Supplement: Overview

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Supplement: Table S1

Neuropsychological Test Scores: Comparison of the non-standardized test values

Test	OLD	YOUNG	t-Test
Trail-Making-Test (A)	35.3 s (2.16)	24.5 s (1.44)	-4.24 ***
Trail-Making-Test (B)	81.30 s (30.52)	51.3 s (17.53)	-4.21 ***
Block Span (forward)	7.56 (1.68)	9.73 (1.89)	4.11 ***
Block Span (backward)	8.00 (1.57)	9.54 (1.50)	3.46 ***
IDG: visual learning	5.00 (2.37)	8.92 (1.23)	7.36 ***
IGD: visual recognition	7.32 (1.49)	9.77 (0.51)	7.85 ***

IGD: visual association	4.82 (2.04)	6.92 (0.39)	5.16 ***
LPS: reasoning	19.45 (5.74)	31.96 (4.07)	8.80 ***
LPS: visual filtering	21.91 (5.30)	29.19 (3.90)	5.48 ***

*** p<0.001, ** p<0.01, * p<0.05

IGD (Inventar zur Gedächtnisdiagnostik, Baller, Brand, Kalbe & Kessler, 2006, Hogrefe Testzentrale) LPS (Leistungsprüfsystem, Horn, 1983, Hogrefe Testzentrale)

Supplement: Figure S1
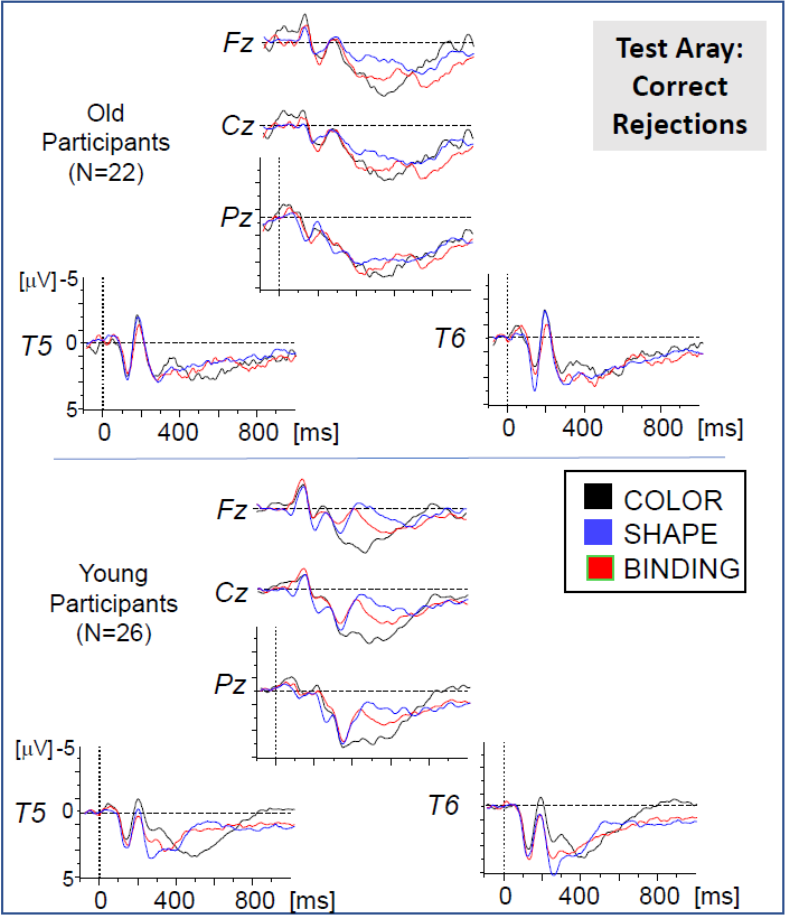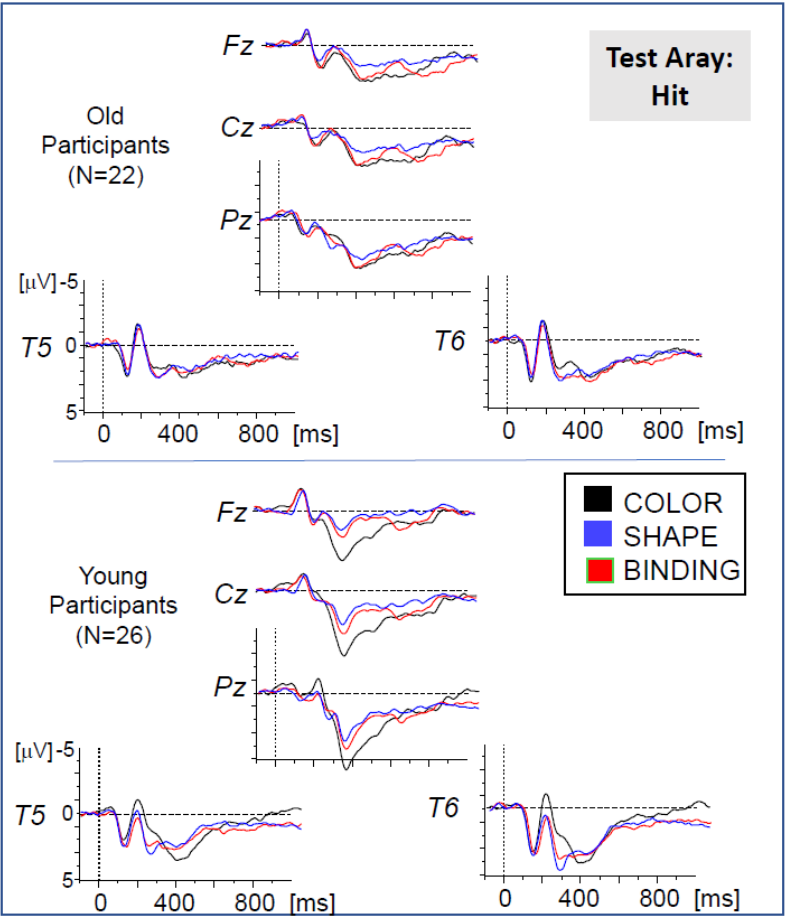
Supplement: Analyis S1

