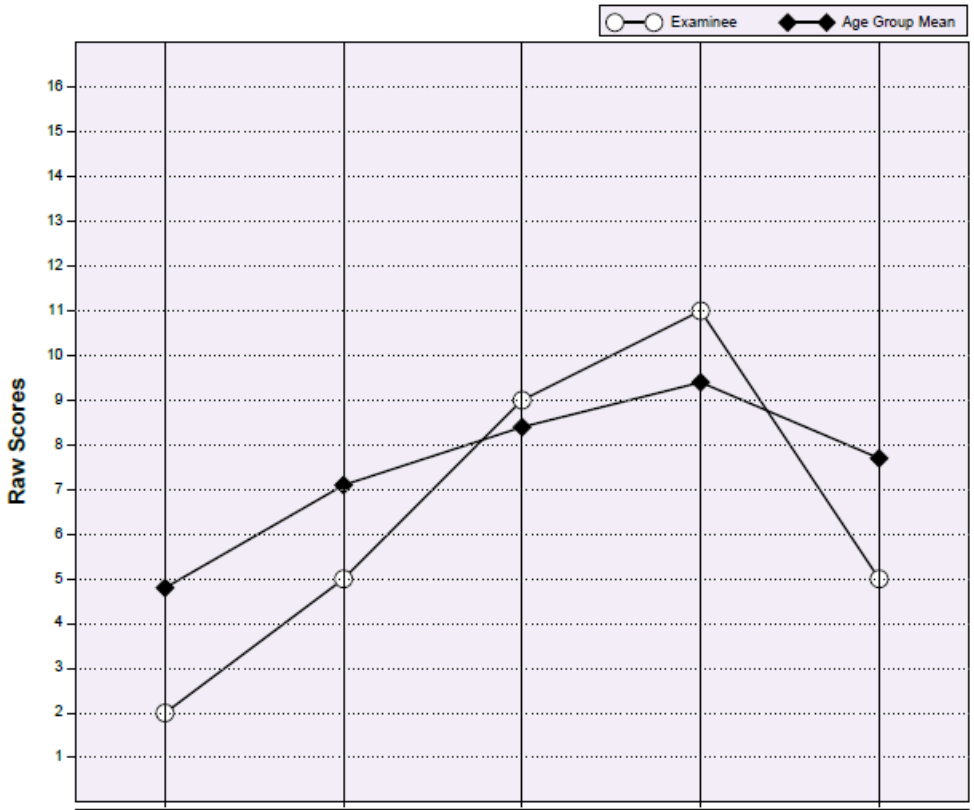
Process Measures

Verbal Learning (Immediate only)

- Intrusion errors
- Repetition errors
- Primacy – Recency conformity
- Learning over Trials (graphed)

Verbal Learning Process Scores – Learning over Trials

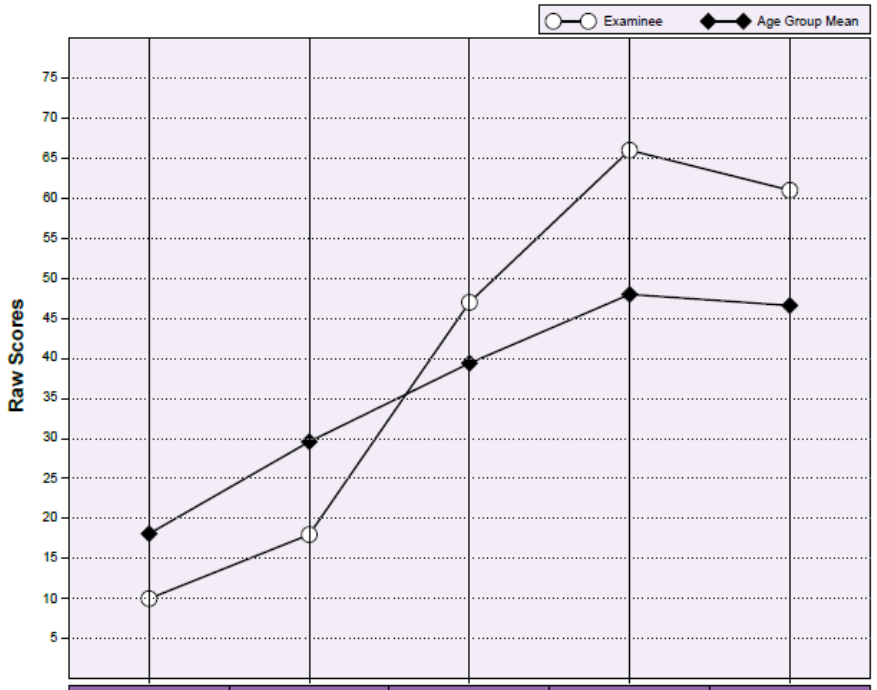
SAM



	Trial 1	Trial 2	Trial 3	Trial 4	Delayed
Raw Score	2	5	9	11	5
Mean (*SD*)	4.8 (1.5)	7.1 (1.8)	8.4 (1.9)	9.4 (1.9)	7.7 (2.0)

