S1. Description of CNB tests.

Tests of the CNB can be divided into five main neurobehavioral functions, each including a selection of a total of 14 cognitive domains.
The 17 tests are assessed in the following order: Motor praxis task, Emotion identification test, Continuous performance test, Face memory test, Word memory test, Letter N-back test, Face memory test - delayed, Word memory test - delayed, Conditional exclusion test, Emotion differentiation test, Finger tapping test, Matrix reasoning test, Visual object learning test, Verbal reasoning test, Age differentiation test, Line orientation test and Visual object learning test – delayed.

1. Executive-control

Conditional exclusion Test (CET)

The Conditional exclusion test measures abstraction and mental flexibility. Participants are instructed to select one out of four objects which they think does not belong. Participants are not informed about which sorting principle (line thickness, shape and size) to follow. The sorting principle changes after six consecutive correct answers. The participant receives feedback after each answer "correct" or "not correct", which may guide their next decision. There is a maximum of 48 trials, without a time limit.
There is no practice session. Accuracy is calculated as follows: number of categories achieved + 1 (to avoid a floor effect if no categories were solved) multiplied by the proportion of correct responses. Speed is the median response time of the correct responses.

Continuous performance test (CPT)

The Continuous performance test measures attention and vigilance. A 7-segment display of red vertical and horizontal lines appear in a frame (resembling a digital clock). Whenever these form a number (or letter on the second half of the test) the participant must press the spacebar as soon as possible. Both conditions are practiced before the actual test starts. Each condition consists of 30 real stimuli and 60 distractors. Stimuli are shown for 300 milliseconds, followed by a blank page for 700 milliseconds, giving 1 second to respond before the next stimulus is shown.
Accuracy is based on the number of true positives, and speed on the median response time for these true positives.

Letter N-back test (LNB)

The Letter N-back test measures working memory. This test consists of 3 conditions: 0-back, 1-back and 2-back (two sessions of each), all of which have a practice session which has to be completed successfully before the actual test begins. During the 0-back, participants are instructed to press the spacebar when the letter that appears on the screen is an "X". In the 1-back participants must press the spacebar whenever the same letter appears on the screen two times in a row. During the 2-back, the participants are supposed to press the spacebar whenever the letter on the screen is the same as the letter before the previous letter. They are instructed to do so as fast as possible, but the next trial is shown after 2.5 seconds.

Accuracy score is based on the number of true positive responses, speed is based on the median reaction time of the true positives.

2. Episodic memory

Face memory test (CPF)

The Face memory test is a measure of face memory. First, participants are shown 20 faces that they will be asked to identify later. Then -the immediate recall- participants are shown a series of 40 faces: the 20 faces they were asked to memorize mixed with 20 novel faces. During the delayed recall (15 – 45 minutes after the immediate recall), participants are again shown 40 faces: the 20 faces they were asked to memorize mixed with 20 novel faces which are different from the distracters shown during the immediate recall.

On both the immediate and delayed recall, participants are instructed to indicate for each face whether they think they have seen the face before by clicking on one of four buttons; "definitely yes", "probably yes", "probably no", and "definitely no". There is no time limit. Facial stimuli are black and white photographs of neutral expressions, balanced for gender and age.

There is no practice session. Accuracy score is based on the number of correct responses (true positives and true negatives), speed is based on the median reaction time of these correct answers.

Word memory test (CPF)

The Word memory test is a measure of verbal memory. First, participants are shown 20 words that they will be asked to identify later. Then -the immediate recall- participants are shown a series of 40 words: the 20 words they were asked to memorize mixed with 20 novel words. During the delayed recall (15 – 45 minutes after the immediate recall), participants are again shown 40 words: the 20 words they were asked to memorize mixed with 20 novel words which are different from the distracters shown during the immediate recall.

On both the immediate and delayed recall, participants are instructed to indicate for each word whether they think they have seen the word before by clicking on one of four buttons; "definitely yes", "probably yes", "probably no", and "definitely no". There is no time limit. Stimuli are equated for frequency, length, concreteness and low imageability.

There is no practice session. Accuracy score is based on the number of correct responses (true positives and true negatives), speed is based on the median reaction time of the correct answers.

Visual object learning test (VOLT)

The Visual object learning test is a measure of spatial memory. First, participants are shown 10 objects (three-dimensional Euclidean shapes) that they will be asked to identify later. Then -the immediate recall- participants are shown a series of 20 shapes: the 10 objects they were asked to memorize mixed with 10 novel shapes. During the delayed recall (15 – 30 minutes after the immediate recall), participants are again shown 20 shapes: the 10 objects they were asked to memorize mixed with 10 novel shapes which are different from the distracters shown during the immediate recall.

On both the immediate and delayed recall, participants are instructed to indicate for each shape whether they think they have seen the object before by clicking on one of four buttons; “definitely yes”, “probably yes”, “probably no”, and “definitely no”. There is no time limit.
There is no practice session. Accuracy score is based on the number of correct responses (true positives and true negatives), speed is based on the median reaction time of the correct answers.

