

Processing speed and working memory task development: The NIH Toolbox project

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Working Memory

- The capacity to:
 - 1) process information across a series of tasks and modalities
 - 2) hold information in a short-term buffer
 - 3) manipulate the information
 - 4) hold the products in the same short-term buffer
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Working Memory – The List Sorting Task

- Adaptation of Mungas' Spanish and English Neuropsychological Assessment Scales (SENAS) working memory task
 - Requires sequencing different orally presented stimuli (e.g., reporting animals in size order, followed by fruits in size order)
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List Sorting – One & Two List examples

Bee Elephant Turtle Pig

___bee ___turtle ___pig ___elephant

Orange Camel Monkey Raspberry

___raspberry___orange___monkey ___camel

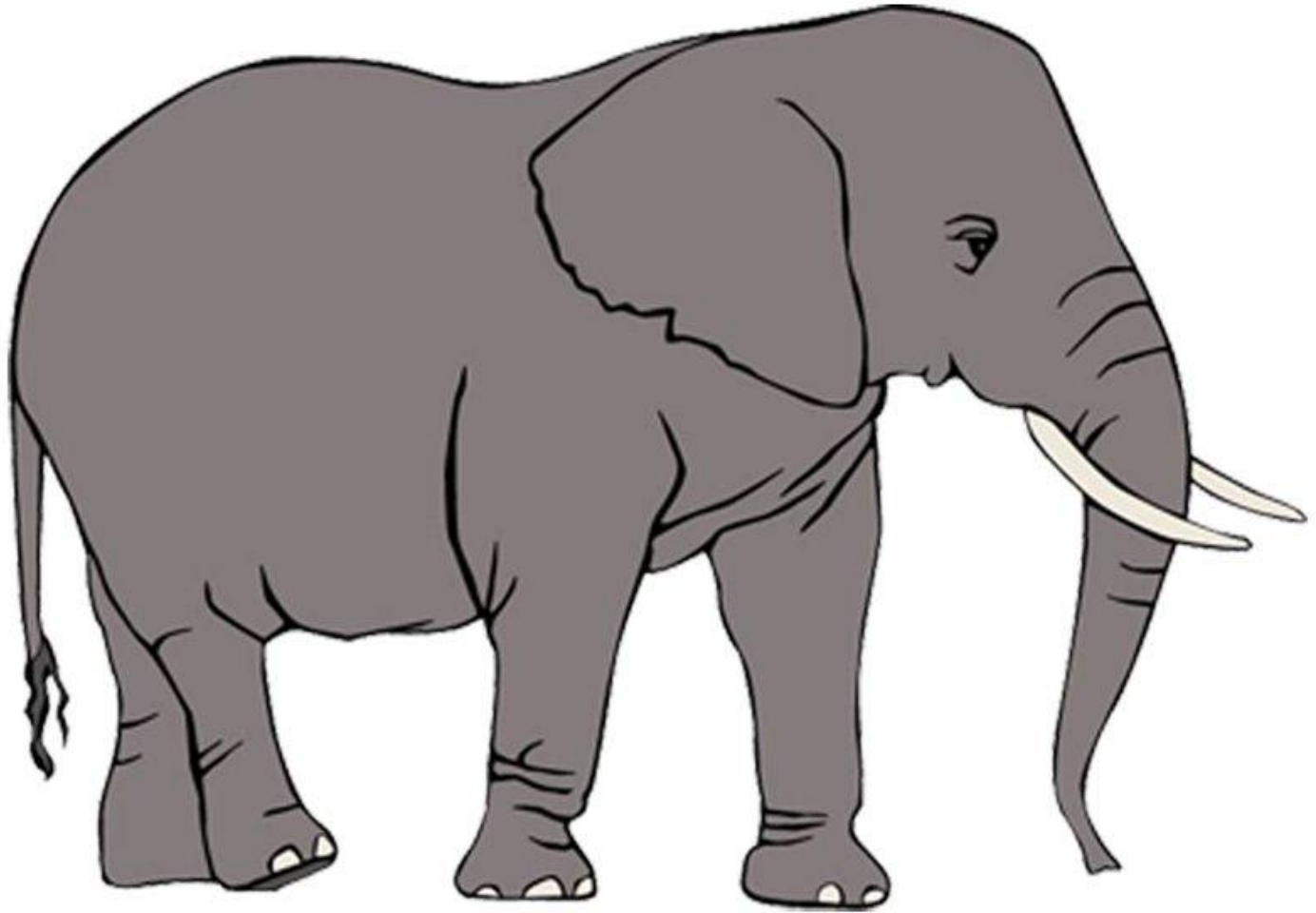
The List Sorting Task

- Adapting the test for children
 - Will auditory presentation be too complicated for young children?
 - Will visual stimuli be more appealing for children?
 - Can the test be simplified?
 - Adapting instructions for children
 - Increasing the number of easy items?
 - Visual presentation more appealing (visually appealing stimuli for kids)
-

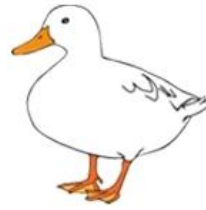
Example #1

List Sorting – One List

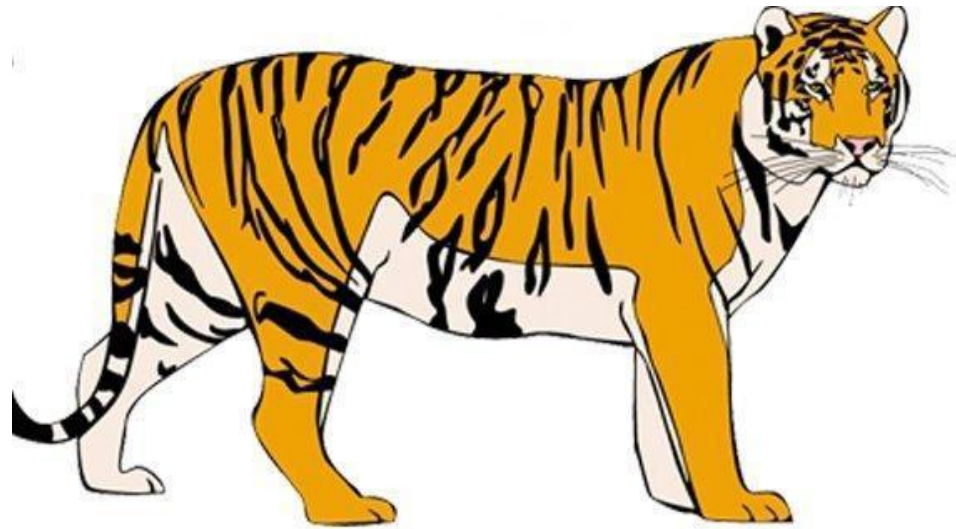
(visual/auditory presentation)