Peak analysis: N1 and P2

Coding of Condition

1=Color, 2=Shape, 3=Binding

N1 latency

Group	Condition	Mean	SD
young	1	187,673	1,969
	2	182,173	1,866
	3	183,712	1,943
old	1	191,545	2,140
	2	188,432	2,028
	3	190,545	2,112

N1 amplitude

Group	Condition	Mean	SD
young	1	-3,272	,503
	2	-3,734	,478
	3	-2,938	,471
old	1	-3,711	,547

2	-4,414	,520
3	-3,614	,512

P2 latency

Group	Condition	Mean	SD
young	1	235,615	2,119
	2	237,519	2,248
	3	234,788	2,398
old	1	240,045	2,304
	2	243,295	2,444
	3	241,500	2,607

P2 amplitude

Group	Condition	Mean	SD
young	1	5,767	,498
	2	4,302	,532
	3	5,015	,488
old	1	2,324	,541
	2	2,086	,578
	3	2,571	,530

Results of the ANOVA (effects of 'condition' and 'condition x age') and subsequent post-hoc comparisons for the behavioral data (hit rate, A'). (B = Binding, C = feature-alone color, S = feature-alone shape).

Variable	Contrast	Factor Condition	Interaction Condition x Age
N1 (Latency)		$F(2,92)=7.54$, $p=.001$, $\eta_p^2=.141$	$F(2,92)=.99$, $p=.374$, $\eta_p^2=.021$
post-hoc	B vs C	$F(1,46)=4.26$, $p=.045$, $\eta_p^2=.085$	n.a.
	B vs S	$F(1,46)=3.52$, $p=.067$, $\eta_p^2=.067$	n.a.
	C vs S	$F(1,46)=14.72$, $p<.001$, $\eta_p^2=.239$	n.a.
N1 (Amplitude)		$F(2,92)=9.50$, $p<.001$, $\eta_p^2=.171$	$F(2,92)=0.26$, $p=.768$, $\eta_p^2=.006$
post-hoc	B vs C	$F(1,46)=1.43$, $p=.238$, $\eta_p^2=.030$	n.a.
	B vs S	$F(1,46)=14.46$, $p<.001$, $\eta_p^2=.239$	n.a.
	C vs S	$F(1,46)=10.74$, $p=.002$, $\eta_p^2=.186$	n.a.
P2 (Latency)		$F(2,92)=1.60$, $p=.208$, $\eta_p^2=.034$	$F(2,92)=.27$, $p=.77$, $\eta_p^2=.006$
post-hoc	B vs C	n.a.	n.a.
	B vs S	n.a.	n.a.
	C vs S	n.a.	n.a.

