Intelligence and Aging

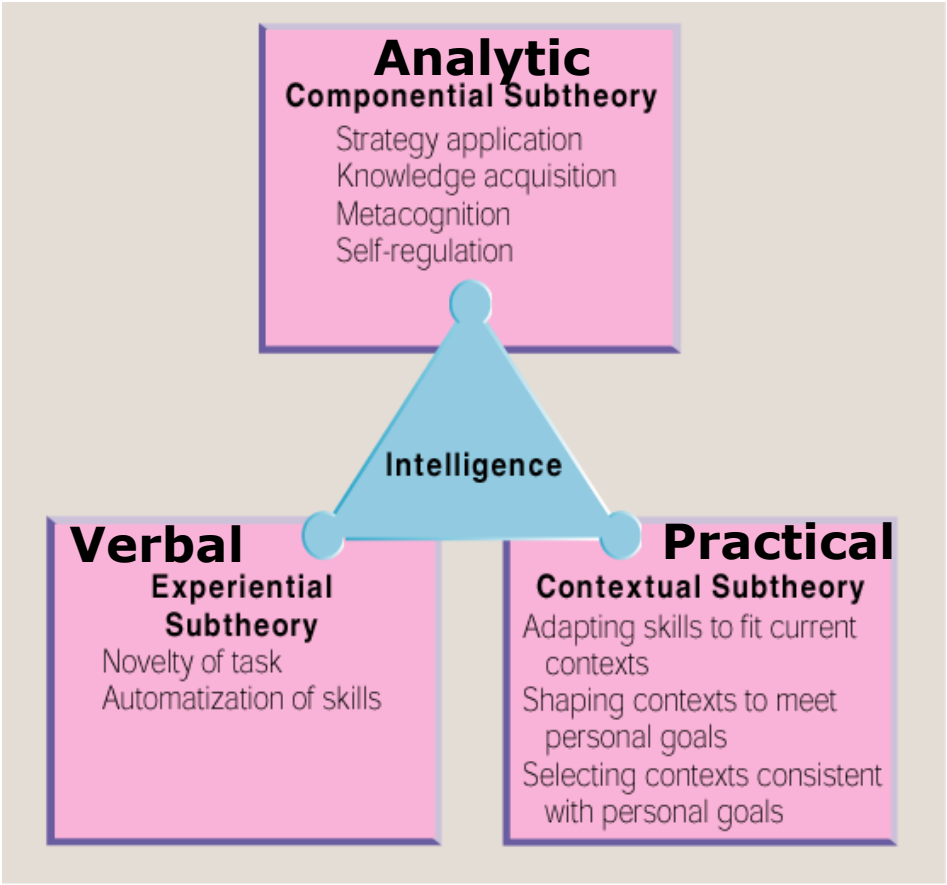
Figures from:

Schaie, K. W. (1994). The course of adult intellectual development. *American Psychologist*, *49*, 304-313.

Forms of intelligence

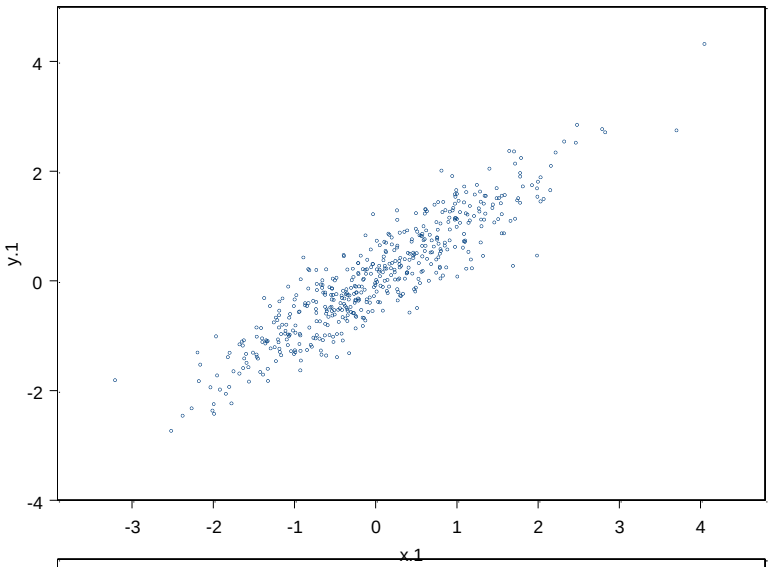
- Sternberg (1985)
  - Problem-solving (Analytic)
    - Logical, reasoning
  - Verbal (also called Creative)
    - Vocabulary, novel tasks
  - Social competence (Practical)
    - “Street smarts”

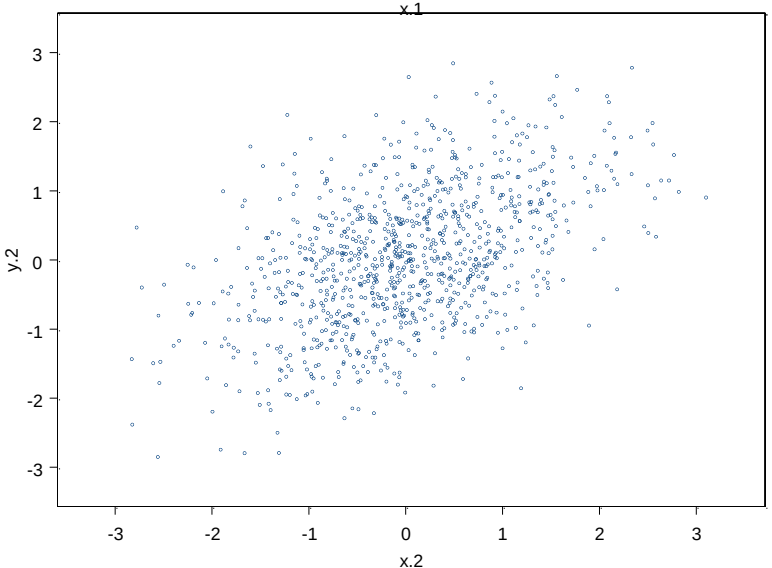
Triarchic theory



Psychometric approach

- *Factor analysis*: Examine correlations between tests
- Spearman (1904)
  - "g" and "s"
- If high correlations
  - "g" or general intelligence
- If low correlations
  - "s" or specific intelligences
- Thurstone (1938)
  - 7 independent "*primary mental abilities*"
  - Verbal meaning, word fluency, numerical ability, spatial ability, verbal memory, perceptual speed, and reasoning