ELEPHANT



DUCK



TIGER



BEE



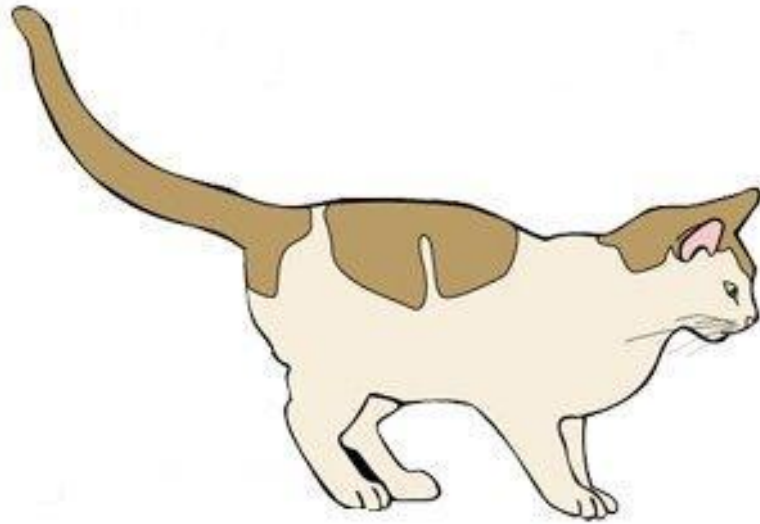
Example #2

List Sorting – Two List

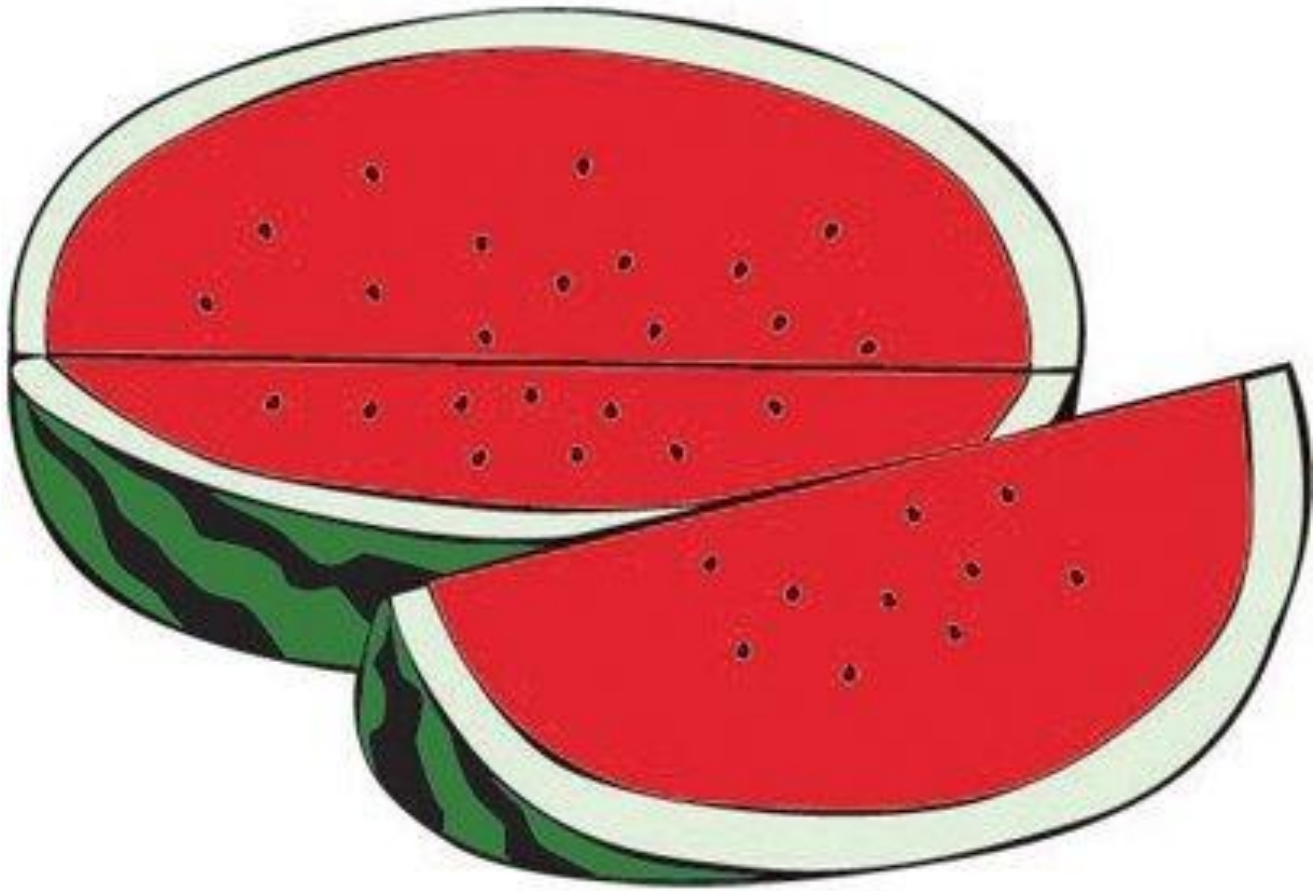
(visual/auditory presentation)



