ARC CENTRE OF EXCELLENCE IN POPULATION AGEING RESEARCH

Cognitive changes in ageing and their impact on decision-making

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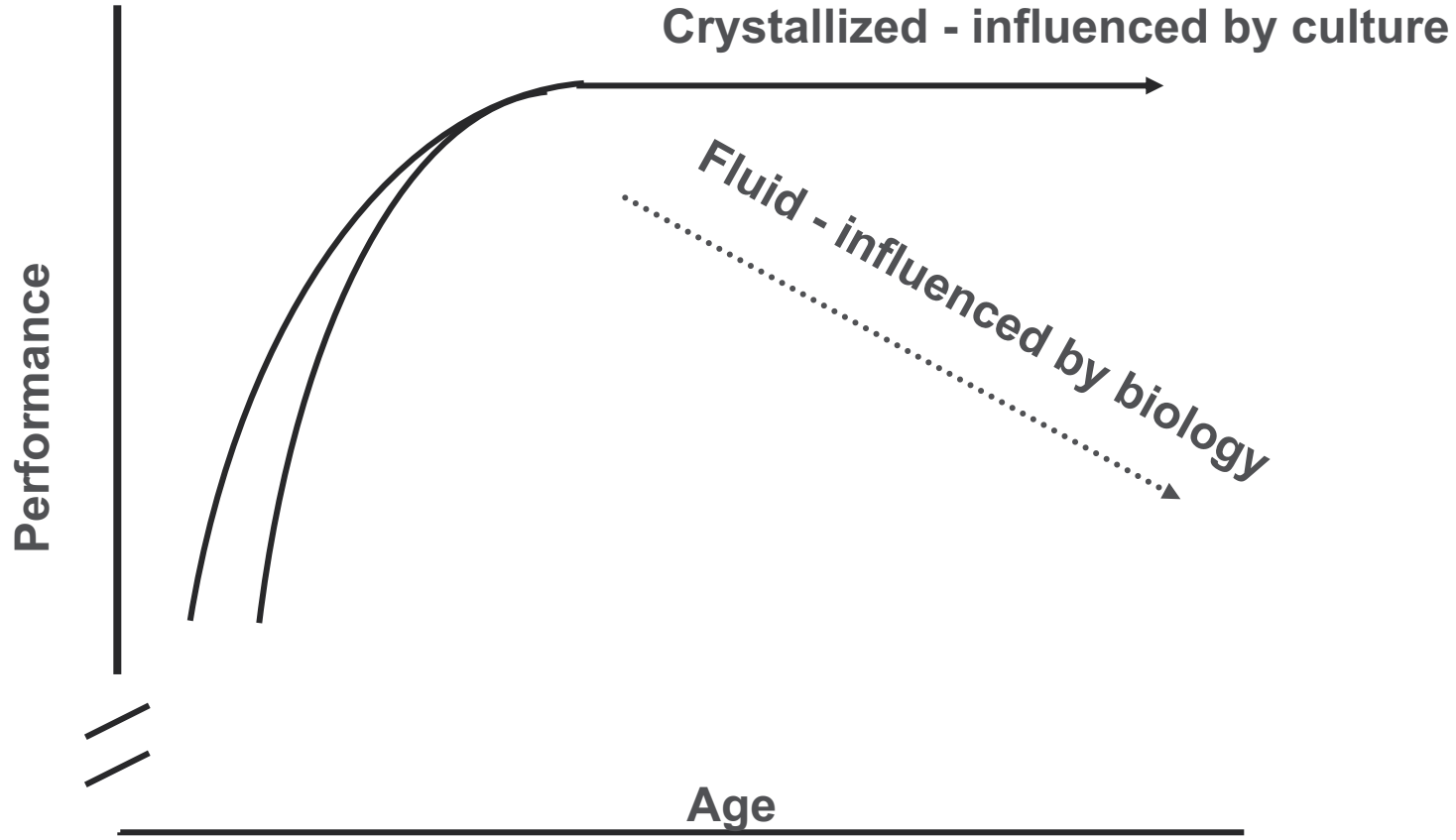
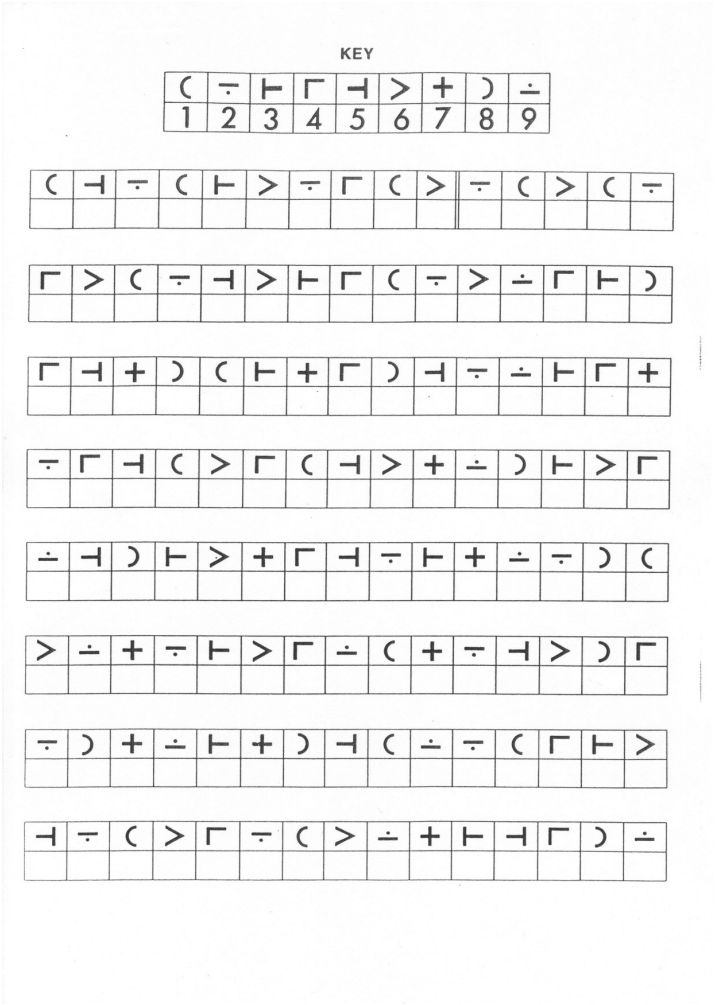
Outline