Process Scores – Design and Verbal Learning Comparison

SAM



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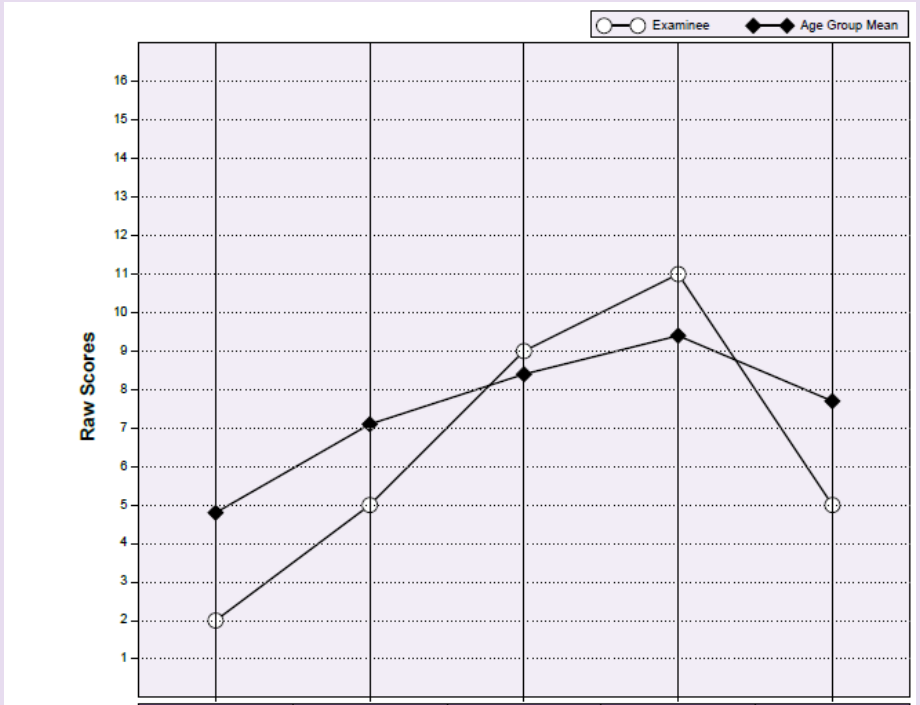