P2 (Amplitude) $F(2,92)=5.86, p=.004, \eta_p^2=.113$ $F(2,92)=3.26, p=.043, \eta_p^2=.066$

B vs C $F(1,46)=1.07, p=.306, \eta_p^2=.023$ old: $F(1,21)=.41, p=.530, \eta_p^2=.019$

post-hoc   young $F(1,25)=6.03, p=.021, \eta_p^2=.194$

B vs S $F(1,46)=4.92, p=.031, \eta_p^2=.097$ old: $F(1,21)=2.46, p=.132, \eta_p^2=.105$
                                                             young: $F(1,25)=2.86, p=.103, \eta_p^2=.103$

                                                             old: $F(1,21)=.62, p=.440, \eta_p^2=.029$
C vs S $F(1,46)=11.68, p=.001, \eta_p^2=.199$ young: $F(1,25)=14.36, p=.001, \eta_p^2=.365$

Supplement: Analyis S2

Statistical effects of the experimental factors age and block, and their interaction effect with the factor condition.

Variable: Discrimination Ability (A')

Group	Block	Task	Mean	SD
young	1	Color	,985	,013
	2	Color	,987	,004
	1	Shape	,954	,016
	2	**Shape**	**,983**	**,007**
	2	Binding	,923	,020
	2	Binding	,949	,017
old	1	Color	,961	,014
	2	Color	,990	,004
	1	Shape	,863	,017
	2	Shape	,948	,008
	2	Binding	,739	,023
	2	Binding	,830	,019

Variable: Mean N1 activity

Gruppe	Condition	Block	Mean	SD
young	Color	1	-2,280	,487
		2	-2,234	,489
	Shape	1	-2,664	,532
		2	-2,446	,4575
	Binding	1	-2,044	,446
		2	-1,612	,436
old	Color	1	-2,741	,529
		2	-2,512	,531
	Shape	1	-3,613	,578
		2	-3,142	,497
	Binding	1	-2,511	,485
		2	-2,549	,474

Variable: Mean P2 activity

Gruppe	Condition	Block	Mean	SD
young	Color	1	4,945	,552
		2	5,067	,478
	Shape	1	2,991	,585
		2	3,771	,558
	Binding	1	3,785	,593
		2	4,169	,495
old	Color	1	,927	,600
		2	1,478	,520
	Shape	1	,751	,636
		2	1,242	,607
	Binding	1	1,035	,645
		2	1,877	,538

Variable: Mean LPC activity

Gruppe	Condition	Block	Mean	SD
young	Color	1	2,741	,467
		2	2,455	,416
	Shape	1	2,951	,498
		2	3,029	,390
	Binding	1	3,272	,459
		2	3,324	,423
old	Color	1	1,305	,508
		2	2,040	,452
	Shape	1	,592	,542
		2	1,406	,424
	Binding	1	2,048	,499
		2	2,825	,460

Results of the ANOVA (F-Statistics=

Variable	Factor age	Factor Block	Interaction Block x Condition x Age
A'	$F(1,46)=27.00, p<.001, \eta_p^2=.375$	$F(1,46)=48.90, p<.001, \eta_p^2=.521$	$F(2,92)=1.14, p=.325, \eta_p^2=.025$
N1	$F(1,46)=1.006, p=.321, \eta_p^2=.021$	$F(1,46)=3.01, p=.086, \eta_p^2=.063$	$F(2,92)=0.95, p=.392, \eta_p^2=.020$
P2	$F(1,46)=18.41, p<.001, \eta_p^2=.286$	$F(1,46)=7.78, p=.008, \eta_p^2=.145$	$F(2,92)=0.44, p=.640, \eta_p^2=.010$
LPC	$F(1,46)=5.50, p=.023, \eta_p^2=.107$	$F(1,46)=4.72, p=.035, \eta_p^2=.093$	$F(2,92)=0.09, p=.911, \eta_p^2=.002$

Supplement: Table S2

Results of the ANOVA (effects of 'condition' and 'condition x age') and subsequent post-hoc comparisons for the behavioral data (hit rate, false alarms). (B = Binding, C = feature-alone color, S = feature-alone shape).