3. Complex cognition

Matrix reasoning test (MAT)
The Matrix reasoning test is a measure of nonverbal reasoning. The participants are instructed to click on the option (out of five) that would best fit the missing part of a pattern (arrangements can be 2x2, 3x3 or 1x5). Patterns can be solved based on spatial, design or numerical relations. Items are of increasing difficulty and the test is aborted after five incorrect answers (followed by three bonus questions based on the participants’ performance). There is no time limit.
The test is preceded by a practice session. Accuracy is based on the number of correct responses, speed is based on the median response time for the correct responses.

Verbal reasoning test (VRT)
The Verbal reasoning test is a measure of language reasoning. The participant must answer eight verbal analogy problems with multiple-choice answers. There is no time limit.
The test is preceded by a practice session. Accuracy is based on the percentage of correct responses, speed is based on the median response time for the correct responses.

Line orientation test (LOT)
The Line orientation test is a measure of spatial ability. The participant is presented with 24 trials in which they see a pair of lines with different orientations: the participant is supposed to rotate the blue line into parallel orientation to the fixed red line. Participants are instructed to use two buttons to rotate the blue line clockwise or counterclockwise and to use as few clicks as possible. Depending on the item, the line may rotate with 3, 6 or 9 degrees, the size of the blue line may change, and positions along the screen may vary (the distance between the centers of the red and blue line is always the same). There is no time limit.
The test is preceded by a practice session. Accuracy is based on the number of correct responses, speed is based on the median response time for the correct responses.

4. Social cognition

Emotion identification test (EI)
The Emotion identification test is a measure of emotion identification or recognition. Participants are shown a series of 40 faces, and asked to determine what emotion the face is showing. Participants respond to each trial by clicking the button corresponding to the emotion each face expresses: happy, sad, anger, fear and no emotion.

In total there are 40 trials (4 male and 4 female faces for each emotion) consisting of color photographs, balanced for intensity of emotion, age, gender and ethnicity. There is no time limit.
The test is preceded by a practice session. Accuracy is based on the number of correct responses, speed is based on the median response time for the correct responses.

Emotion differentiation test (EDT)
The Emotion differentiation test measures the ability to detect emotion intensity. The subject is presented with a pair of faces. The task is to determine which face is showing more, or a stronger, emotion (anger, fear, happiness, sadness). There are three buttons: one below each face and as a third option, the participant could choose the button in the middle "equal". There is no time limit.
There are 36 trials in total, four show no emotional difference, while the remaining 32 trials have emotion differentials between 10% - 60% (increments of 10%).
The test is preceded by a practice session. Accuracy is based on the number of correct responses, speed is based on the median response time for the correct responses.

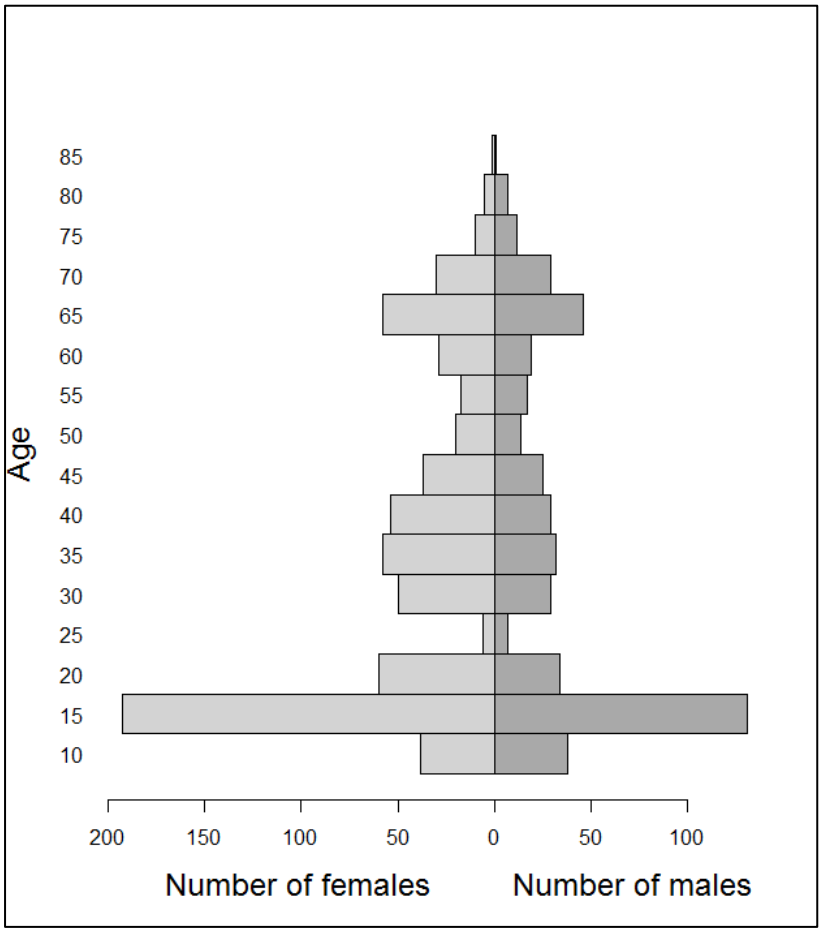
Age differentiation test (ADT)
The Age differentiation test measures the ability to detect small visual differences. With the ADT and EDT in the test battery, it is possible to determine to what extent poor performance on the EDT is attributable to the inability to perceive small facial differences rather than a deficiency in emotion perception specifically.
The participant has to choose which face appears older (click on button below the right face) or if both faces appear to be the same age (button in between "same age"). There are 36 trials (18 male; 18 female), in four trials the two faces are identical, in the remaining 32 trials age differential ranges from 10% to 60% (increments of 10%). There is no time limit.
The test is preceded by a practice session. Accuracy is based on the number of correct responses, speed is based on the median response time for the correct responses.