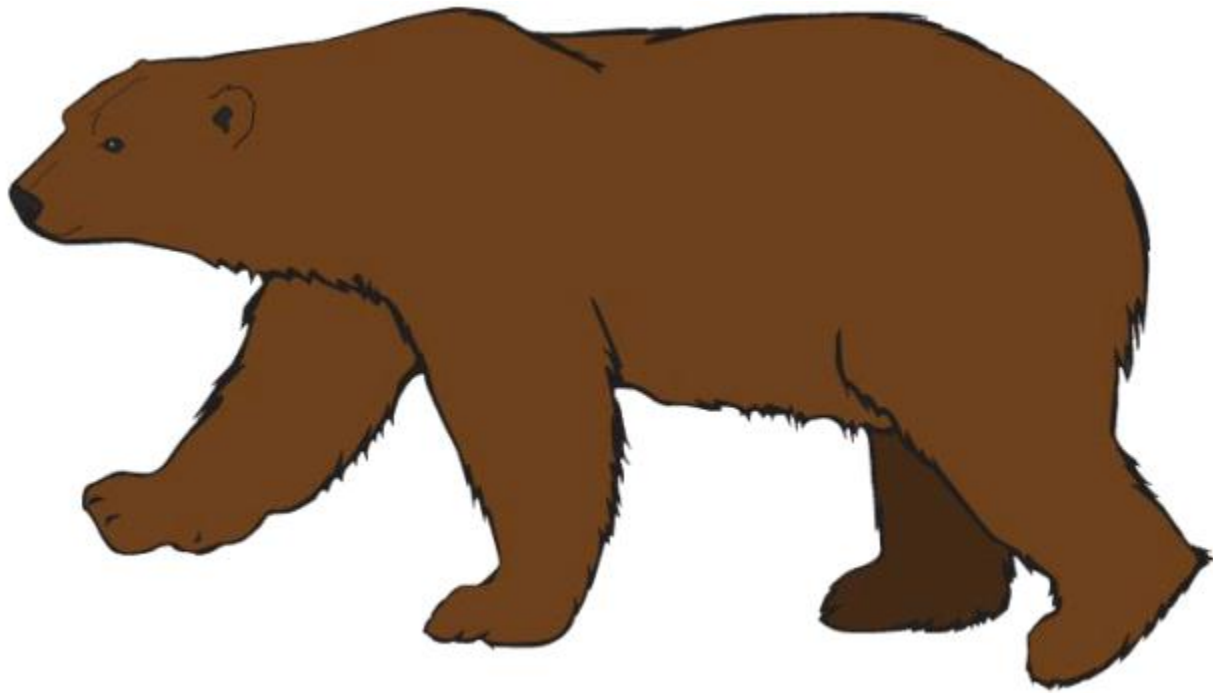
APPLE



CAT



WATERMELON



BEAR



Test Development Studies

- $N = 21$ ($n = 10$ 3-year-olds & $n = 11$ young adults)
 - Most 3-year olds able to do the task
 - Adults weren't able to complete all items
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Formal Pilot Testing Data ($N = 123$)

Age	N
Child (3-6)	47
Adult (18-50)	41
Older Adult (65-85)	35

Formal Pilot Testing Results

Task	N	M(SD)	Range
1 List Total Score	121	12.63(5.71)	0-21
1 List Retest	48	13.19(5.77)	0-21
2 List Total Score	120	8.08(4.45)	0-17
2 List Retest	48	7.98(4.27)	1-17

Working Memory Descriptive Statistics By Age

Task		N	M(SD)	Range
1 List Total Score	Child	46	6.67(4.42)	0-16
	Adult	38	17.26(1.97)	13-21
	Older	35	15.03(1.99)	12-19
1 List Retest	Child	21	7.81(4.32)	0-17
	Adult	17	18.12(1.69)	15-21
	Older	8	15.38(1.60)	12-17

Working Memory Descriptive Statistics By Age

Task		N	M(SD)	Range
2 List Total Score	Child	45	3.4(2.33)	0-10
	Adult	38	11.87(2.12)	8-16
	Older	35	9.86(2.45)	6-16
2 List Retest	Child	21	3.95(2.36)	1-9
	Adult	17	11.47(2.40)	8-17
	Older	8	10.13(2.23)	7-13