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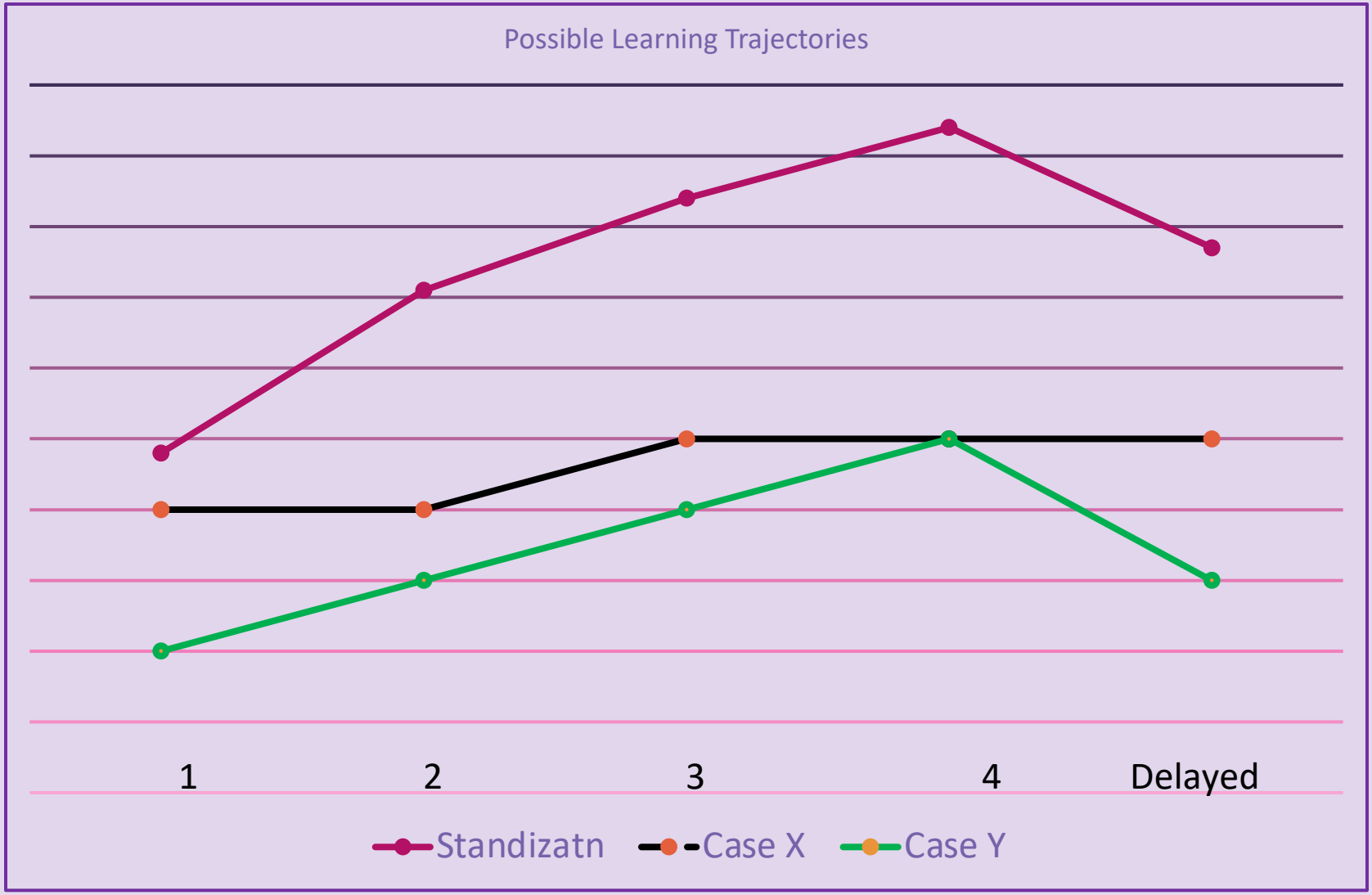
Verbal Learning
Hypothetical Learning Trajectories