5. Sensorimotor speed

Motor praxis test (MP)
The Motor praxis test measures sensorimotor ability. It is the first test of the battery, so it also enables the participants to familiarize with the computer mouse. Participants are instructed to click the green box in the screen, which moves over different locations on screen and decreases in size. There are five seconds to respond before the next box appears.
The test is preceded by a practice session. Accuracy is based on the number of correct responses, speed on the median response time for the correct responses.

Finger tapping test (TAP)
The Finger tapping test measures motor speed and manual dexterity. Participants are asked to press the space bar with their index finger as often as possible. There are six trials, each of 10 seconds, alternating between their dominant and non-dominant hand. The test is preceded by a practice session for each hand. Speed is calculated as the total number of taps on the 6 trials.

Figure S2.
Number of female and male participants per age cohort (of 5 years).



S3. Calculating an IQ score from the CNB tests.

To obtain a testee's (or group's) standardized test score, one can make use of the validation sample's average score (proportion correct, median reaction time, or number of TAPS) and calculate how many standard deviations the testee's score (or group's mean score) deviates from this average. For example, if a testee has an accuracy score of 30.0 on the LNB test, whereas the average LNB accuracy score in the validation's sample is 27.9 with a standard deviation of 2.7 (see Table 1, main text), then the testee's score deviates (30.0-27.9)/2.7 = 0.778 standard deviations from this average. Expressed as a traditional intelligence quotient score with a mean of 100 and standard deviation of 15, this deviation would denote an IQ score of 0.778*15+100 = 111.67, or 112 in whole points. Broader domain IQ scores or a total IQ score can be derived by weighing the tests specific IQ scores by their corresponding factor loadings (Table below), which are based on a single-factor model fitted in the entire validation sample. Note that each IQ score would denote a non-age effect corrected score. Hence, if used in a meta-analysis, for instance, age effects need to be regressed out.

Table with correlations between accuracy scores and psychometric IQ (as measured by the WAIS).

Cognitive function (test name)	TIQ	VIQ	PIQ	g-CNB
Abstraction / flexibility (Conditional Exclusion Test)	0.13	0.23	0.20	0.43
Attention (Continuous Performance Test)	0.18	0.15	0.20	0.40
Working memory (Letter-N-Back Test)	0.09	0.10	0.12	0.43
Verbal Memory (Word Memory Test)	0.27	0.15	0.26	0.53
Verbal Memory - Delayed	0.25	0.17	0.26	0.58
Face Memory (Facial Memory Test)	0.09	0.14	0.13	0.51
Face Memory - Delayed	0.22	0.25	0.28	0.60
Spatial Memory (Object Learning Test)	0.18	0.31	0.27	0.50
Spatial Memory - Delayed	0.18	0.34	0.30	0.50
Nonverbal reasoning (Matrix Reasoning Test)	0.29	0.23	0.31	0.52
Language reasoning (Verbal Reasoning Test)	0.27	0.29	0.33	0.58
Spatial ability (Line Orientation Test)	0.31	0.17	0.30	0.49
Emotion Identification (Emotion Identification Test)	0.37	0.60	0.56	0.69
Emotion Differentiation (Emotion Differentiation Test)	0.57	0.37	0.58	0.46
Age Differentiation (Age Differentiation Test)	0.32	0.36	0.41	0.49

Figure S4.

Correlations between the cognitive tests and participants' age (including 95% confidence intervals). Correlations with accuracy scores are given in black and with speed scores in grey.
See Table 1 for abbreviations of cognitive tests.
No accuracy score available for TAP.