Study Waves					
1956	1963	1970	1977	1984	1991
S_1T_1 (N = 500)	S_1T_2 (N = 303)	S_1T_3 (N = 162)	S_1T_4 (N = 130)	S_1T_5 (N = 92)	S_1T_6 (N = 71)
	S_2T_2 (N = 997)	S_2T_3 (N = 420)	S_2T_4 (N = 337)	S_2T_5 (N = 204)	S_2T_6 (N = 161)
		S_3T_3 (N = 705)	S_3T_4 (N = 340)	S_3T_5 (N = 225)	S_3T_6 (N = 175)
			S_4T_4 (N = 612)	S_4T_5 (N = 294)	S_4T_6 (N = 201)
				S_5T_5 (N = 628)	S_5T_6 (N = 428)
					S_6T_6 (N =690)

S = Sample; T = Time of Measurement

Schaie (1994)
Seattle Longitudinal Study

- Core battery: Thurstone's (1938) primary mental abilities
  - Verbal meaning
  - Space
  - Reasoning
  - Number
  - Word fluency

- First, whether intelligence changes uniformly through adulthood or whether there were different life-course ability patterns.
- Second, at what age reliably detectable age decrements in ability occurred and to determine the magnitude of that decrement.
- Third, investigate patterns of generational (cohort) differences in intellectual abilities as well as their magnitude.
- Fourth, stability of the factor structure of the psychometric abilities across the adult life course.
- Fifth, what accounts for the vast individual differences in age-related change in adulthood.
- And, whether intellectual decline with increasing age can be reversed by educational interventions.

Schaie, K. W., Maitland, S. B., Willis, S. L., Intrieri, R. C. (1998). Longitudinal invariance of adult psychometric ability factor structures across 7 years. *Psychology and Aging,13*,

Table 2
Psychometric Intelligence Measurement Battery

Primary ability	Test	Source	Test–retest correlation
Inductive Reasoning	PMA Reasoning (1948)	Thurstone & Thurstone, 1949	.884
	ADEPT Letter Series (Form A)	Blieszner et al., 1981	.839
	Word Series	Schaie, 1985	.852
	ETS Number Series	Ekstrom et al., 1976	.833
Spatial Orientation	PMA Space (1948)	Thurstone & Thurstone, 1949	.817
	Object Rotation	Schaie, 1985	.861
	Alphanumeric Rotation	Willis & Schaie, 1983	.820
	ETS Cube Comparisons	Ekstrom et al., 1976	.951
Numerical Facility	PMA Number (1948)	Thurstone & Thurstone, 1949	.875
	ETS Addition (N-1)	Ekstrom et al., 1976	.937
	ETS Subtraction & Multiplication (N-3)	Ekstrom et al., 1976	.943
Verbal Comprehension	PMA Verbal Meaning (1948)	Thurstone & Thurstone, 1949	.890
	ETS Vocabulary (V-2)	Ekstrom et al., 1976	.928
	ETS Advanced Vocabulary (V-4)	Ekstrom et al., 1976	.954
Perceptual Speed	ETS Identical Pictures	Ekstrom et al., 1976	.814
	ETS Finding As	Ekstrom et al., 1976	.860
	ETS Number Comparison	Ekstrom et al., 1976	.865
Verbal Recall	Immediate Recall	Zelinski et al., 1993	.820
	Delayed Recall	Zelinski et al., 1993	.732
	PMA Word Fluency	Thurstone & Thurstone, 1949	.896

Note. PMA = Primary Mental Abilities test; ADEPT = Adult Development and Enrichment Project; ETS = Educational Testing Service.

http://geron.psu.edu/sls/researchers/measures.html

Differences in Life-Course Ability Patterns

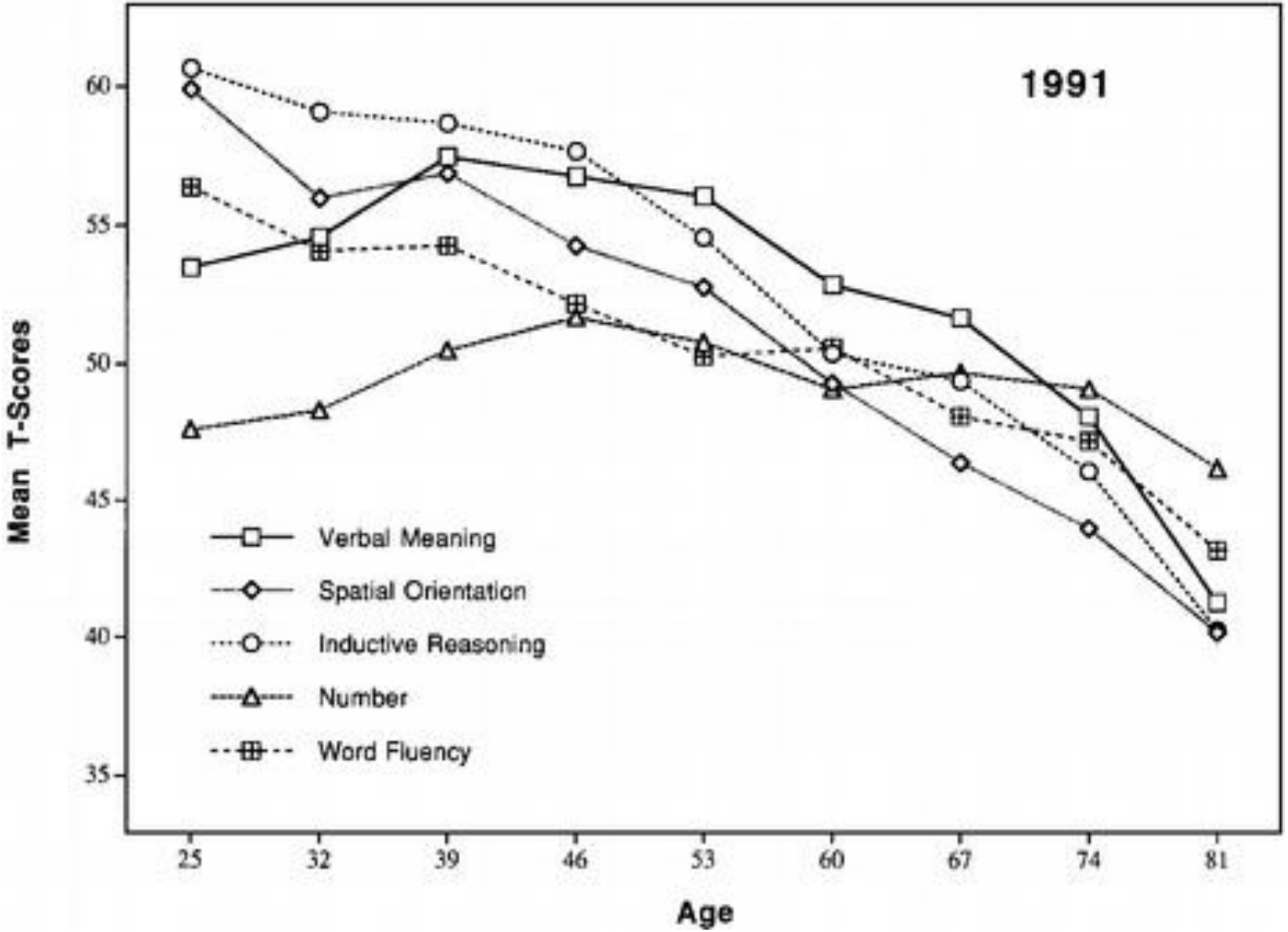


Figure 2. ***Cross-Sectional*** *Mean T Scores for Single Markers of the Primary Mental Abilities*