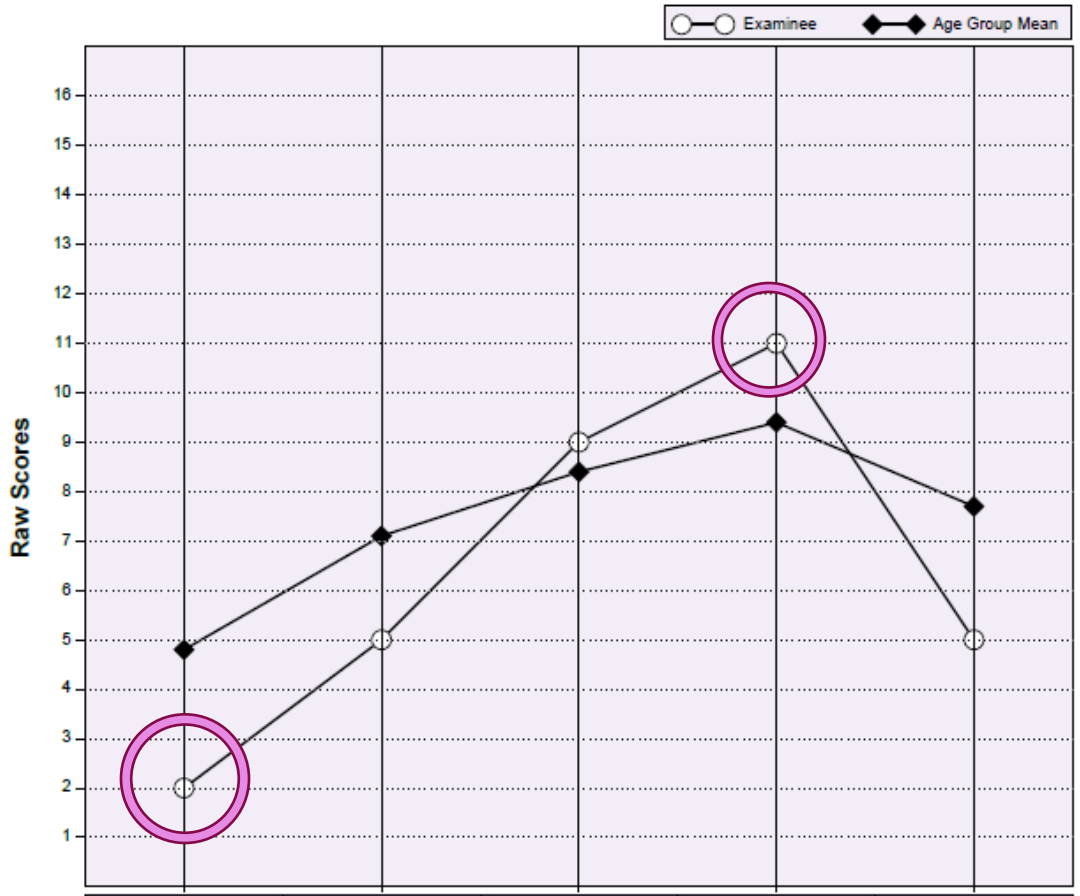


Process Measures

Verbal Learning (Immediate only)

Slope *(Trial 4 – Trial 1)*

Verbal Learning Process Scores – Slope



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Mean (*SD*)	4.8 (1.5)	7.1 (1.8)	8.4 (1.9)	9.4 (1.9)	7.7 (2.0)

Verbal Learning

Supplemental subtests

- **Delayed Recall**

Supplemental Subtest

Verbal Learning Recognition

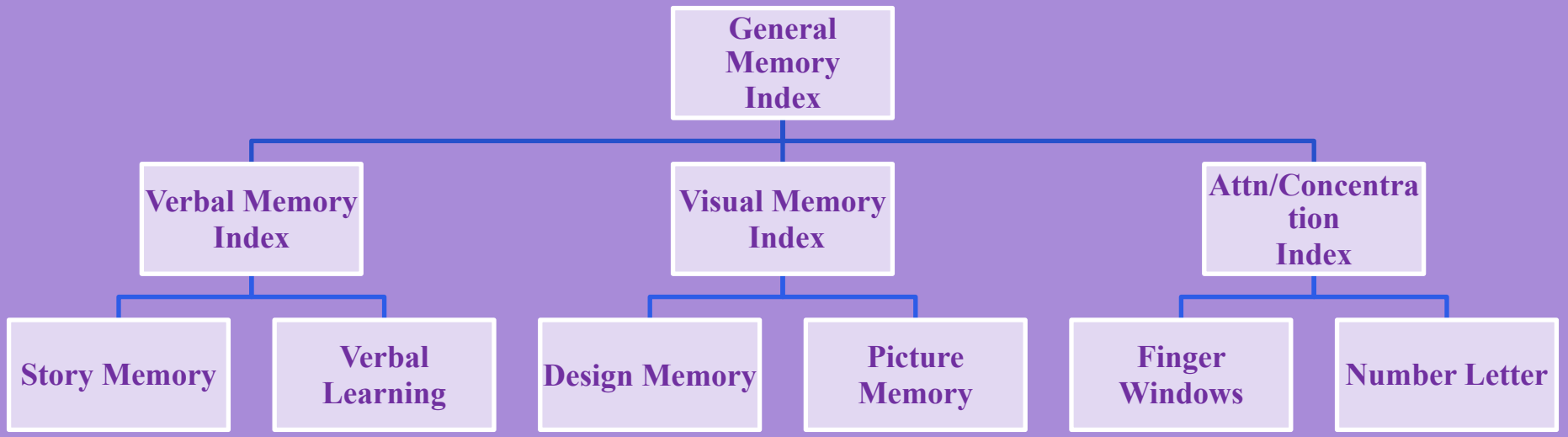
- 4-choice options
- Process Measure: Semantic vs Phonological recall comparison

SAM – more test performance results

- VL Immediate Memory ss= 7
- (Trials: 2,5,9,11; 5)
- (Intr.Err. = 5 (*base rate=<5%*)
- VL Delayed Recall: ss = 7
- VL Recognition Memory: ss = 8

Interpretation?