- Introduction to normal cognitive aging
- Mild Cognitive Impairment
- The impact of cognitive decline on financial decision-making
- Summary and implications

Simplified model of cognitive changes in ageing



Fluid ability example: Symbol Digit Modality test of processing speed



- Participant codes as many symbols as possible in 90 seconds
- Very sensitive to ageing, brain damage etc.
- Average score for 25 year-old is 78, 70 year-old is 51
- Poor performance predictive of falls, crashes

Crystallized ability example

Baddeley's Spot the Word Test

- Measures lexical decision ability, i.e. word knowledge
- Performance increases with age
- Robust against illness and early cognitive decline

broxic	–	oasis
pinnace	–	strummage
mannerism	–	whitten
daffodil	–	gombie
bellissary	–	cyan
vellicle	–	sampler
necromancy	–	ghoumic
narwhal	–	epilair
venady	–	monad
plargen	–	savage
clegger	–	minim
knibbet	–	mandrake
canticle	–	grammule
threnody	–	epigrot
brastome	–	banshee
shako	–	strubbage
paraclete	–	elezone
froopid	–	clod
rouse	–	choffid
goblet	–	prelly
flexipore	–	viscera
agipect	–	almond
tarantula	–	hostent
trelding	–	rafters
legify	–	archaic
obsidian	–	plassious
restance	–	zombie
pimple	–	brizzler
frellid	–	static
hilfren	–	domain