Working Memory Test-Retest Correlations

		N	Pearson R	p
1 List Test-Retest	Child	21	.85	<.0001
	Adult	17	.71	.001
	Older	8	.70	.05
2 List Test-Retest	Child	20	.86	<.0001
	Adult	17	.63	.007
	Older	8	.81	.02

Working Memory: Next steps

- Combine 1 and 2 List scores to ensure sufficient range across age groups
 - Add some additional easy items to increase the range for the youngest participants

 - For Phase 4. Pre-Testing with Validation Measures ($N=150$)
 - All participants will receive a retest
 - Test will be validated against “gold standards” in the field: WISC-IV/WAIS-IV Letter-Number Sequencing
-



Processing Speed

- The amount of time to process a set amount of information or the amount of information processed within a certain unit of time
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Processing Speed

- Adaptation of Salthouse's Pattern Comparison task
 - This task requires participants to identify whether a pattern is either the "same" or "different" from another pattern
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Processing Speed

- Do we need to develop different versions for different ages?
 - use age-appropriate pictures for children?
 - vary complexity of the stimuli?
 - ensure children understand this task
 - How do we adapt for computerized administration?
-

Processing Speed

- Do we need to develop different versions for different ages?
 - use age-appropriate pictures for children?
 - vary complexity of the stimuli?
 - ensure children understand this task
 - How do we adapt for computerized administration?
-

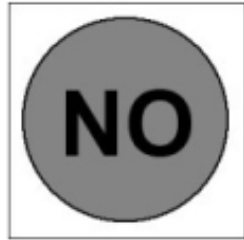
Touchscreen Computer Response Buttons

Are the pictures the same, yes or no?

■ Adults

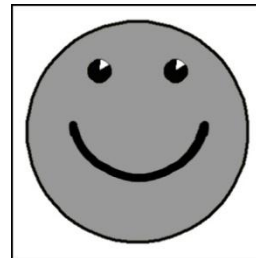


“Yes”
response

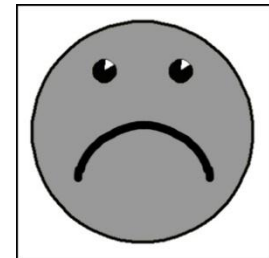


“No”
response

■ Children

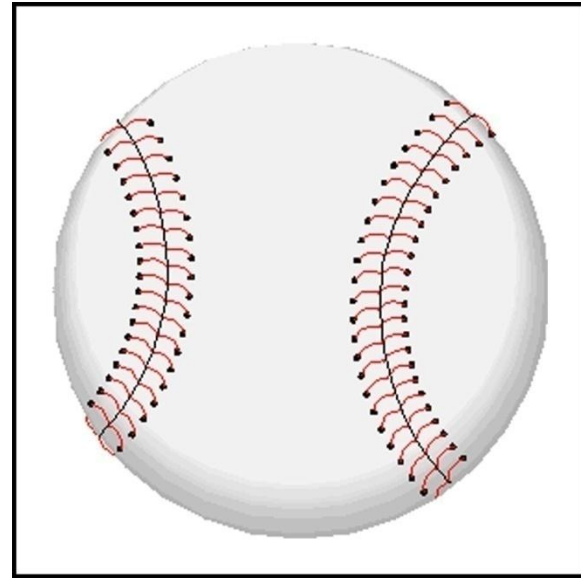
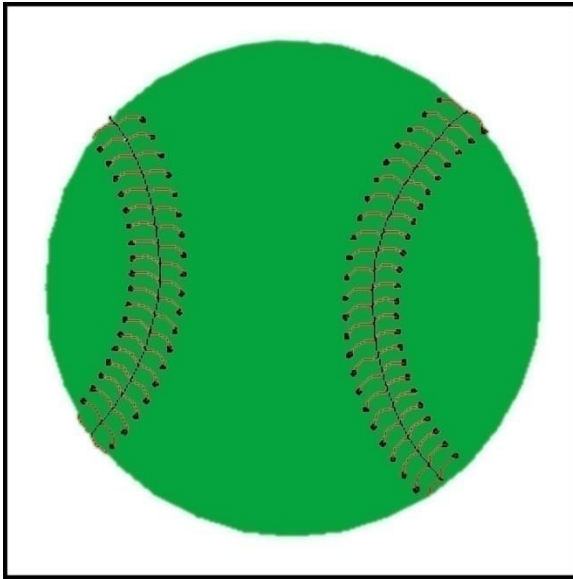