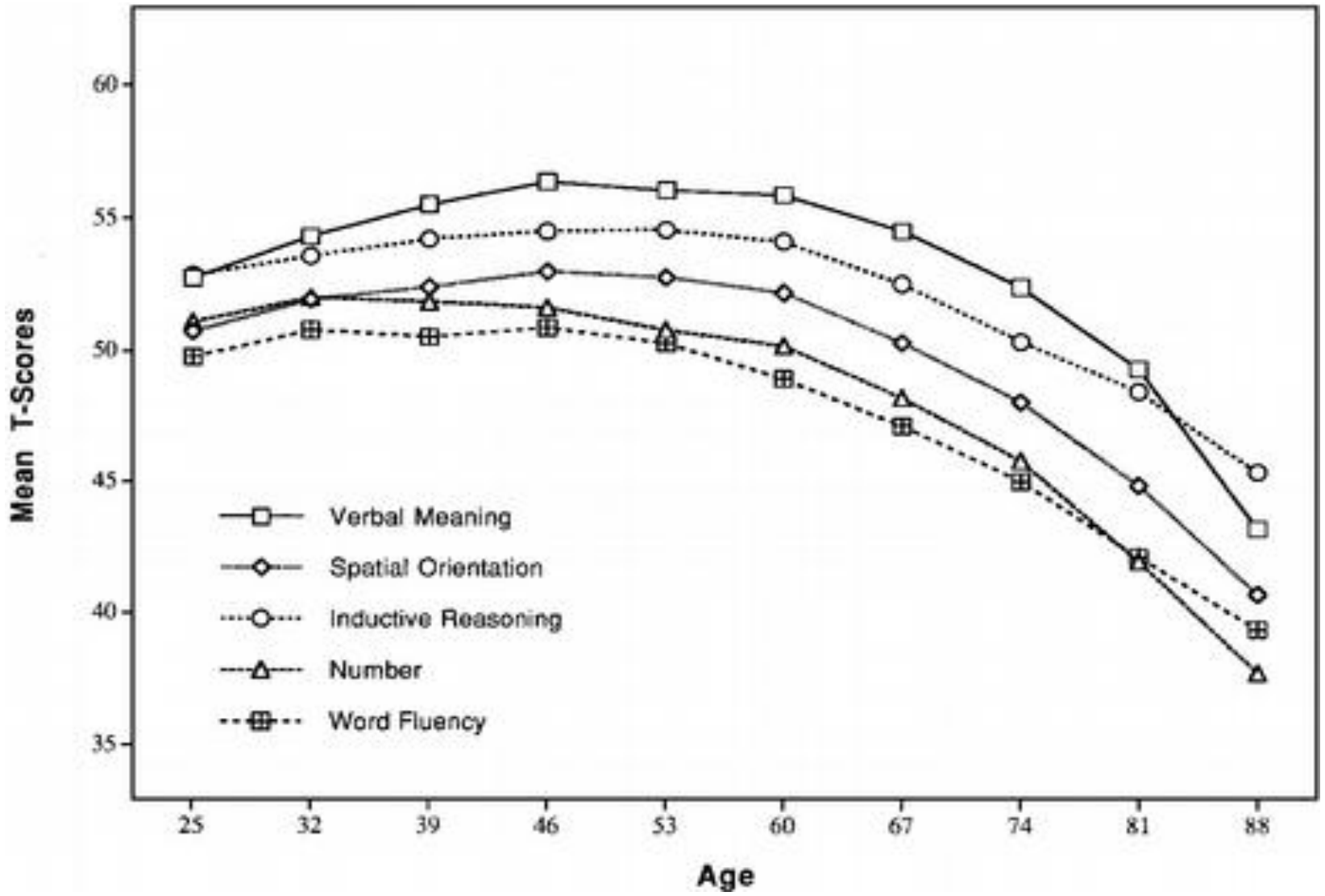


Figure 3. ***Longitudinal Estimates*** *of Mean T Scores for Single Markers of the Primary Mental Abilities*