WRAML3 Structure
Indexes and Subtests

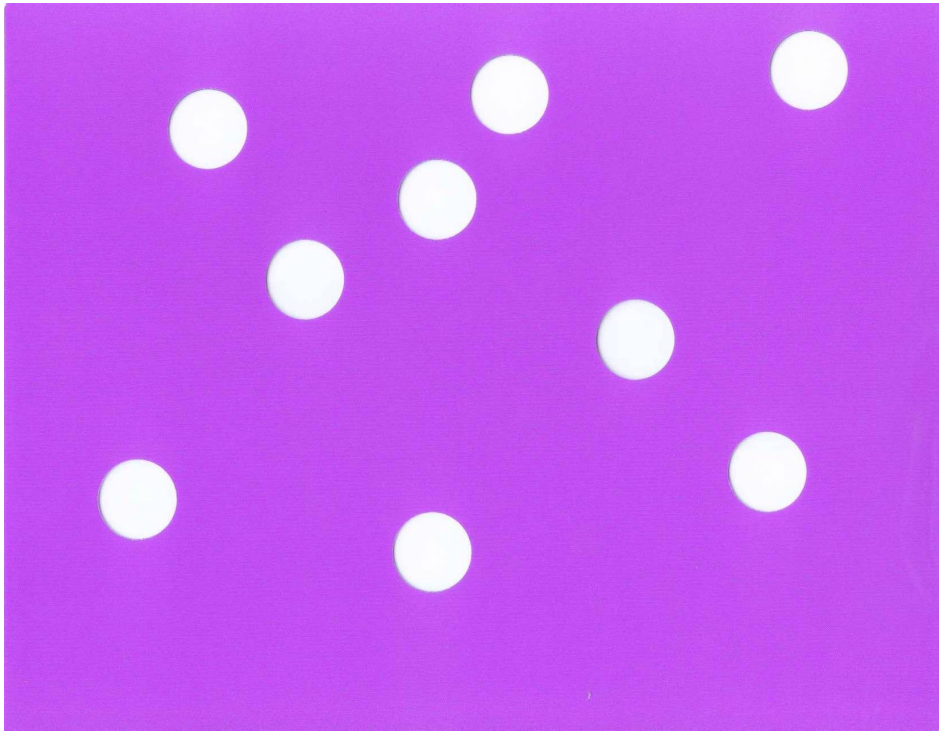


Attention/Concentration Index

(2 immediate (& rote) Memory subtests)

- Finger Windows
- Number Letter

Finger Windows



“This card has holes like windows. I am going to put the end of my pencil into one window and then another. When I am done, I want you to do the same thing with your finger. Let’s try one. Wait until I say ‘Begin’ before you start.”

Attention/Concentration Index

Finger Windows

Start places determined by age

(5-9 yrs and 10 yrs & older)

1 sec. in window; 1 second between windows

Attention/Concentration Index

Number Letter subtest

"I am going to say some numbers and letters. Listen carefully because I will ask you to repeat them to me. I can say them only once. It is alright to guess."