Variable	Contrast	Factor Condition	Interaction Condition x Age
Hit Rate		$F(2,92)=12.00, p<.001, \eta_p^2=.207$	$F(2,92)=4.70, p=.012, \eta_p^2=.093$
post-hoc	B vs C	$F(1,46)=21.58, p<.001, \eta_p^2=.319$	Old: $F(1,21)=17.66, p<.001, \eta_p^2=.457$ Young F(1,25)=2.40, p=.341, η_p^2=.087
	B vs S	F(1,46)=.66, p=.664, η_p^2=.004	Old: F(1,21)=0.55, p=.465, η_p^2=.026 Young F(1,25)=.65, p=.654, η_p^2=.026
False Alarms		$F(2,92)=138.94, p<.001, \eta_p^2=.757$	$F(2,92)=27.71, p<.001, \eta_p^2=.376$
post-hoc	B vs C	$F(1,46)=194.91, p<.001, \eta_p^2=.809$	Old: $F(1,21)=128.39, p<.001, \eta_p^2=.859$ Young F(1,25)=53.17, p<.001, η_p^2=.680
	B vs S	F(1,46)=101.47, p<.001, η_p^2=.688	Old: F(1,21)=61.15, p<.001, η_p^2=.744 Young F(1,25)=34.69, p<.001, η_p^2=.581

Supplement: Table S3

Comparision of experimental setups used in studies on age-specific binding capacity

Study Reference: see Text	sample (young)	sample (old)	Type: task
Niedeggen et al.	N=26 (mean age 23.8)	N=22 (mean age 68.8)	change detection
Brockmole et al., (2008)			
Experiment 2	N=12 (mean age 21.5)	N=12 (mean age 67.3)	change detection
Isella et al., 2015	N=25 (mean age 24.8)	N=26 (mean age 73.2)	change detection
Parra et al., 2009	N=14 (mean age 20.7)	N=14 (mean age 65.9)	change detection
Pertzow et al., 2015	N=32 (mean age 25.2) and N=53 (mean age 35.2)	N=35 (mean age 49.2) and N=35 (mean age 67.5)	item recognition
Brown & Brockmole, 2010			
Experiment 1	N=24 (mean age 18.9)	N=24 (mean age 72.2)	single item recognition
Experiment 2	N=24 (mean age 20.3)	N=24 (mean age 72.3)	single item recognition
Chalfonte & Johnson, 1996			
Experiment 1b	N=32 (mean age 19.1)	N=32 (mean age 69.5)	item recognition
Experiment 2	N=32 (mean age 19.4)	N=32 (mean age 71.0)	item recognition
Experiment 3b	N=32 (mean age 19.9)	N=32 (mean age 71.9)	item recognition
Cowan et al., 2006			
Experiment 1a	N=53 (mean age 20.4)	N=33 (mean age 71.1)	change detection
Experiment 2a	N=24 (mean age 18.9)	N=32 (mean age 71.4)	change detection
Mitchel et al., 2000			
Experiment 1	N=24 (mean age 19.5)	N=24 (mean age 74.1)	change detection
Experiment 2	N=16 (mean age 19.6)	N=16 (mean age 75.1)	change detection
Rhodes et al., 2017	N=24 (mean age 20.7) and	N=24 (mean age 70.9)	
Experiment 1	N= 24 (mean age 21.1)	and N=25 (mean age 70.2)	change detection
Experiment 2	N=24 (mean age 20.7) and N= 24 (mean age 21.1)	N=25 (mean age 70.0) and N=24 (mean age 71.4)	change detection
Brown et al., 2016			
Experiment 1	N=24 (mean age 19.9)	N=24 (mean age76.0)	single item recognition
Experiment 2	N=24 (mean age 22.1)	N=24 (mean age 77.6)	single item recognition
Experiment 3	N=24 (mean age 20.5)	N=24 (mean age 75.4)	single item recognition
van Geldorb et al., 2014	N=31 (mean age 22.3)	N= 30 (mean age 54.8 and N=30 (mean age 70.2)	item recall

Comparision of experimental setups used in studies on age-specific binding capacity