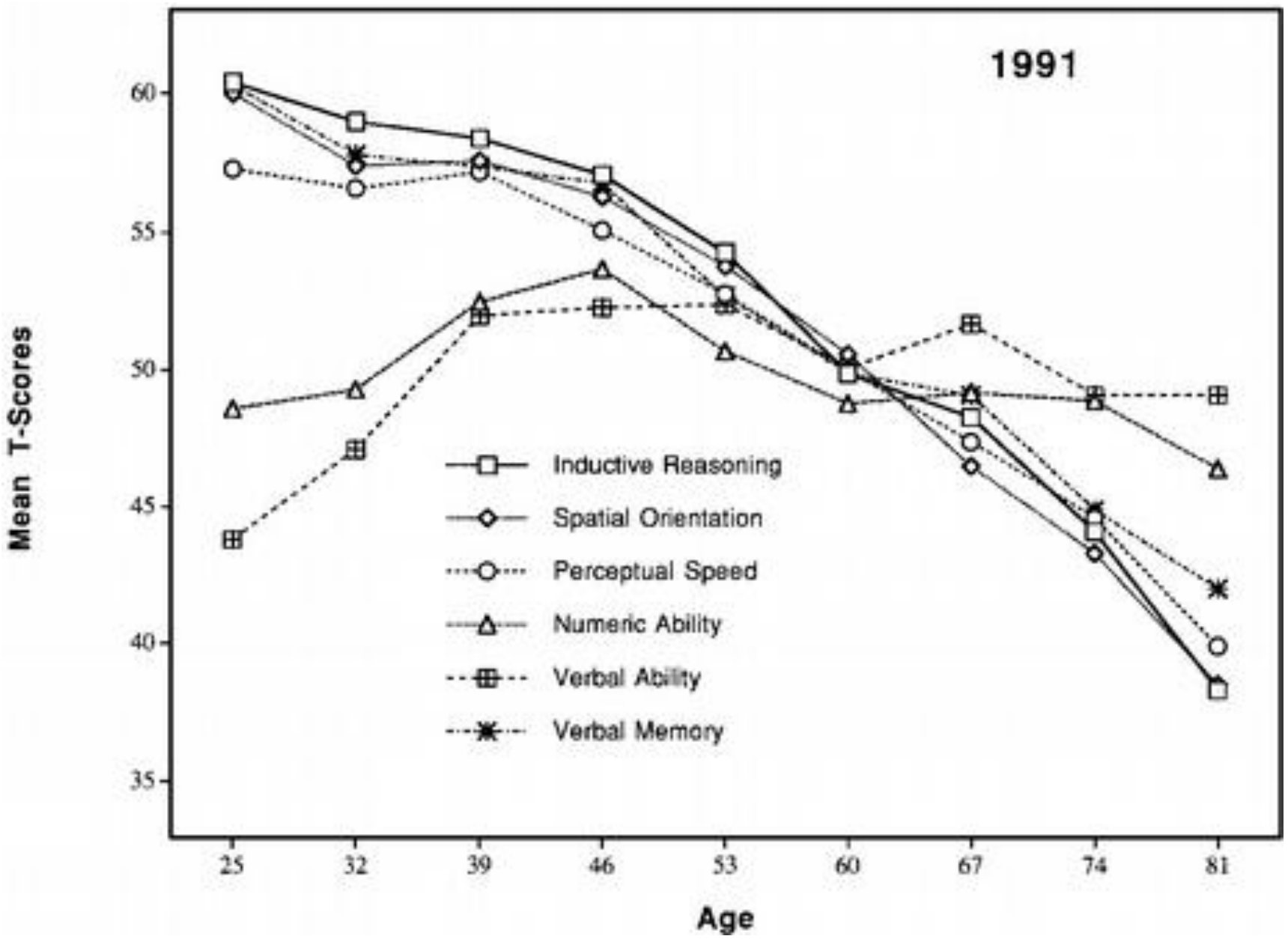


Figure 5. Cross-Sectional Mean Factor Scores for the Latent Ability Constructs

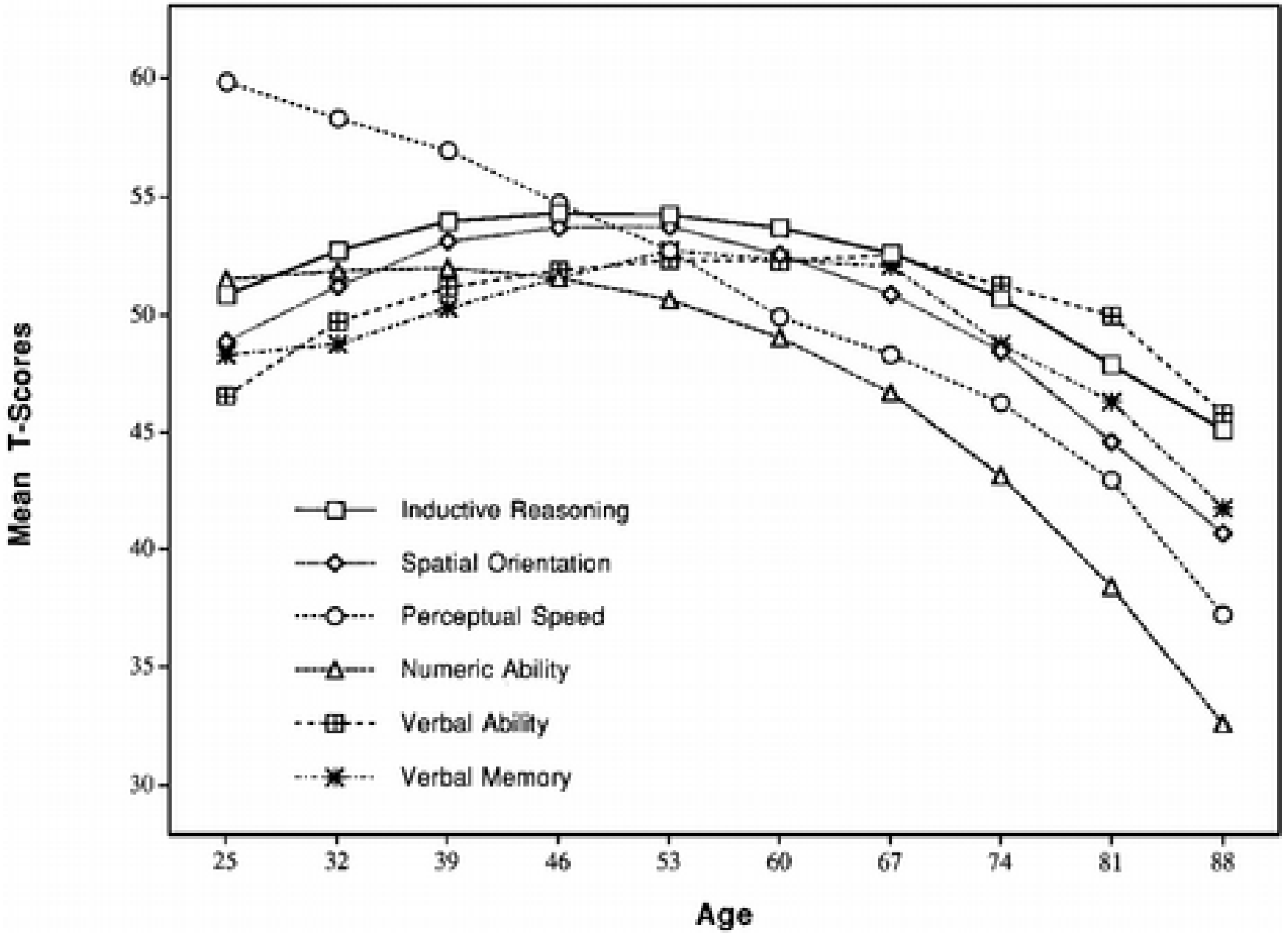


Figure 6. Longitudinal Estimates of Mean Factor Scores for the Latent Ability Constructs