Cognitive function in middle age – overall stability in Australian Cohort

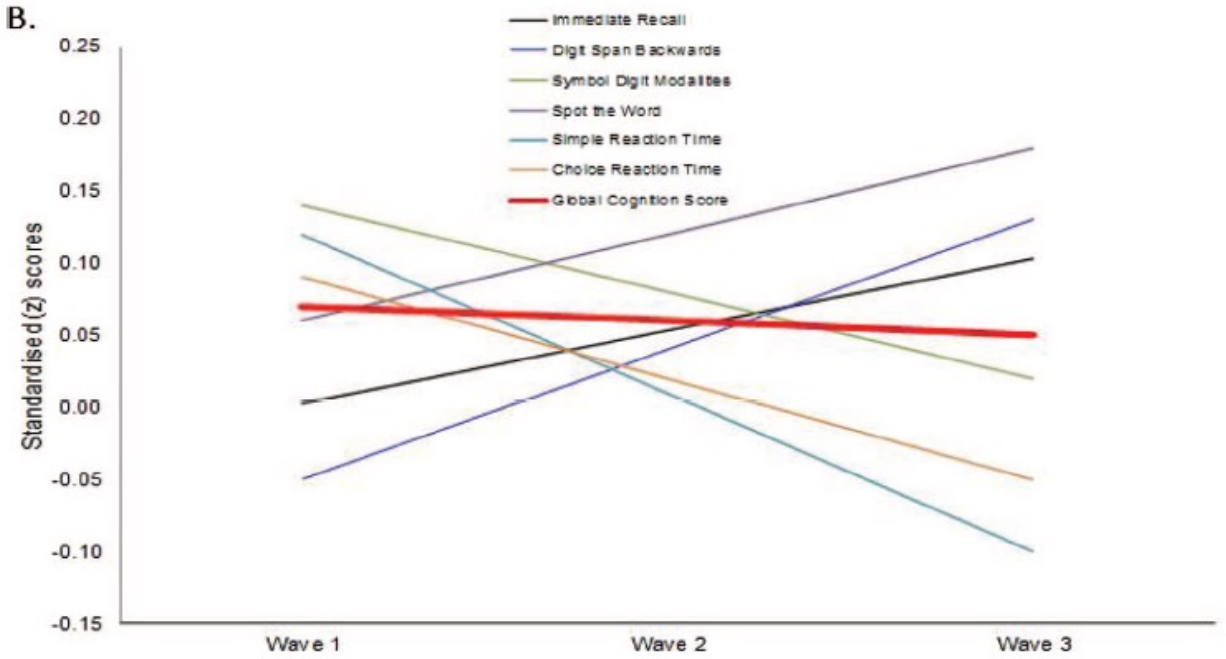


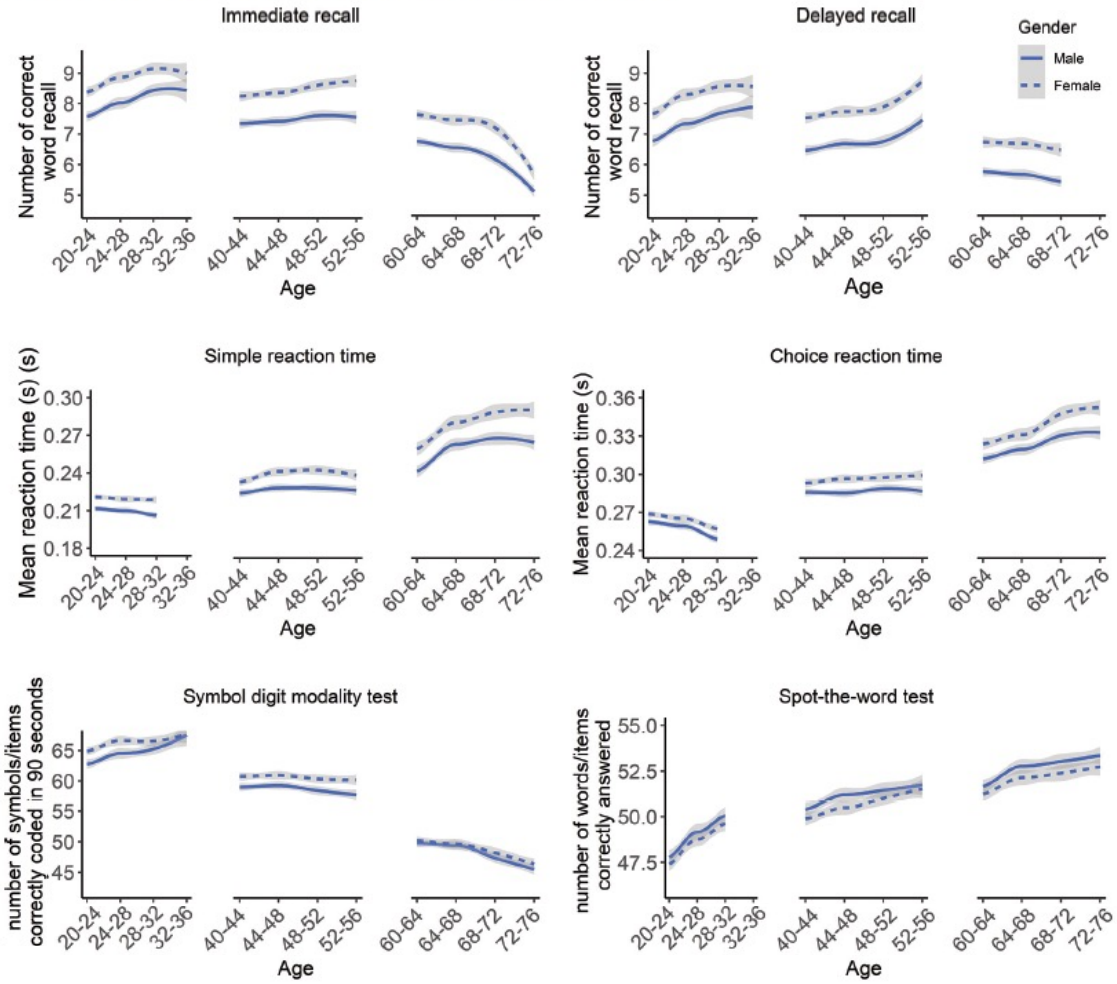
Figure 2. Plotted linear trajectories of (a) unadjusted and (b) adjusted for patterns of test completion. Estimates of linear growth from multilevel models for individual cognitive test scores and aggregate global cognition scores across three waves (8 years).