“Yes”
response

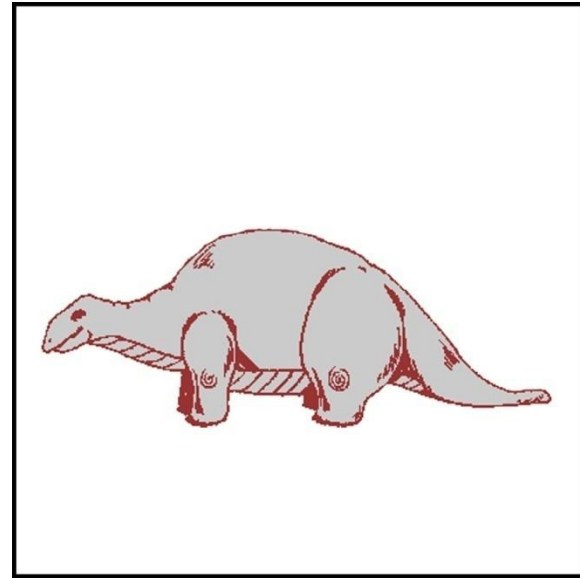
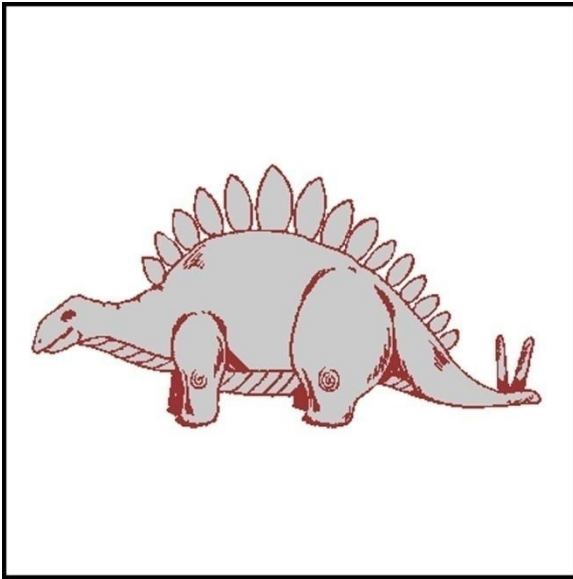


“No”
response

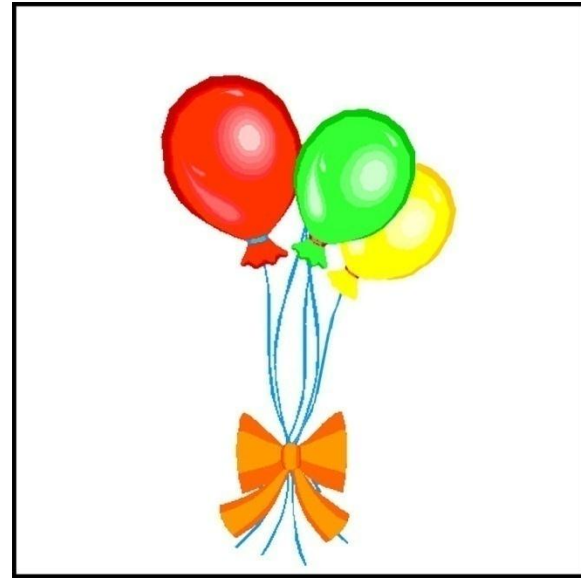
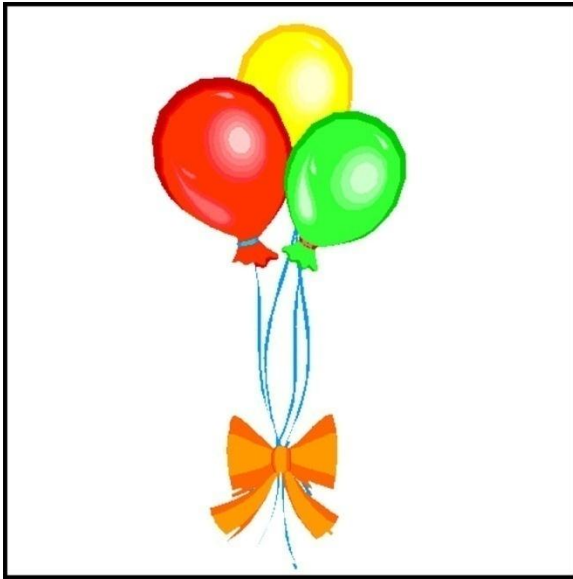
Example Stimuli (Clipart version)