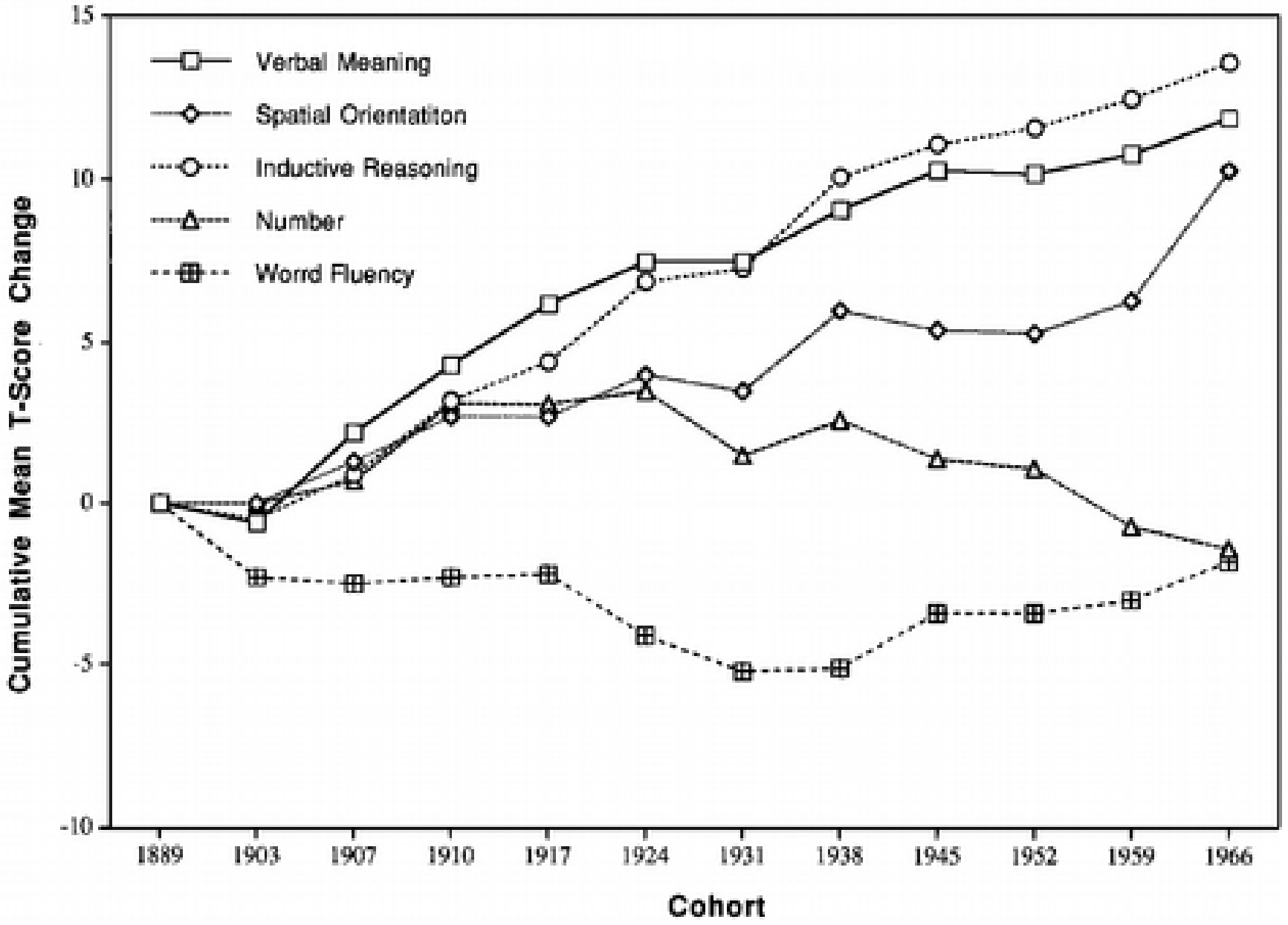
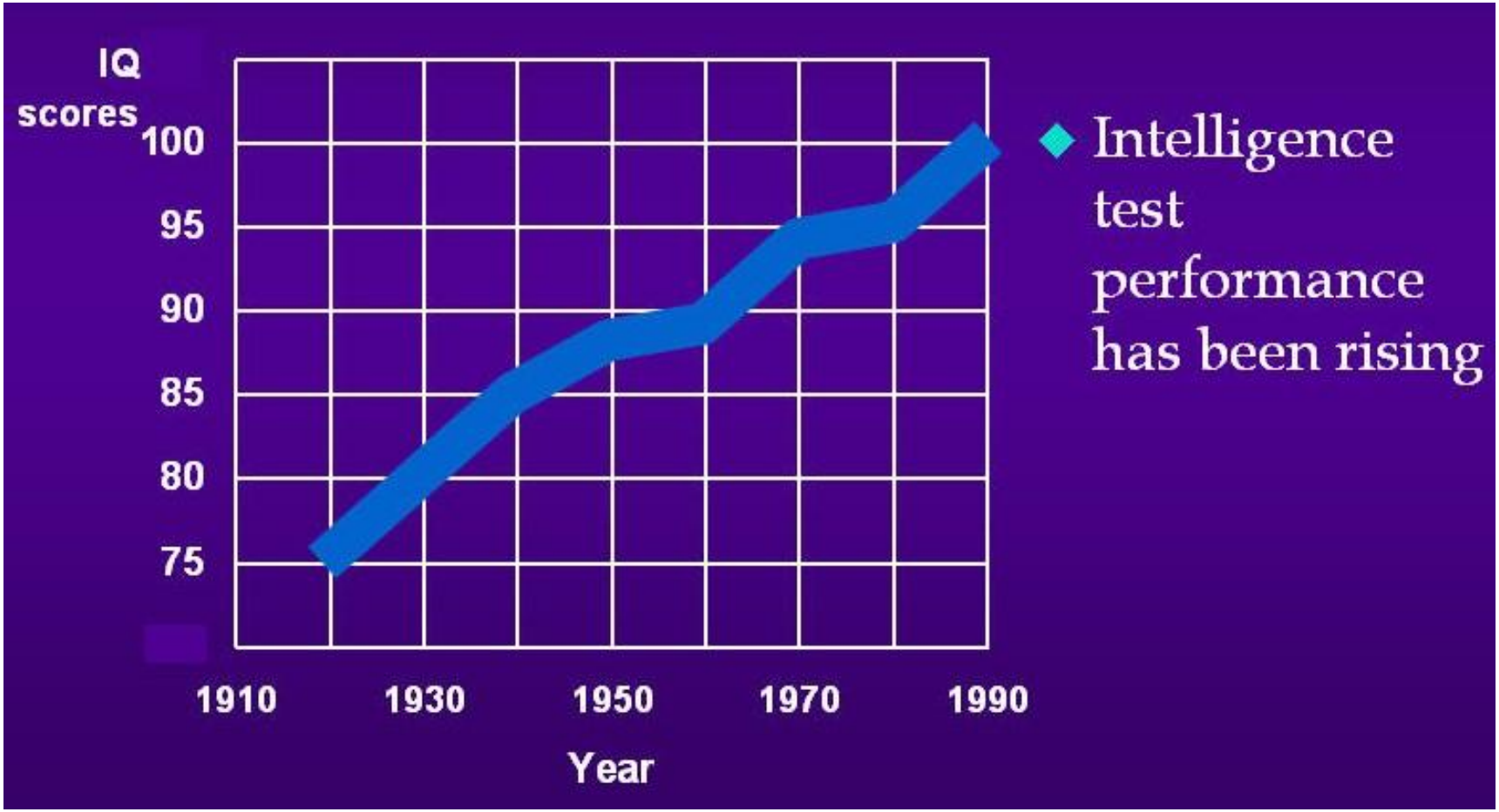


Figure 7. Cohort Gradients for the Single Markers of the Primary Mental Abilities