Anstey, K.J., Sargent-Cox, K.A., Garde, E., Cherbuin, N., Butterworth, P. (Mar 2014) Cognitive development over 8 years in mid-life and its association with cardiovascular risk factors. *Neuropsychology*, 28(4) 653-665. doi: 10.1037/neu0000044.

Lifecourse changes in cognitive function

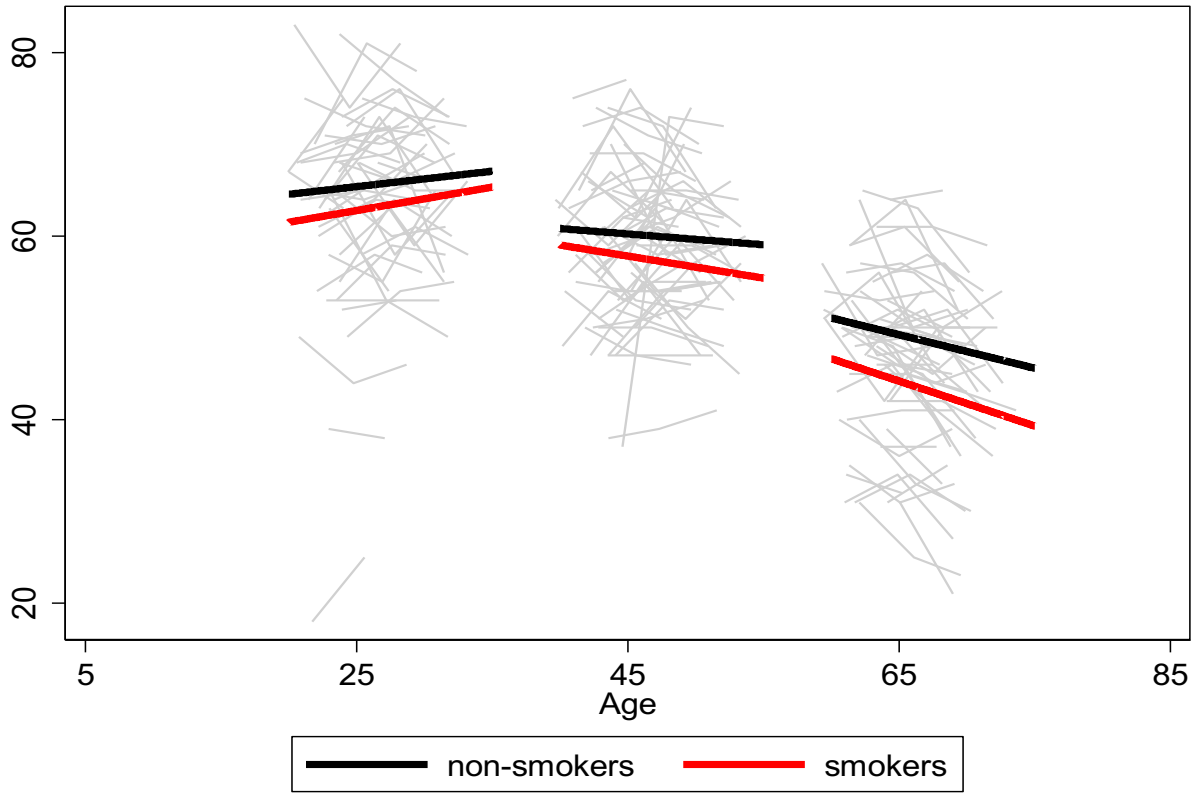
Figure 1

Trajectories of Cognitive Abilities Over 12 Years in Three Age Cohorts