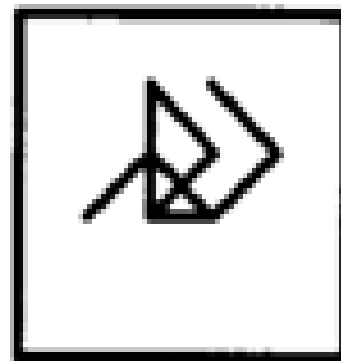
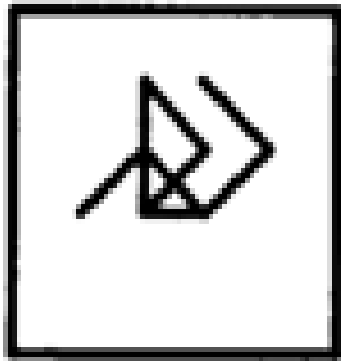
Example Stimuli (Clipart version)



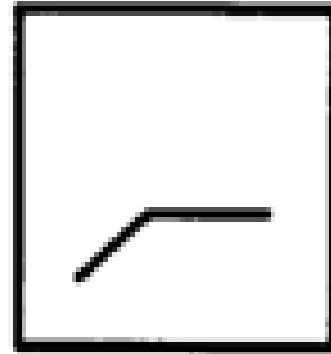
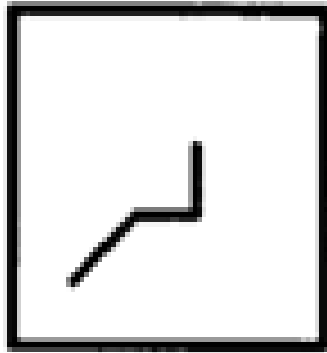
Example Stimuli (Clipart version)



Stimuli Examples (Salthouse Version)



Stimuli Examples (Salthouse Version)



Test Development Studies

- $N = 21$ ($n = 10$ children & $n = 11$ adults)
 - average 44.4 (SD = 12.3) for children
 - average 110.8 (SD = 18.9) for adults
-

Descriptive Statistics for Pattern Comparison ClipArt Images

TEST 1	N	Total Items Completed M (SD)	Total Items Correct M (SD)
Child	54	72.94 (36.80)	55.33 (28.32)
Adult	39	131.33 (33.16)	129.05 (32.39)
Older	45	95.73 (29.91)	93.73 (29.30)
RETEST	N	Total Items Completed M (SD)	Total Items Correct M (SD)
Child	22	86.81 (46.33)	70.5 (34.35)
Adult	20	156.3 (35.63)	155.05 (35.11)
Older	7	110.14 (10.93)	107.57 (10.06)

Descriptive Statistics for Pattern Comparison Salthouse Images

TEST 1	N	Total Items Correct M (SD)	Total time (sec) M(SD)Median
Adult	59	59 (2.04)	120.26 (40.88)
Older	52	56.47 (6.18)	167.87 (35.56)
RETEST	N	Total Items Correct M (SD)	Total time (sec) M (SD)
Adult	20	57.8 (4.73)	113.75 (37.62)
Older	7	58.57 (1.72)	140 (17.53)

Processing Speed: Next Steps

- Determine ideal administration time
 - Determine if we can use the same version across all age groups

 - For Phase 4. Pre-Testing with Validation Measures ($N=150$)
 - All participants will receive a retest
 - Test will be validated against “gold standards” in the field: Processing Speed Index from the WISC-IV/WAIS-IV (Coding and Symbol Search) and PASAT
-

Future Steps...