Flynn effect



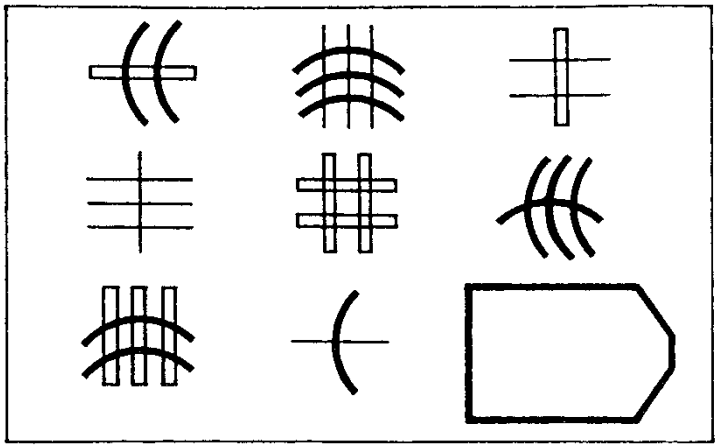
Schaie (1994)

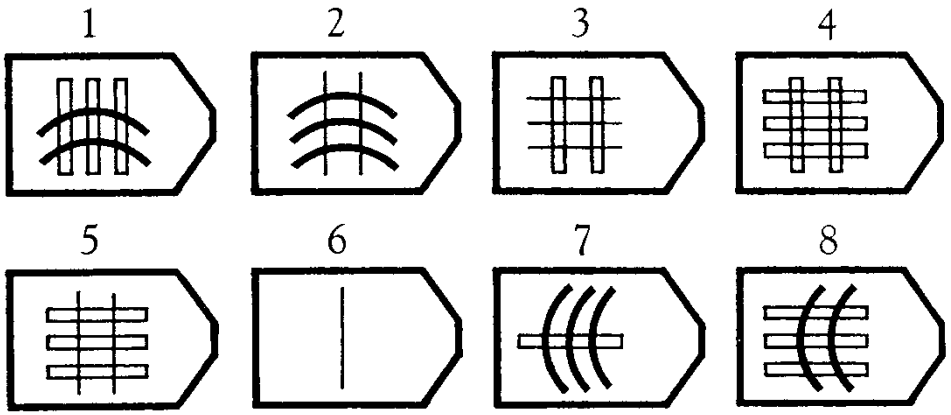
The variables identified to reduce the risk of cognitive decline in old age include the following:

- The absence of cardiovascular and other chronic diseases.
- Living in favorable environmental circumstances as would be the case for those persons characterized by high SES.
- Substantial involvement in activities such as: reading, travel, attendance at cultural events, pursuit of continuing education activities, and participation in clubs and professional associations
- Individual's self-report of a flexible personality style at midlife as well as flexible performance on objective measures of motor–cognitive perseveration tasks
- Being married to a spouse with high cognitive status.
- The maintenance of high levels of perceptual processing speed into old age
- Rating one's self as being satisfied with one's life's accomplishment in midlife or early old age.

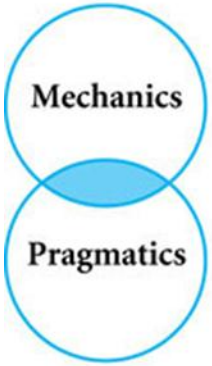
Forms of intelligence

- Cattell & Horn (1966)
  - Crystalized intelligence
  - Fluid intelligence
- Raven's progressive matrices



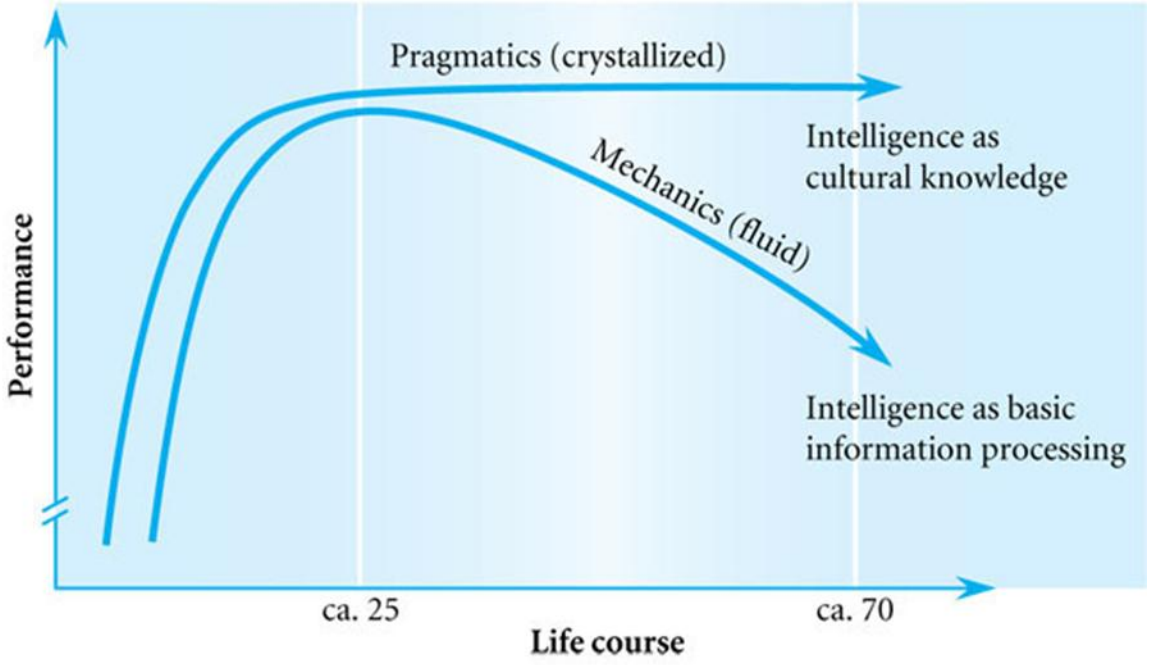


Crystalized vs fluid intelligence



Basic information processing
Content-poor
Universal, biological
Genetically predisposed

Content-rich
Culture-dependent
Experience-based



Vocabulary test

- Connect:

Accident lace flint join bean field

- Provide:

Harmonize hurt annoy commit supply divide

- Dwindle:

Swindle diminish linger pander wheeze compare

- Bombastic:

Democratic bickering destructive pompous cautious anxious

- Recumbent:

Fugitive unwieldy reclining cumbersome repelling penitent

- Glower:

Extinguish disguise aerate shine gloat scowl

IQ tests: Visual reasoning

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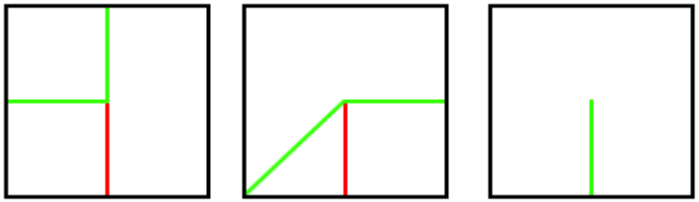
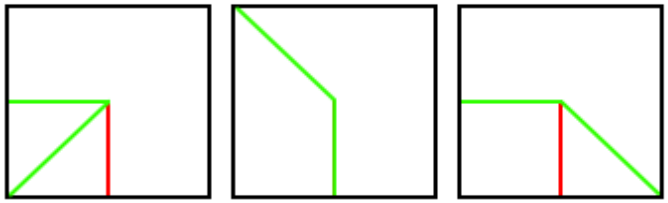
Question