Anstey K.J., Ehrenfeld L., Mortby M.E., Cherbuin N., Peters R., Kiely K.M., Eramudugolla R., Huque, M.H. (2021). Gender differences in cognitive development in cohorts of young, middle, and older adulthood over 12 years. *Developmental Psychology.* PMID: 34591581. doi: 10.1037/dev0001210

Raw data shows variability between people



Data from the PATH Through Life Study

Memory decline in older age – sex differences and Alzheimer's genetic risk

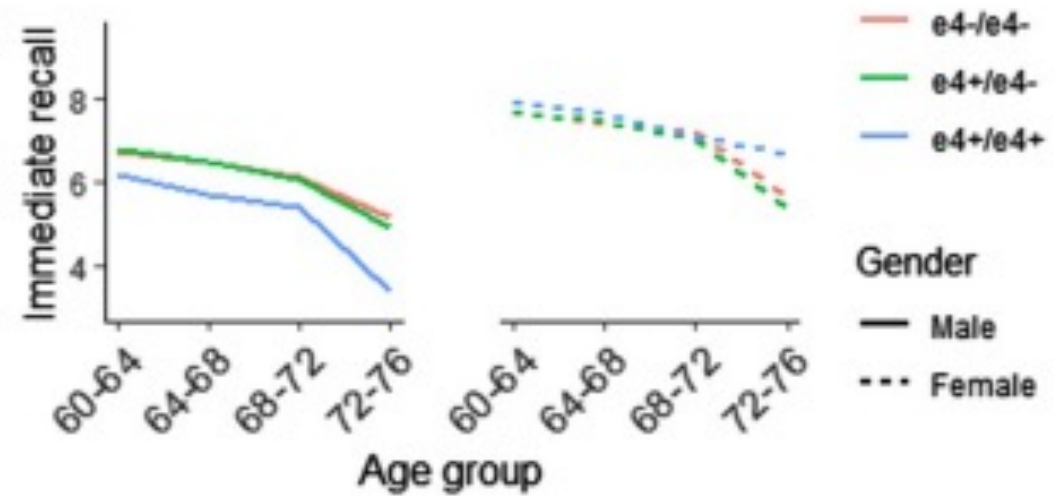
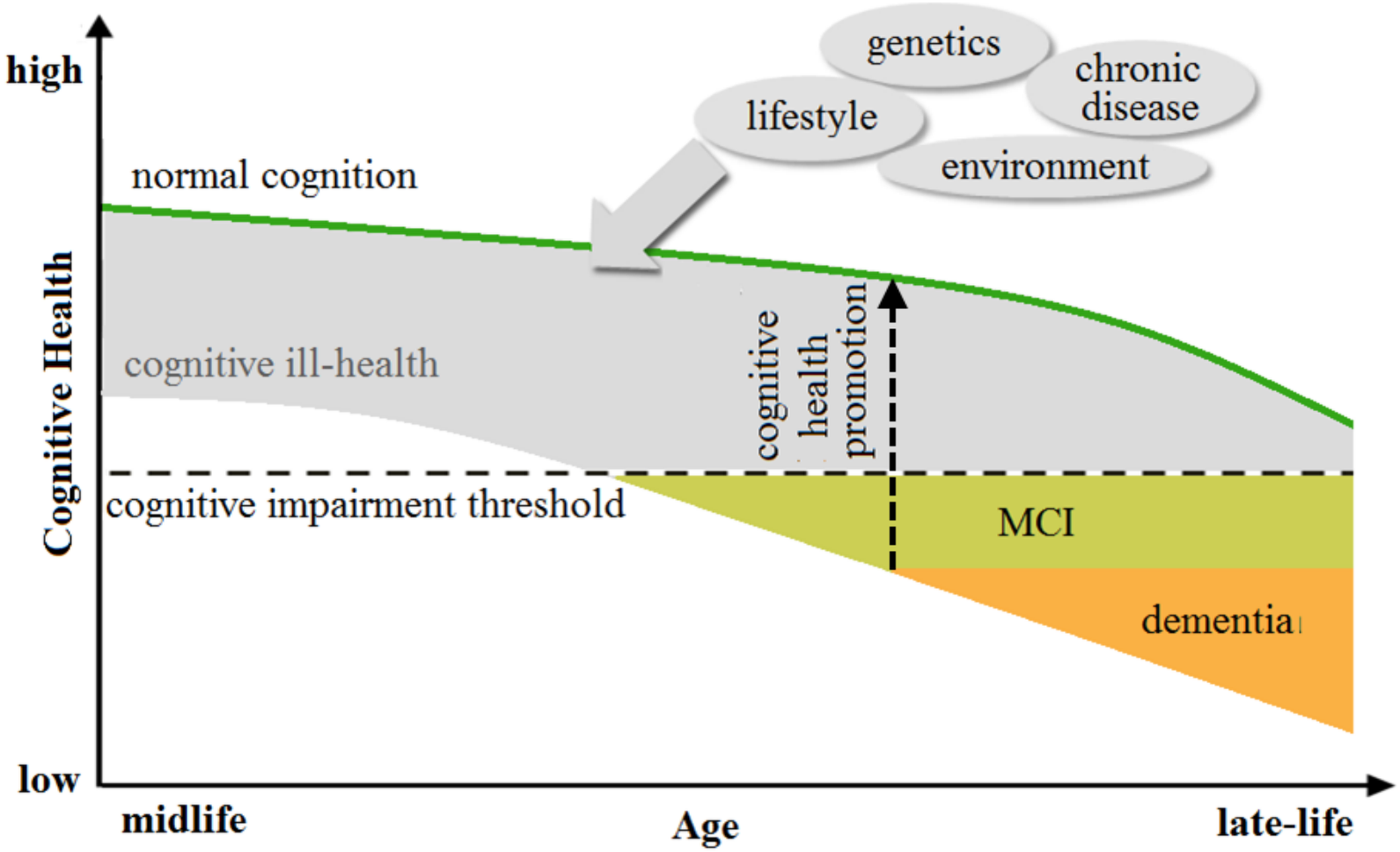