Attention/Concentration Index

Number Letter subtest

- 1 per second
- Only “forwards” order
- Note pronunciation and loudness

Optional Subtests

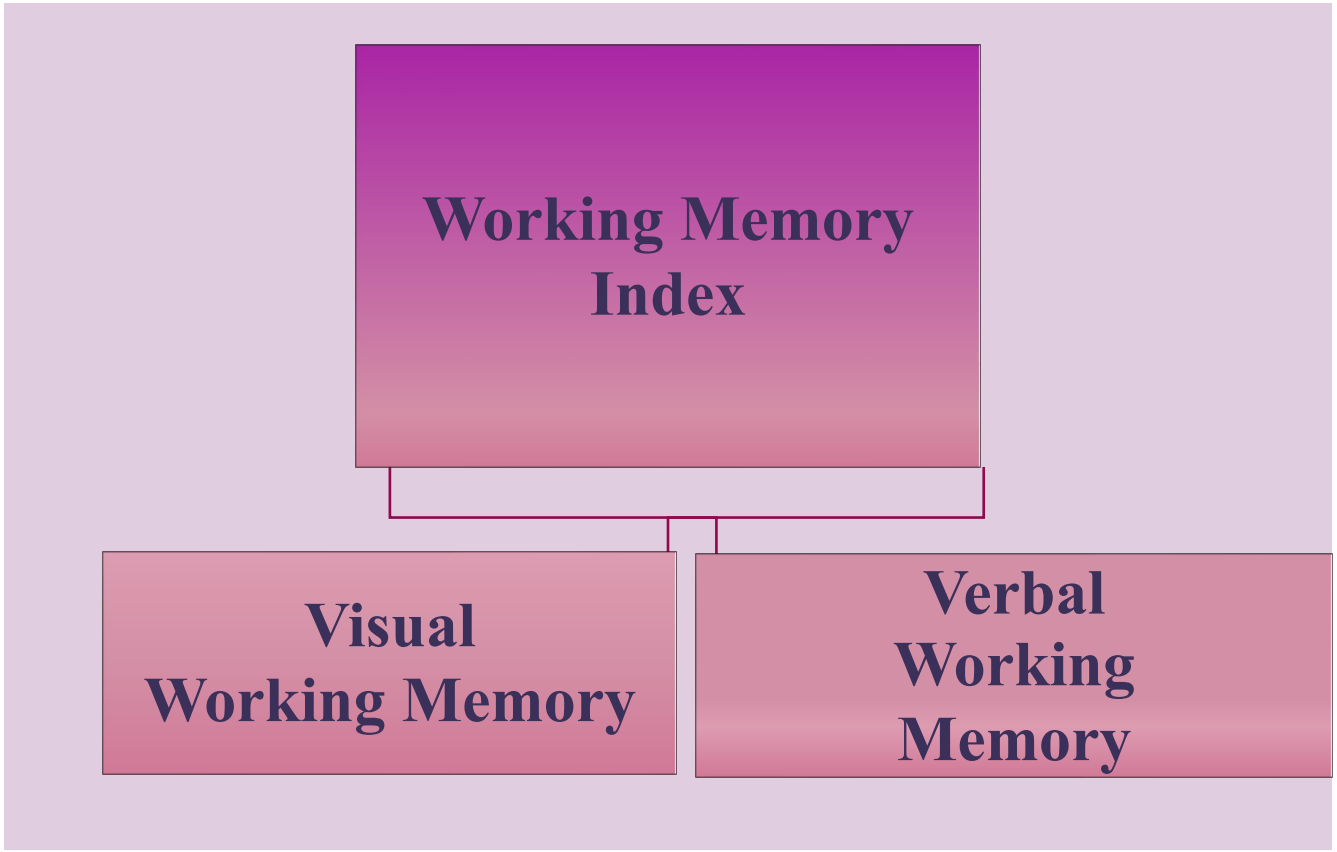
Sentence Memory

- Sentence repetition, 2 – 19 words
- Score 0, 1, 2
- Read with “friendly” intonation and normal pacing

Inter-Subtest Comparisons: Interpretation

Subtest	Scaled Scores for Client		
	A	B	C
Sentence Memory	8	7	10
Story Memory	8	5	12
Number Letter	8	10	8

Additional Index and Subtests



Visual Working Memory

Administer two Sets (age dependent)

Set A

Two category groupings, touch specified items in the first category before the touched items in the second.

Set B: Category 1 items first in order of size, then category 2 items in any order.

Set C: Category 1 items first in order of size, then category 2 items in order of size.

Optional Subtests *(continued)*

Working Memory Index

Verbal Working Memory

Verbal Working Memory subtest

- Like VisWM, two set levels administered (dependent on age)

- A & B for 5-9 yrs; B & C: 10 yrs and older)
  - A: Repeat animals first, then non-animals
  - B: Repeat animals small to large first; then non-animals
  - C: Repeat animals small to large first; then non-animals small to large.

Verbal Working Memory subtest

Example

Level B: Item 8 (of 10)

Level C: Item 6 (of 8)

Summary of SAM's Performance

RfR: Should Sam return to school?

Index	St. Score
General Immediate Memory	**97**
General Delayed Memory	**97**
General Recognition Memory	**115**

SAM

Index	Subtest	St. Score
VisMI - Immediate		**115**
VisMI - Delayed		**121**
VISMI - Recognition		**114**
Picture Memory		
	Immed.	**14**
	Delayed	**13**
	Recog.	**11**
Design Learning		
	Immed.	**11**
	Delayed	**14**
	Recog.	**14**

SAM

Index	Subtest	St. Score
VerMI - Immediate		**115**
VerMI - Delayed		**121**
VerMI - Recognition		**114**
Story Memory		
	Immed.	**7**
	Delayed	**4**
	Recog.	**13**
Verbal Learning		
	Immed.	**9**
	Delayed	**7**
	Recog.	**11**