- Validation ($N = 600$)
 - Norming
-

Questions?



Gender

Gender	Male %	N	Female %	N
Child	53.2		46.8	
Adult	31.7		68.3	
Older Adult	74.3		25.7	
All participants	52	64	48	59

Race

Race	Child		Adult		Older Adult		All	
	%	N	%	N	%	N	%	N
Caucasian	87.2	41	85.4	35	97.1	34	89.4	110
African American	4.3	2	9.8	4	2.9	1	5.7	7
Hispanic	2.1	1	2.4	1	0	0	1.6	2
Asian	2.1	1	2.4	1	0	0	1.6	2
Indian/Eskimo	0	1	0	0	0	0	.8	1

Education Level

Highest Grade Completed	Adult		Older Adult	
	%	N	%	N
High School Grad/GED	2.4%	1	5.7%	2
Some college (< 1 year)	0	0	34.3%	12
1+ college (no degree)	34.1%	14	28.6%	10
Associates degree	22.0%	9	31.4%	11
Bachelor's degree	24.4%	10		
Masters degree	17.1%	7		

List Sorting – One List examples (verbal administration)

From 2 objects:

Apple Strawberry

___strawberry ___apple

Pig Mouse

___mouse ___pig

To 6 objects:

Pumpkin Pear Strawberry Lemon Pineapple Cherry

___cherry ___strawberry ___lemon ___pear ___pineapple ___pumpkin

Duck Bee Elephant Pig Bear Turtle Tiger Mouse

___bee ___mouse ___turtle ___duck ___pig ___tiger ___bear___elephant

List Sorting – Two List examples (verbal administration)

From 2 objects:

Turtle Ice-cream

___ice-cream ___turtle

Carrot Monkey

___carrot ___monkey

To 9 objects:

Raspberry Rabbit Pineapple Bee Orange Camel Strawberry Monkey Pumpkin

___raspberry___strawberry___orange___pineapple___pumpkin___bee___rabbit___
monkey ___camel

Horse Popcorn Butterfly Pear Elephant Hamburger Cat Hot-dog Sheep

___popcorn___pear___hot-dog ___hamburger
___butterfly___cat___sheep___horse___elephant

Descriptive Statistics for Pattern Comparison ClipArt Images

TEST 1	N	Total Items Completed M(SD)Median	Total Items Correct M(SD)
Child	54	72.94(36.80)67.5	55.33(28.32)52.5
Adult	39	131.33(33.16)139	129.05(32.39)137
Older	45	95.73(29.91)94	93.73(29.30)91
RETEST	N	Total Items Completed M(SD)Median	Total Items Correct M(SD)Median
Child	22	86.81(46.33)83	70.5(34.35)69
Adult	20	156.3(35.63)159.5	155.05(35.11)156.5
Older	7	110.14(10.93)107	107.57(10.06)105

Test-retest for ClipArt (N = 49)

Test		Pearson R	P
Total Items Completed	Child	.18	NS
	Adult	.59	.0057
	Older Adult	-.31	NS

Clipart test-retest correlations for Salthouse

(N = 27) **PICK ONE GRAPH**

Test	Pearson R	P
Total Items Correct	.39	.0471

Test		Pearson R	P
Total Items Correct	Adult	.38	NS
	Older Adult	.82	.0235

Descriptive Statistics for Pattern Comparison Salthouse Images

TEST 1	N	Total Items Correct M(SD)Median	Total time (sec) M(SD)Median
Adult	59	59(2.04)59	120.26(40.88)105
Older	52	56.47(6.18)58	167.87(35.56)159
RETEST	N	Total Items Correct M(SD)Median	Total time (sec) M(SD)Median
Adult	20	57.8(4.73)58	113.75(37.62)99.5
Older	7	58.57(1.72)59	140(17.53)143