Figure 2. Raw scores for Immediate Recall over time for men and women by *APOE e4* genotype.

Anstey K.J., Peters R., Mortby M.E., Kiely K.M., Eramudugolla R., Cherbuin N., Huque M.H., Dixon R.A., (2021). Association of sex differences in dementia risk factors with sex differences in memory decline in a population-based cohort spanning 20-76 years. *Scientific Reports*. PMID: 33833259. doi: 10.1038/s41598-021-86397-7


genetics
chronic disease
lifestyle
environment
normal cognition
high
Cognitive Health
low
cognitive ill-health
cognitive health promotion
cognitive impairment threshold
MCI
dementia
midlife
Age
late-life

Mild Cognitive Impairment criteria – Mayo Clinic

- Subjective and/or informant cognitive complaint,
- Normal functional ability,
- No dementia, and
- Objective cognitive impairment in one or more cognitive domains relative to normative data.

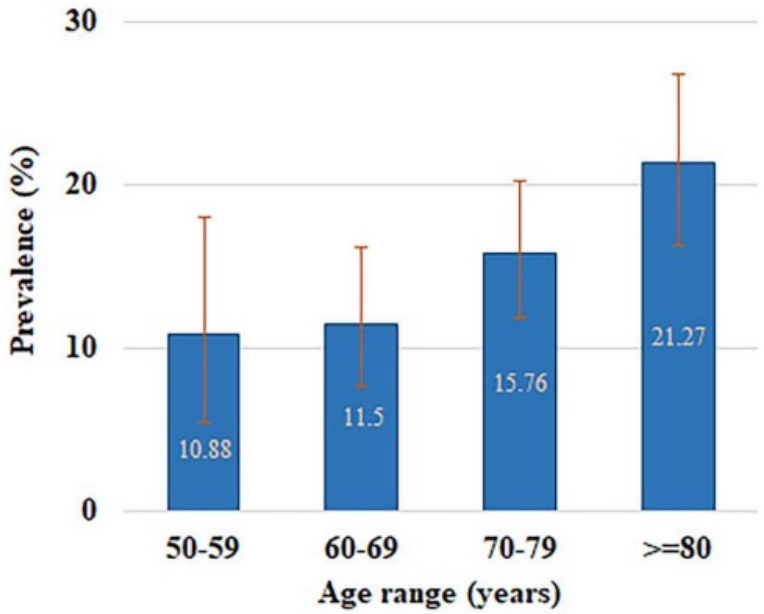
- Impairment is usually 1.5 SD below mean for age