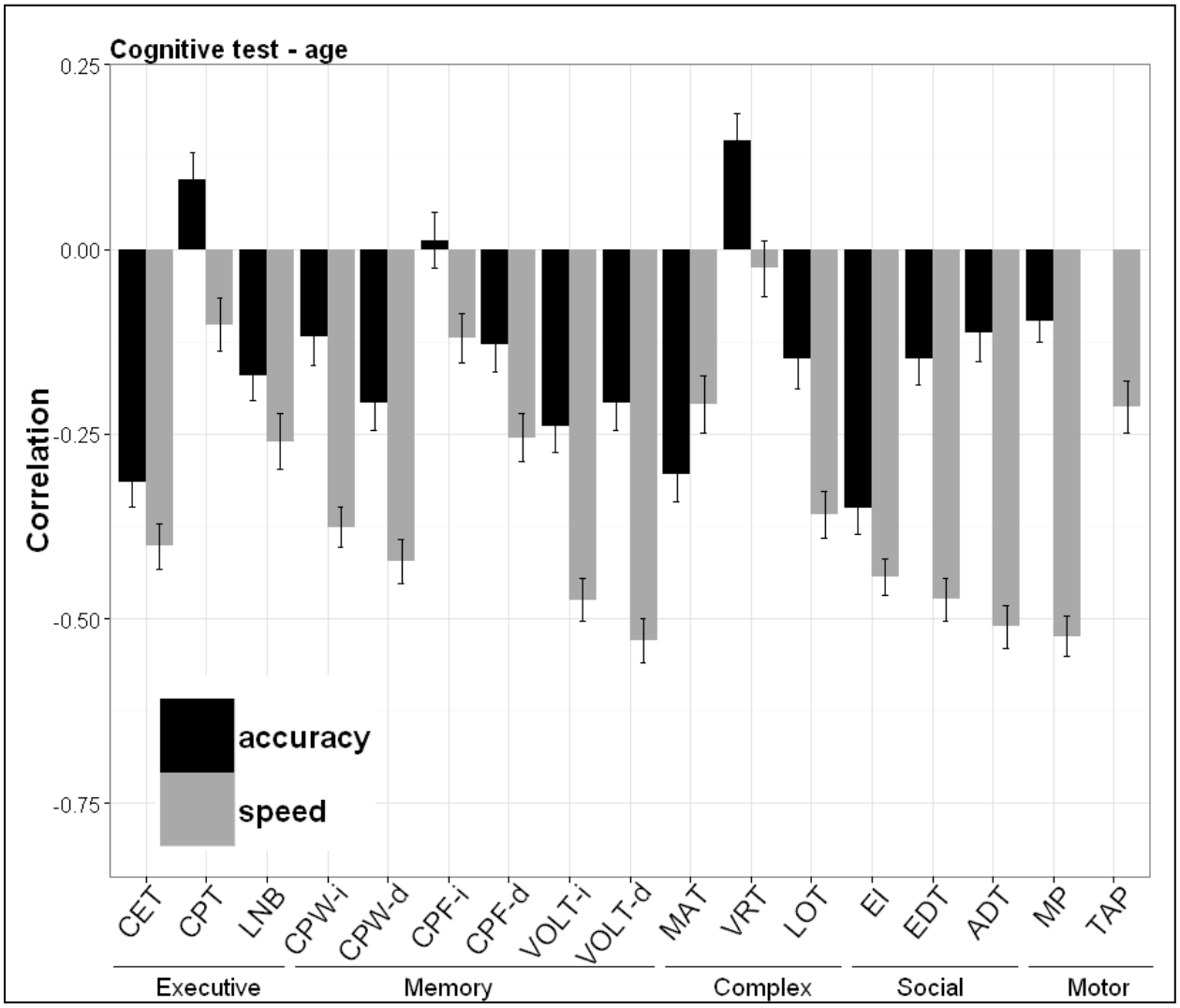
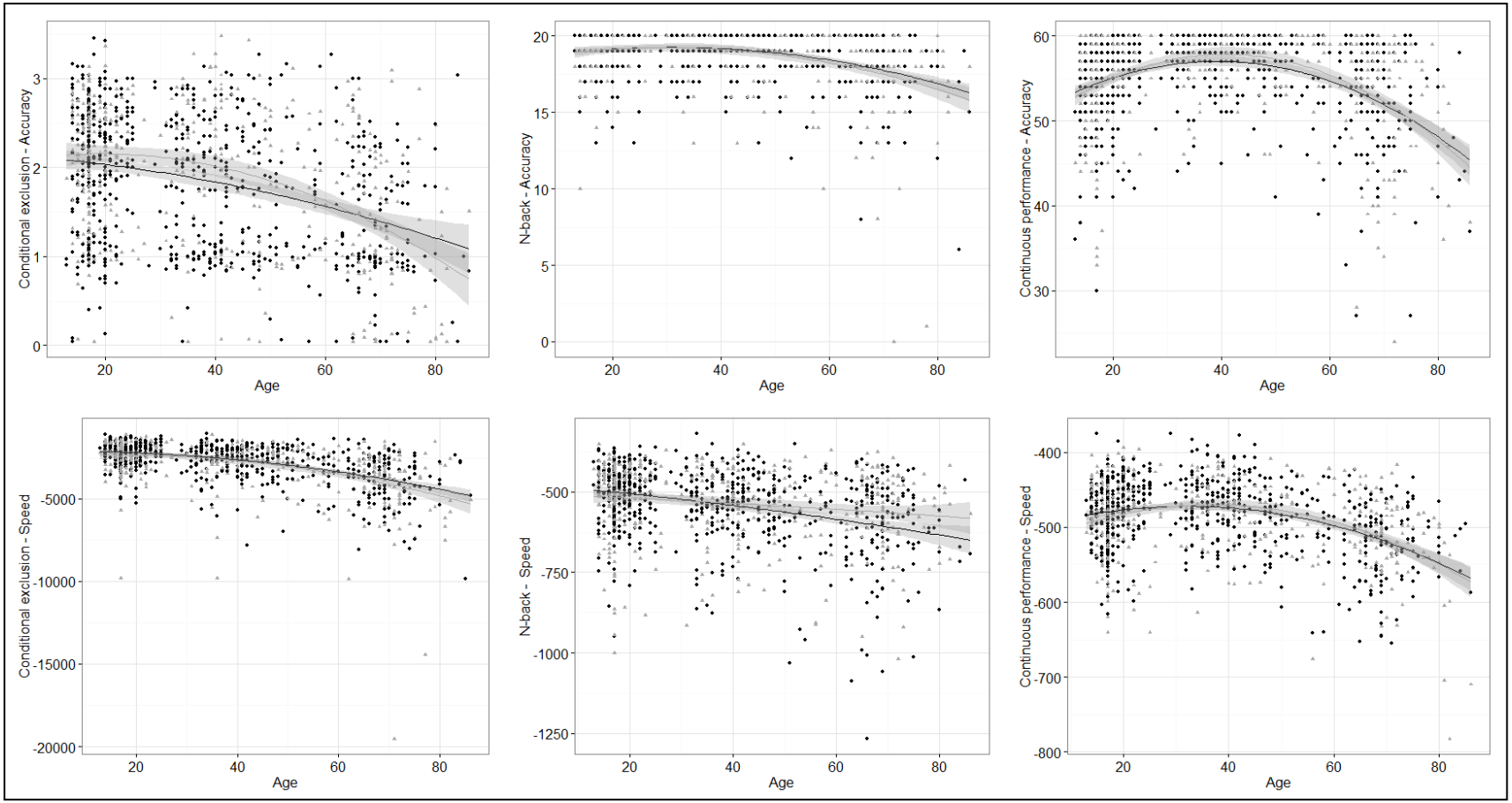