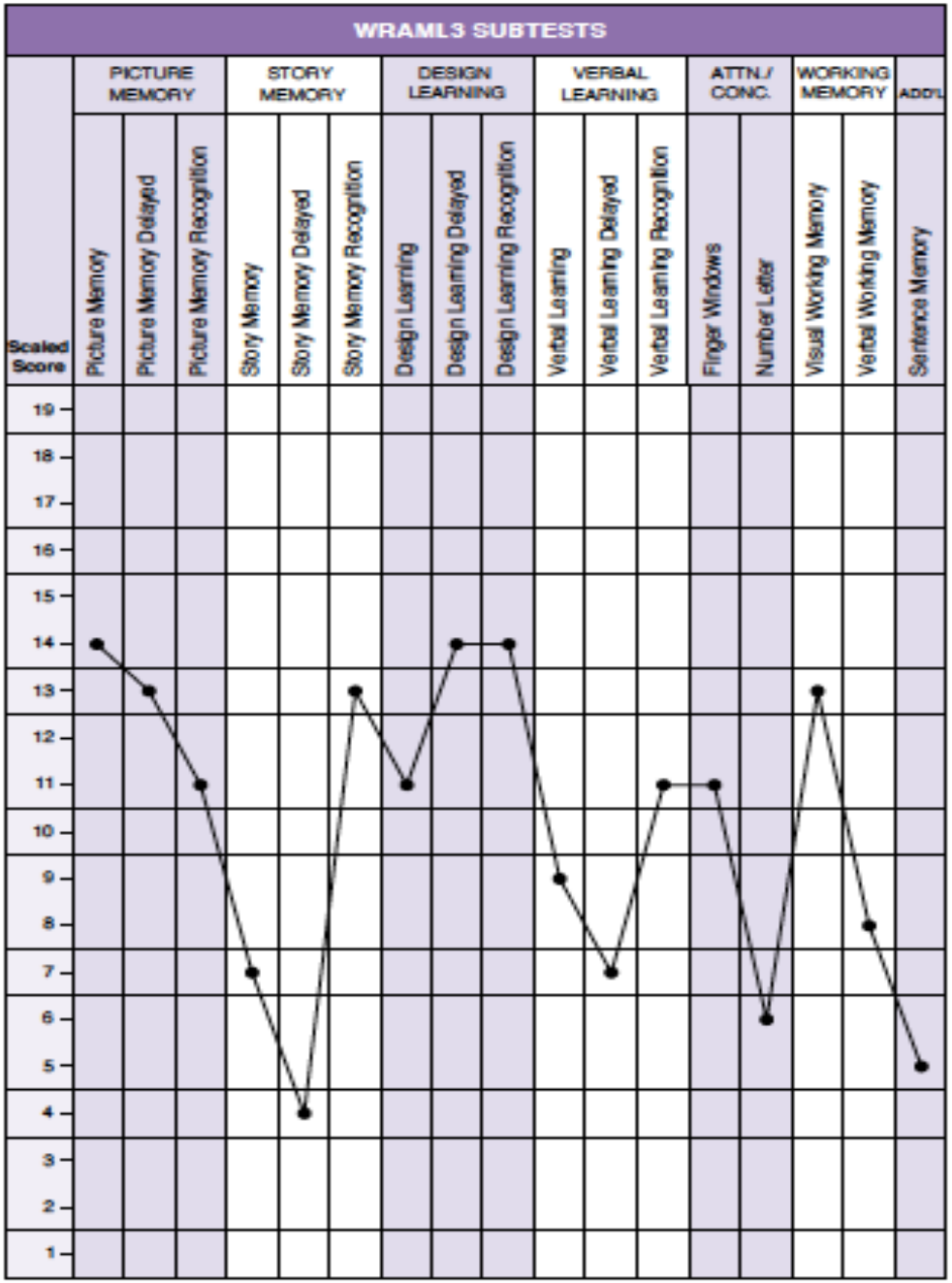
SAM

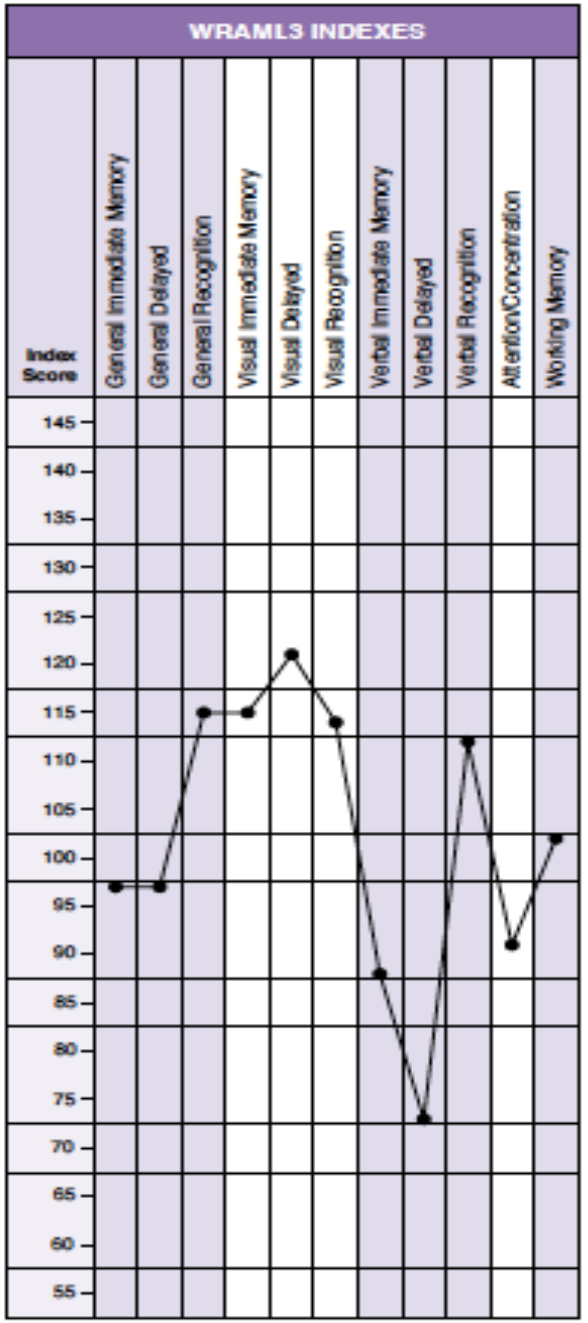
Index	Subtest	St. Score
Attention/Concentration		**91**
	Finger Windows	**11**
	Number Letter	**6**

SAM

Index	Subtest	St. Score
Working Memory Index		**102**
	Visual WM	**13**
	Verbal WM	**8**
Other		
	Sentence Memory	**5**

Score Summary Profiles





WRAML3: Performance Validity

PERFORMANCE VALIDITY INDICATORS

Recognition Subtests	Picture Memory	Design Learning	Story Memory	Verbal Learning	Total
First Five Recognition Items Raw Score					

Indicator 1: Attention/Concentration Index	55–70	71–145
Score	1	0
Indicator 2: Recognition Raw Score Total	0–16	17–20
Score	1	0

Validity Indicator Total	0	1	2
	Acceptable	Indeterminate	Questionable

Performance Validity

Clinical Validity Statistics for Performance Validity Indicators			
Indicator	**Sensitivity**	**Specificity**	**% correctly classified**
Indicator 1. Attention/Concentration Index	.67	.98	96 %
Indicator 2. Recognition Raw Score	.59	.82	81%
Both Validity Indicators together	.52	.99	97%