Choose the next sequence:



Choose Your Answer



1) ○ 2) ○ 3) ○

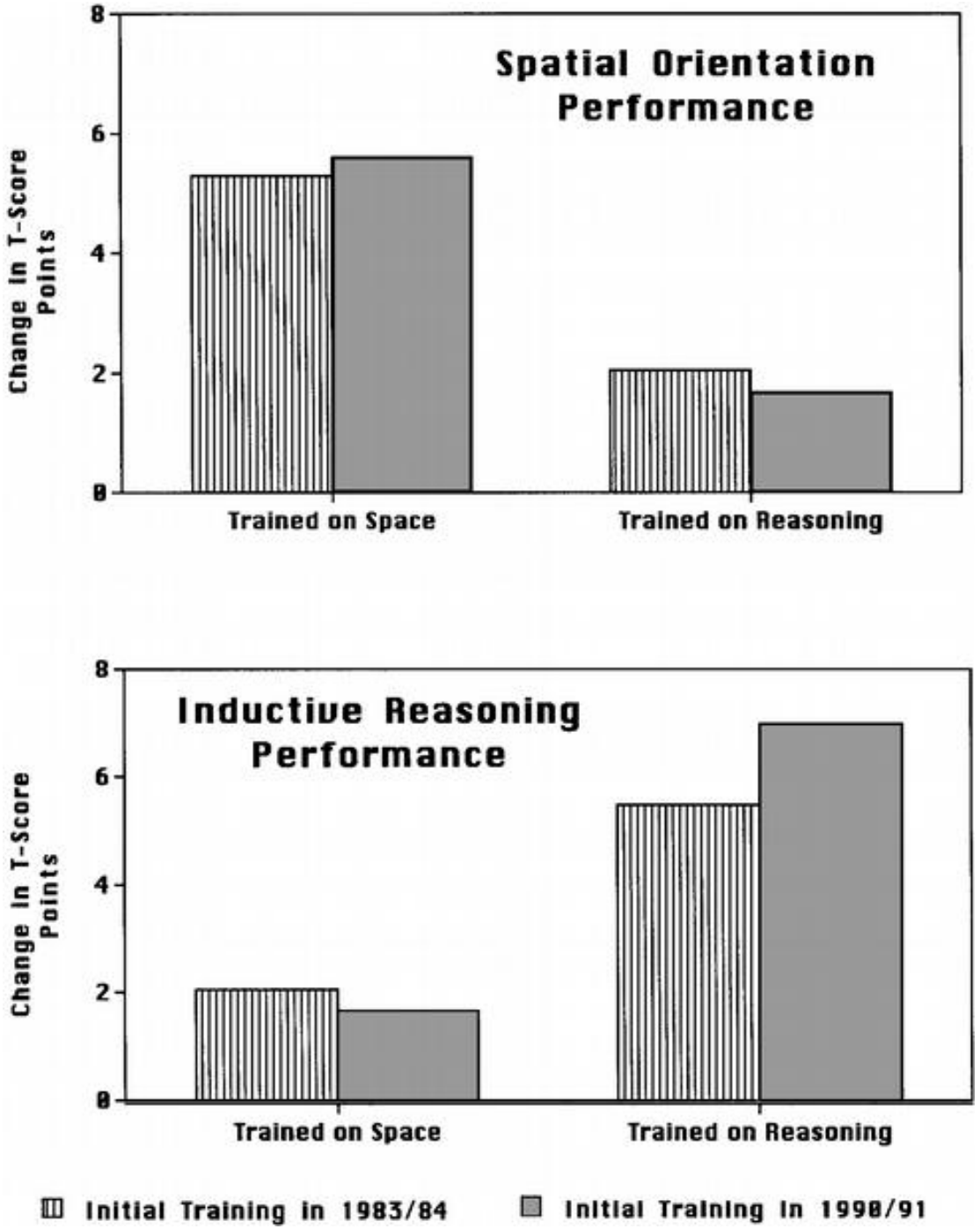
Next Question

Stanford-Binet Test: **IQ**

- Verbal reasoning
  - Vocabulary
  - Comprehension
  - Verbal relations
- Quantitative reasoning
  - Number series
  - Equation-building
- Abstract/visual reasoning
  - Pattern analysis
  - Copying
  - Paper folding and cutting
- Short-term memory
  - Bead memory
  - Memory for sentences and digits
  - Memory for objects

Training studies

- Willis & Nesselroade (1990)
- Cattell's Culture Fair Test
  - Figure series
  - Figure classify
  - Matrices
  - Topology
- http://www.alliqtests.com/tests/7/8/

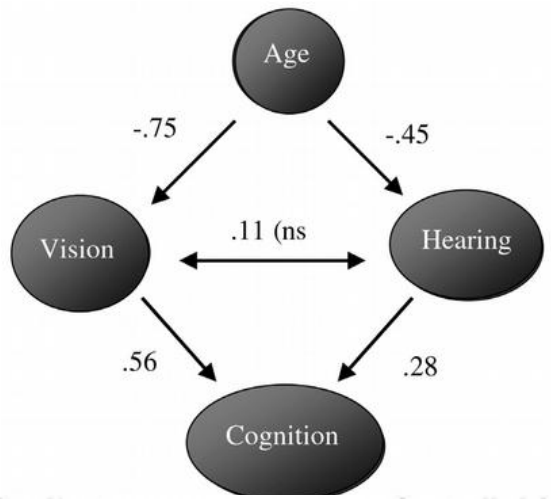

Spatial Orientation Performance
Change in T-Score Points
8
6
4
2
0
Trained on Space
Trained on Reasoning
Inductive Reasoning Performance
Change in T-Score Points
8
6
4
2
0
Trained on Space
Trained on Reasoning
Initial Training in 1983/84
Initial Training in 1990/91