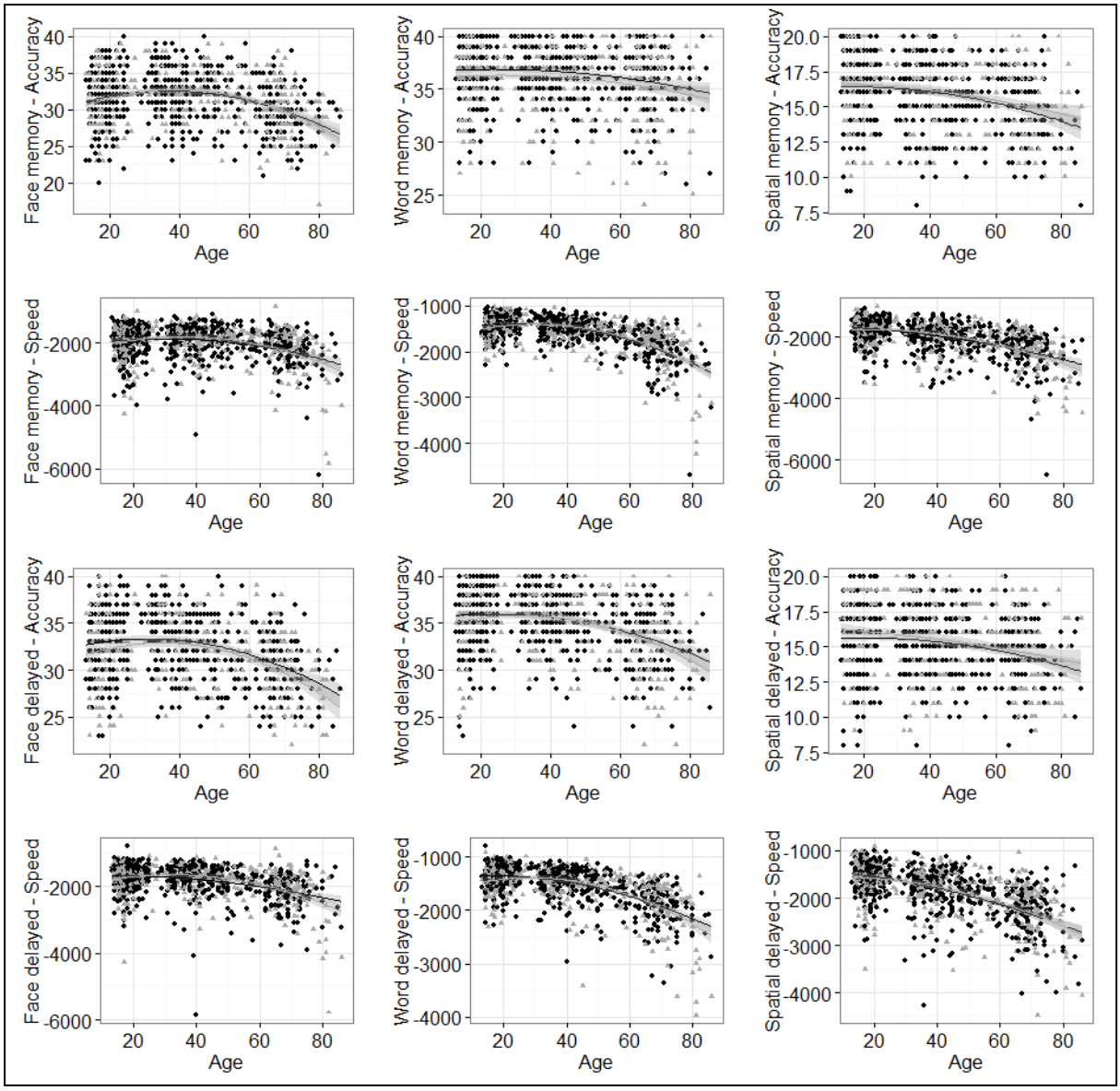
Figure S5.