SAM

Performance Validity

Indicator 1: Attn/Conc Index = 0
Indicator 2: Recognition Tot. Raw Score = 0

= Acceptable Validity

Performance Validity
% identified as "Questionable"

Clinical Group	Indicator 1 % ADHD ≤ 70	Indicator 2 % Recognition ≤ 16	% Indicators 1 and 2
ADHD	5.9	3.6	0.0
ID-Mild	65.5	60.0	50.0
LD-R	3.2	13.0	4.3
MCI/ALZ	20.0	82.1	19.0
MDD	4.0	25.0	0.0
TBI	3.4	13.8	3.4
Standardization	2.5	17.8	1.1

Abbreviated Formats of WRAML3

- Screening Format
- Brief Format

WRAML3 Screening Format

1st four immediate subtests

No ACI subtests

1. Picture Memory
2. Story Memory
3. Design Learning
4. Verbal Learning

- GIMI: *r* = .92,
- Δ = 1.0 – 1.5 ss point
- ≈ 23-28 min.

Allows continuing with more WRAML if desired
(if time delays observed)

WRAML3 Brief Format

2 Subtests

1. Story Memory
2. Design Learning

- *(Immediate, Delayed and Recognition possible)*
- ≈ immediate = 12-14 min.; all: 25-31 min.
- GIMI: r = .84, Δ = 1.4
- GDMI: r = .78, Δ = 1.4
- GRMI: r = .70, Δ = 0.8

Time for memory consolidation!

Questions?