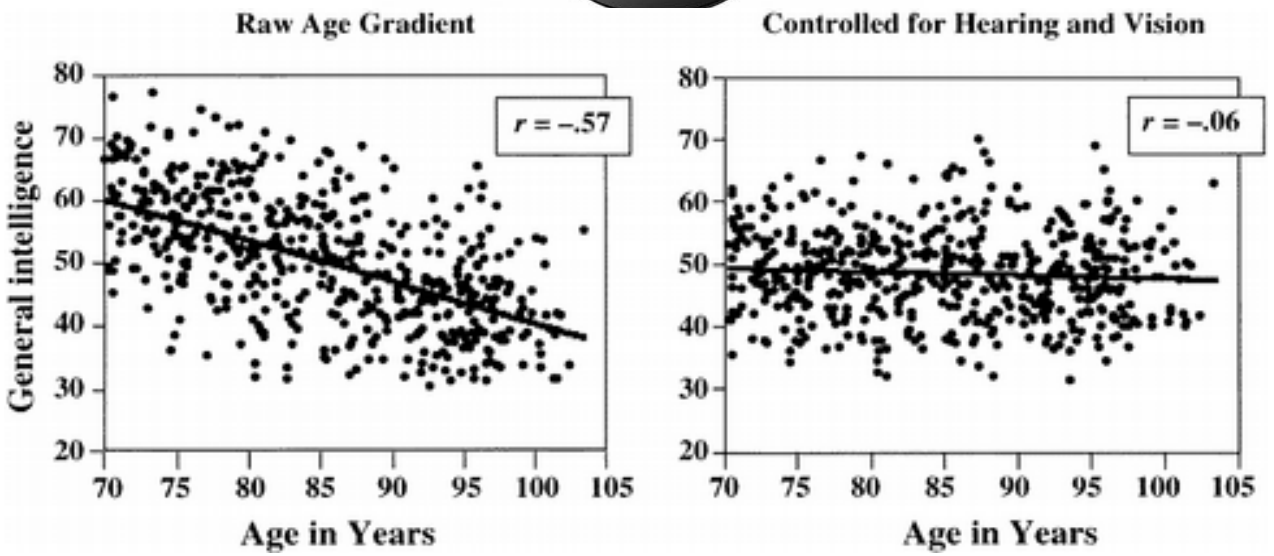
Moderators of intellectual change

- Age-related changes
- Cohort differences
- Educational level
- Change in cognition
  - Perceptual (processing) speed
  - Working memory
  - Inhibition or inability to avoid interference
- Social variables
  - Occupations
  - Socioeconomic status
  - Exposure to stimulating environments
  - Social engagement (vs lonliness)
- Personality
  - Self-efficacy; positive beliefs or attitudes
  - Neuroticism and chronic psychological distress
- Health and lifestyle
  - Cardiovascular disease, hypertension, sensory functioning
- Relevancy and appropriateness of tasks

Baltes & Lindenberger (1997)

- Visual and auditory acuity related to fluid intelligence





Willis et al. (Allaire & Marsiske, 2002)

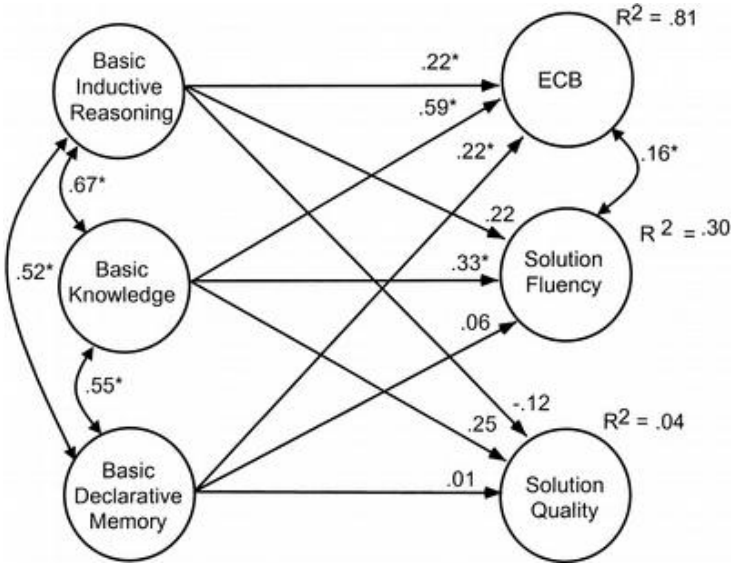
- Examine correlations of 7 primary mental abilities
  - Traditional tasks vs everyday tasks
- Which primary abilities predict everyday performance?
  - Fluid intelligence (figural relations)

Table 1

Intercorrelations Among Everyday Cognition Battery (ECB) and Basic Ability Tests

Measure	1	2	3	4	5	6
1. ECB Knowledge Test	—					
2. ECB Reasoning Test	.71	—				
3. ECB Memory Test	.64	.74	—			
4. Verbal Meaning Test	.70	.74	.71	—		
5. Letter Sets Test	.41	.56	.53	.51	—	
6. HVLT	.47	.50	.53	.46	.37	—

Note. All correlations are significant at $p < .05$. HVLT = Hopkins Verbal Learning Test.



Allaire & Marsiske, 2002

Table 1
Descriptive Statistics of Study Variables Prior to Creation of Composites

Variable	65- to 75-year-olds (n = 439) Mean (*SD*)	76- to 94-year-olds (n = 259) Mean (*SD*)	Complete sample (n = 698) Mean (*SD*)	Age correlation	Reliability estimate
		Participant characteristics			
Age	70.20 (2.98)	80.58 (3.96)	74.05 (6.05)		
Gender	75%	71%	74%	−.05	
Education	13.54 (2.64)	13.10 (2.80)	13.37 (2.70)	−.08	
MMSE	27.50 (1.95)	26.88 (2.02)	27.27 (2.00)	−.17*	
		Measures of everyday functioning			
Timed Instrumental Activities of Daily Living	.10 (.53)	−.24 (.73)	−.03 (.64)	−.32*	.64
Observed Tasks of Daily Living	18.31 (4.20)	15.82 (4.38)	17.38 (4.43)	−.30*	.75
Everyday Problem Solving	19.14 (5.46)	16.72 (6.04)	18.25 (5.79)	−.22*	.87
Self-reported difficulty with Instrumental Activities of Daily Living[a]	1.05 (1.97)	1.75 (2.93)	1.31 (2.39)	.13*	.76[b]
		Neurocognitive measures			
Word Series	10.26 (4.89)	7.56 (4.16)	9.26 (4.81)	−.33*	.84
Letter Series	10.62 (5.70)	7.79 (4.75)	9.57 (5.54)	−.31*	.86
Letter Sets	6.14 (2.90)	4.90 (2.57)	5.69 (2.85)	−.24*	.69
UFOV Task 2[a]	104.34 (100.45)	192.15 (144.13)	136.90 (125.82)	.38*	.69[c]
UFOV Task 3[a]	286.32 (125.43)	389.08 (122.36)	324.05 (133.75)	.41*	.73[c]
UFOV Task 4[a]	445.99 (72.65)	482.01 (41.48)	459.22 (65.34)	.30*	.48[c]
HVLT	27.08 (4.60)	23.21 (6.46)	25.68 (5.66)	−.40*	.73
AVLT	49.99 (9.56)	43.03 (11.12)	47.47 (10.68)	−.41*	.78

Note. All reliability estimates come from Ball et al. (2002) except where otherwise noted.
[a] Lower scores reflect better performance/higher functioning. [b] Estimate comes from Morris et al. (1997). [c] Estimate is a 12-week test-retest correlation.
* Age correlation is significant at $p < .01$.