Illustration of non-linear effects in all cognitive functions.

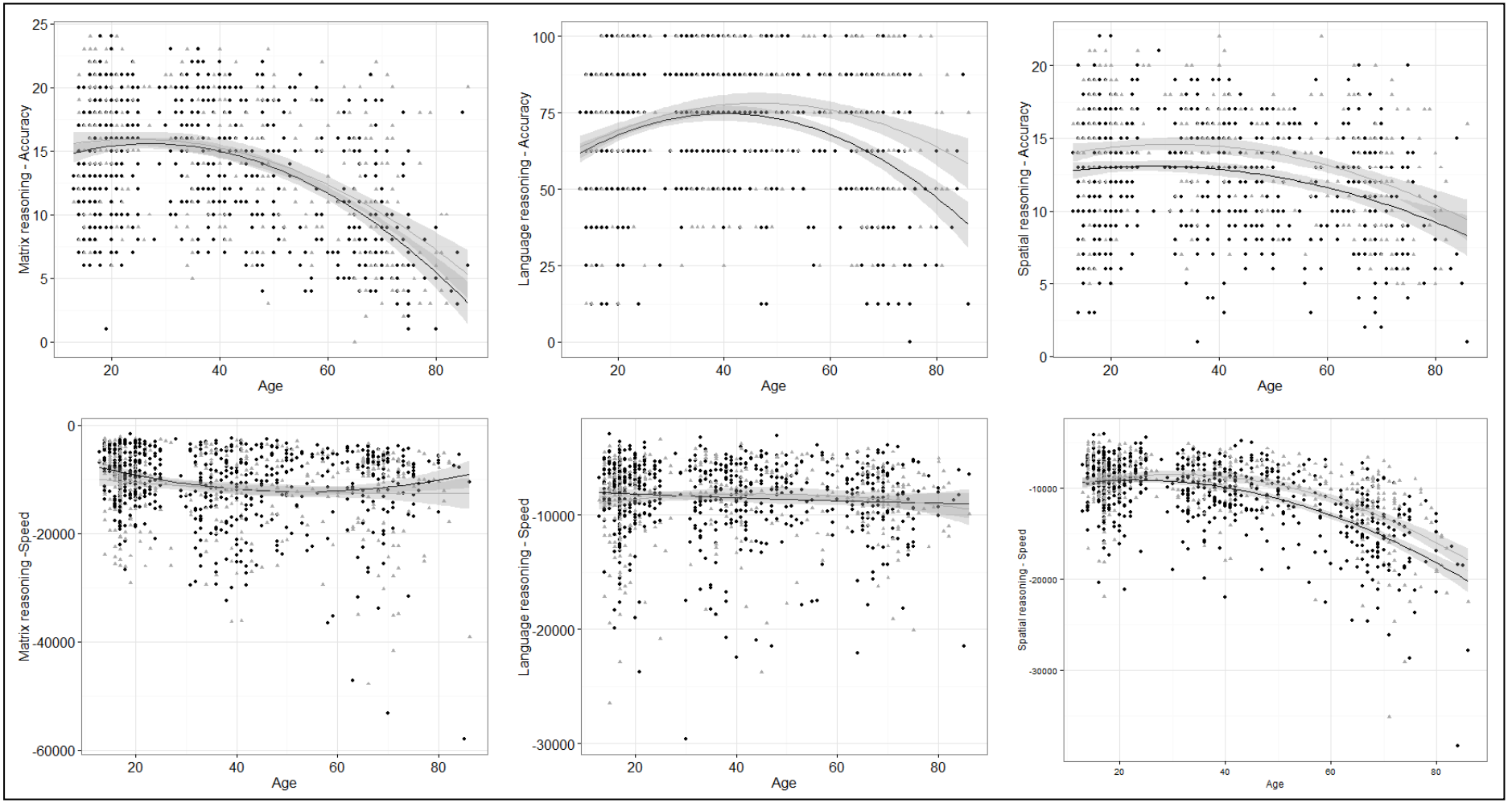
5.1 Executive control (females black ●, males grey ▲).



