Diversity in successful aging: Deep cognitive phenotyping of the Cam-CAN cohort

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Introduction
What is the nature of “successful” cognitive aging?

Avoiding cognitive decline
Cognitive aging = end of life, age-related decline² Key measures decline with age and intercorrelate (e.g., fluid intelligence, memory, speed, inhibitory control)³ Models aim to identify small numbers of factors underpinning declines³, ⁴ "Successful" aging and proposed interventions focus on avoiding or reversing decline in key measures³, ⁴ Prediction: small number of factors underpinning decline cognition

Lifespan cognitive development
Cognitive aging = lifelong process², variable trajectories² Key measures include range of spared and impaired functions, both domain-general and domain specific Models are underdeveloped: few studies collect cross-domain measures, examine lifespan trajectories, or propose mechanisms of preservation "Successful" aging may be multivariate; interventions may involve spared as well as impaired abilities Prediction: complex factor structure underpinning range of cognitive performance

Participants
N=706 adults cognitively healthy adults, aged 18-88
Sample of ~1000 participants drawn from the general population within Cambridge, UK.
Group of ~700 participants recruited across 7-deciles, equal number of men and women
3 age groups used in some analyses: Young = 18-47, Middle = 48-67, Older = 68-88

Cognitive measures
5 cognitive domains → 16 cognitive tasks
domains: Intelligence & attention
- tasks:
  - Cellatt culture fair
  - Spot the word
  - Hotel task
  - Proverb comprehension
  - Visual short term memory
  - Emotional memory²
  - Language
  - Picture-painting priming
  - Sentence comprehension
  - Tip-of-the-tongue task
  - Familiar face recognition
  - Emotion reactivity & regulation³
  - Unfamiliar face recognition
  - Emotion recognition
  - Motor learning
  - Force matching³

20 diverse measures → 5 typical “cognitive decline” measures
- diverse measures:
  - Fluid intelligence
  - Crystallized intelligence
  - Multitasking
  - Proverb comprehension
  - Visual short term memory
  - Emotional memory²
  - Source memory
  - Repetition priming
  - Memory recall
  - Visual short term memory
  - Source memory
  - Tip-of-the-tongue rate
  - Familiar face recognition
  - Positive emotion processing
  - Unfamiliar face recognition
  - Negative emotion processing
  - Motor learning
  - Force matching³

5 typical “cognitive decline” measures → 6 factors
- declining measures:
  - Fluid intelligence
  - Sentence comprehension
  - Picture naming accuracy
  - Memory recall
  - Repetition priming
  - Force matching³

Results
Age relationships
- Diverse measures: Age-related declines, stability, and improvements
- Across tasks, declines at different ages and to different degrees

Diverse measures
- Measures load onto 6 factors, with top factor explaining >30% of variance
- Little change in number of factors across age groups, but factor loadings are diverse

Correlations across measures
- Cognitive decline measures load strongly compared to diverse measures
- This pattern held across the age groups

Cognitive decline measures
- Measures load onto one factor explaining over 50% of variance
- Simple factor structure is consistent across the age groups

Principle components
- First component: % variance
- Fluid intelligence: 27%
- Sentence comprehension: 23%
- Picture naming accuracy: 18%
- Memory recall: 18%
- Repetition priming: 18%
- Force matching³: 18%

Summary & Conclusions
Current findings
- Cognitive decline measures replicate previous findings of common factors that decline with age
- Diverse cognitive measures support notion of cognitive diversity across age range

Implications for models of cognitive aging
- Need multivariate accounts of lifespan cognition, not just mechanisms of decline in old age

Future research question: How do spared and impaired abilities interact across the lifespan?
- Do cross-domain interactions underpin age-related change in factor loadings?
- Do preserved abilities provide support to declining abilities?