Study Reference: see Text	Type: Feature binding	Number of Items	Presentation time: study array	Maintenance time
Niedeggen et al.	intrinsic intra-item (color/shape)	3	2000 ms	900 ms
Brockmole et al., (2008)				
Experiment 2	intrinsic intra-item (color/shape)	4	1000 ms	900 ms
Isella et al., 2015	intrinsic intra-item (color/shape)	4	4000ms	1000ms
Parra et al., 2009	intrinsic intra-item (color/color)	3 and 4	2000ms and 1000ms	900ms
Pertzow et al., 2015	extrinsic intra-item (object/location)	1 and 3	1000ms and 3000ms	1000ms and 4000ms
Brown & Brockmole, 2010				
Experiment 1	intrinsic intra-item (color/shape)	3	900ms	1000ms
Experiment 2	intrinsic intra-item (color/shape)	3	1500ms	1000ms
Chalfonte & Johnson, 1996	intrinsic (color/object) and extrinsic			
Experiment 1b	(object/location)	30	90sec	immediate
Experiment 2	intrinsic (color/object)	30	90sec	immediate
Experiment 3b	intrinsic (color/object)	30	90sec	immediate
Cowan et al., 2006				
Experiment 1a	extrinsic intra-item (object/location)	4-10	250ms	immediate
Experiment 2a	extrinsic intra-item (object/location)	4-10	250ms	immediate
Mitchel et al., 2000				
Experiment 1	extrinsic intra-item (object/location)	9	1000ms per Item	8000ms
Experiment 2	extrinsic intra-item (object/location)	9	1000ms per Item	8000ms
Rhodes et al., 2017				
Experiment 1	intrinsic (color/shape)	9	900ms	1000ms
Experiment 2	extrinsic intra-item (object/location)	9	900ms	1000ms
Brown et al., 2016				
Experiment 1	intrinsic intra-item (color/shape)	3	900ms and 1500ms	1000ms
Experiment 2	intrinsic intra-item (color/shape)	3	1500ms	1000ms
Experiment 3	intrinsic intra-item (color/shape)	3	900ms	1000ms
van Geldorb et al., 2014	intrinsic intra-item (color/shape) and relational (color/shape)	4	4000ms	1000ms

Supplement 6

Comparision of experimental setups used in studies on age-specific binding capacity

Study	Performance: variable	Contrasts	Age-specific effect
Reference: see Text	A' and d' refer to discrimination ability	Comparison of experimental conditions reported in the study	
Niedeggen et al.	A' and hit rate	Binding<Color and Binding<Shape	yes
Brockmole et al., (2008)			
Experiment 2	not specified (A' or proportion correct)	Binding=Shape<Color	no
Isella et al., 2015	A'	Binding<Color; Color=Shape; Shape=Binding	no
Parra et al., 2009	A'	Binding=Non-Conjunctive Colors<Colors and Binding<Non-Conjunctive Colors<Colors	no
Pertzow et al., 2015	swap errors	Between Age Groups	no
Brown & Brockmole, 2010			
Experiment 1	A'	Shape<Color; Binding=Shape	no
Experiment 2	A'	Binding<Shape<Color	yes
Chalfonte & Johnson, 1996			
Experiment 1b	A'	Intrinsic vs. Extrinsic Binding	yes
Experiment 2	A'	Binding<Item and Binding<Color	yes
Experiment 3b	A'	Incidental vs. Intentional Learning of Bound Objects	yes
Cowan et al., 2006			yes
Experiment 1a	d'	Binding Change<Item Change	yes
Experiment 2a	d'	Binding Change<Item change	yes
Mitchel et al., 2000			
Experiment 1	d'	Binding<Single Feature (Object/Location)	yes
Experiment 2	d'	Binding<Single Feature (Object/Location)	yes
Rhodes et al., 2017			
Experiment 1	Corrected recognition P_r	Binding<Color and Binding=Shape	no
Experiment 2	Corrected recognition P_r	Binding=Color=Location	no
Brown et al., 2016			
Experiment 1	A'	Binding=Shape<Color (different retention times)	no
Experiment 2	A'	Binding=Shape<Color (sequential presentation)	no
Experiment 3	A'	Binding<Shape<Color (suffix interference)	yes
van Geldorb et al., 2014	number correct	relational<conjunctional binding interference<non-interference (stronger in relational binding)	yes