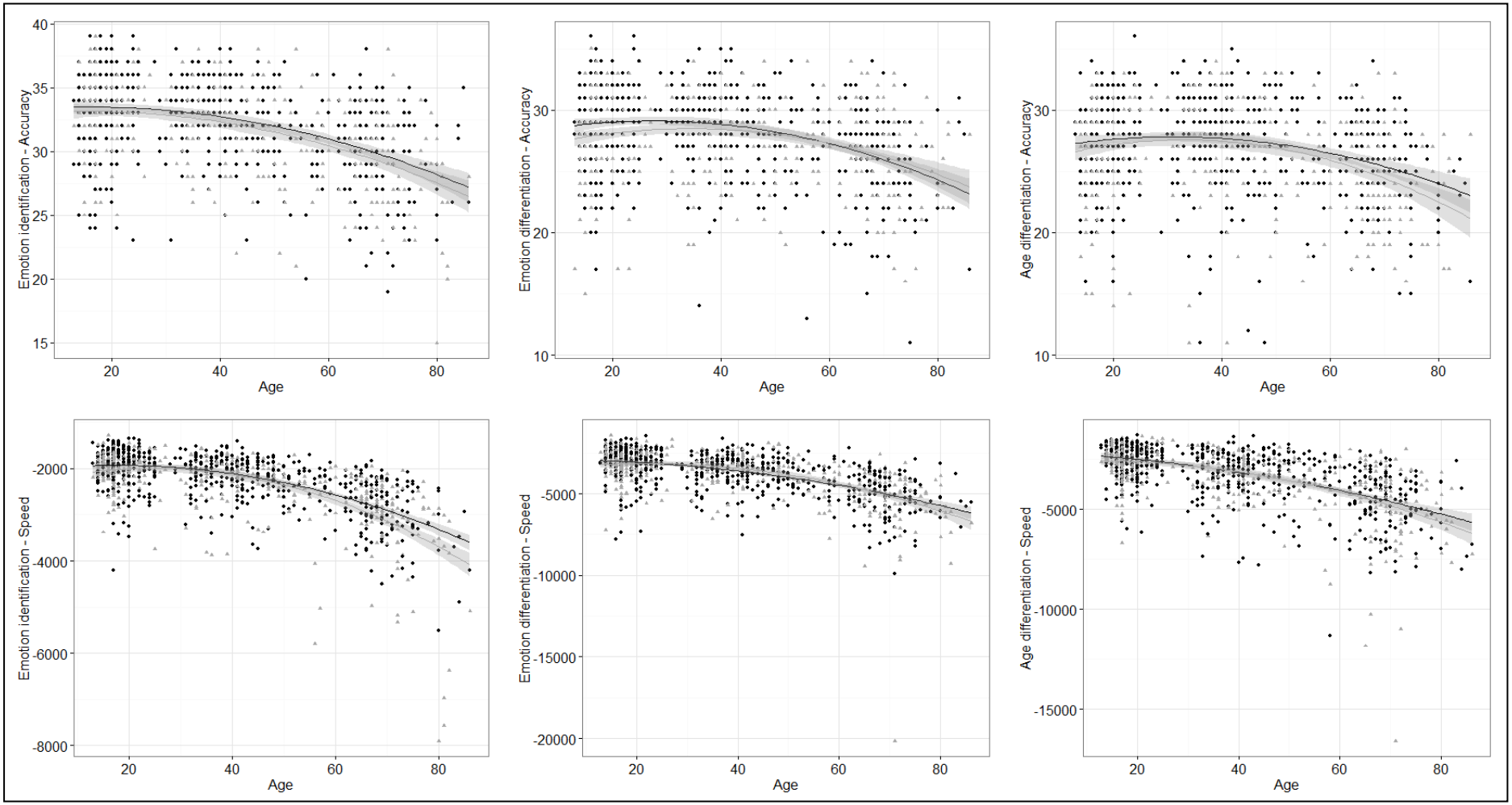
5.2 Memory (females black ●, males grey ▲).



5.3 Complex Cognition (females black ●, males grey ▲).



5.4 Social Cognition (females black ●, males grey ▲).



5.5 Sensorimotor (females black ●, males grey ▲).

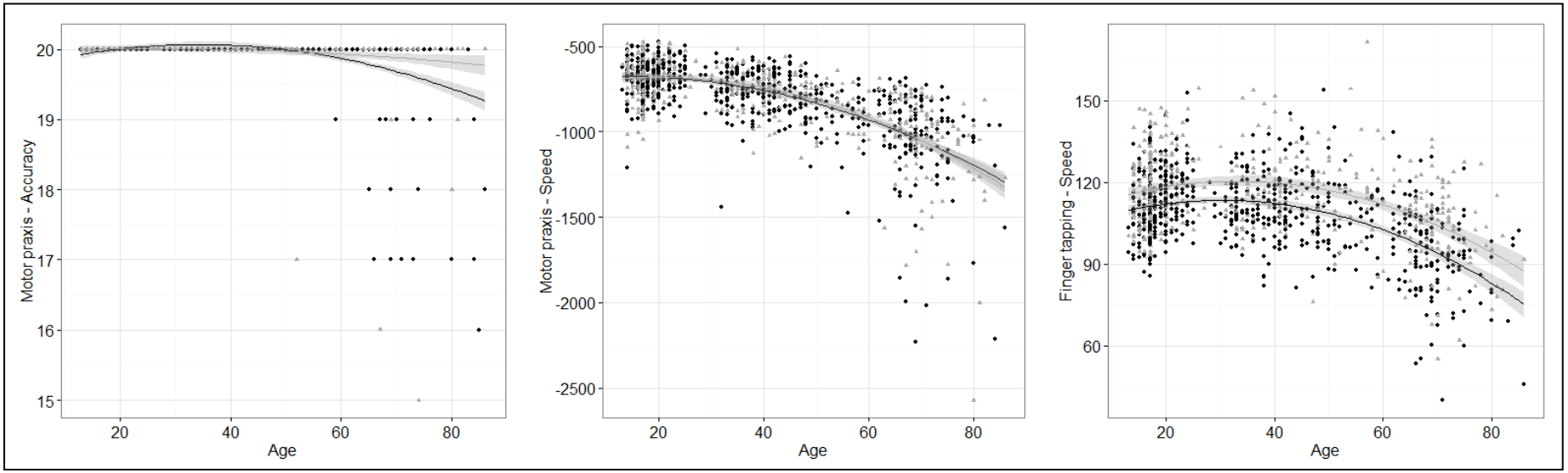


Table S6.

Twin correlations of monozygotic (MZ) and dizygotic (DZ) twin pairs. Variance explained by common and unique environmental factors, based on analyses in twins and in all family members. Fit indices for the twin analyses are given (-2 log likelihood), and the p-value of the fit of the saturated model versus the ACE model (6 degrees of freedom).

		Twin correlations		Common environment		Unique environment		Fit indices twin analyses		
Cognitive function (test name)		MZ	DZ	Twins	All family members	Twins	All family members	saturated	ACE	*p*
Executive Control										
Abstraction / flexibility	Accuracy	.18	-.07	0	0	88	87	1268.18	1285.28	.01
(Conditional Exclusion Test)	Speed	.47	.19	0	11	59	51	4856.29	4865.24	.18
Attention	Accuracy	.34	.09	0	0	58	62	3550.49	3591.77	0
(Continuous Performance Test)	Speed	.43	.22	9	0	61	60	3340.4	3348.59	.22
Working memory	Accuracy	.29	.16	5	0	72	78	1994.01	2007.6	.03
(Letter-N-Back Test)	Speed	.35	.24	18	15	67	54	4173.23	4148.76	.2
Memory										
Face Memory - immediate	Accuracy	.35	.22	5	3	64	63	3101.48	3110.31	.18
(Word Memory Test)	Speed	.48	.10	0	4	57	60	4447.94	4462.0	.03
delayed	Accuracy	.31	.16	0	0	65	69	3109.02	3119.6	.1
	Speed	.53	.19	0	2	51	55	4349.17	4364.67	.02
Verbal Memory - immediate	Accuracy	.33	.00	0	1	73	74	2824.64	2833.53	.18
(Facial Memory Test)	Speed	.44	.15	0	0	59	56	3898.54	3903.49	.55
delayed	Accuracy	.16	.05	0	1	84	81	3001.84	3013.57	.07
	Speed	.39	.13	0	0	64	64	4027.91	4044.89	.01
Spatial Memory - immediate	Accuracy	.32	.08	0	0	70	69	2643.09	2650.45	.29
(Object Learning Test)	Speed	.36	.11	0	0	67	67	4336.58	4341.37	.07
delayed	Accuracy	.33	.07	0	0	69	70	2662.83	2674.09	.08
	Speed	.40	.09	0	3	65	64	4327.9	4331.2	.77
Complex Cognition										
Nonverbal reasoning	Accuracy	.52	.27	1	15	47	45	3451.74	3453.53	.94
(Matrix Reasoning Test)	Speed	.49	.21	0	10	54	57	5603.89	5609.65	.45
Language reasoning	Accuracy	.33	.05	0	0	71	63	5241.05	5249.41	.21
(Verbal Reasoning Test)	Speed	.38	.20	6	0	63	69	5995.85	5012.2	.01
Spatial ability	Accuracy	.51	.09	0	0	54	51	3170.07	3177.73	.26
(Line Orientation Test)	Speed	.40	.22	4	10	61	60	4663.21	4674.01	.25
Social Cognition										

Emotion Identification	Accuracy	.30	.23	7	30	66	56	3003.81	3008.67	.56
(Emotion Identification Test)	Speed	.40	.22	8	0	62	63	4182.68	4188.64	.43
Emotion Differentiation	Accuracy	.24	.16	17	12	79	71	3126.73	3138.59	.07
(Emotion Differentiation Test)	Speed	.44	.24	15	9	61	56	4562.96	4579.85	.01
Age Differentiation	Accuracy	.25	.24	24	15	76	63	3332.47	333.17	.99
(Age Differentiation Test)	Speed	.44	.14	0	17	60	51	4796.0	4801.86	.44
Sensorimotor										
Sensorimotor Speed (Motor Praxis Test)	Speed	.43	.33	23	16	58	40	4003.22	4009.18	.43
Motor speed (Finger-Tapping Test)	Speed	.38	.11	0	29	62	40	3542.16	3553.7	.07
General intelligence										
g-CNB		.70	.29	0	5	30	27	2305.43	2310.39	.55
Total IQ		.76	.51	0	-	25	-	1322.18	1324.44	.89