Four subtypes depending on the number and type of cognitive impairments:

- Amnestic MCI single domain
- Amnestic MCI multiple domains
- Non-amnestic MCI single domain
- Non-amnestic MCI multiple domains

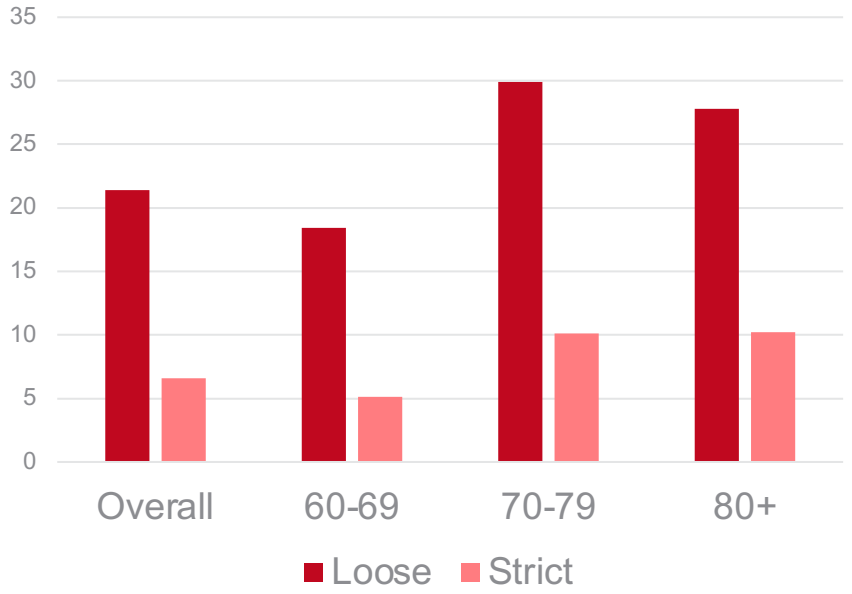
Prevalence of Mild Cognitive Impairment – depends on criteria, age and education

Worldwide prevalence



Bai et al., Worldwide prevalence of mild cognitive impairment among community dwellers aged 50 years and older: a meta-analysis and systematic review of epidemiology studies, *Age Ageing* 2022; 51: 1–14

Prevalence of MCI - Sweden



Overton et al, Prevalence and Incidence of Mild Cognitive Impairment across Subtypes, Age, and Sex, *Dement Geriatr Cogn Disord* 2019;47:219–232

Cognitive decline is associated poorer financial decision-making

1. Older adults with cognitive decline are more risk averse and less likely to choose temporal discounting (James et al., 2015, PloSOne, Rush study USA).
2. Cognitive decline is associated with reduction in numeracy and financial literacy.

	Numeracy Change			Knowledge Change		
	Estimate	SE	p-value	Estimate	SE	p-value
Episodic Memory Decrease	0.725***	0.242	0.00	0.294	0.213	0.17
Intercept	0.173	0.130	0.18	0.024	0.114	0.83
Perceptual Speed Decrease	0.369*	0.219	0.09	0.212	0.191	0.27
Intercept	−0.022	0.122	0.86	0.013	0.107	0.90
Semantic Memory Decrease	0.404	0.300	0.17	0.632**	0.246	0.01
Intercept	0.065	0.134	0.63	0.203*	0.112	0.07
Visuospatial Ability Decrease	0.472**	0.212	0.03	0.024	0.194	0.90
Intercept	0.136	0.143	0.34	−0.060	0.131	0.65
Working Memory Decrease	0.333	0.254	0.19	0.153	0.211	0.47
Intercept	−0.017	0.145	0.68	−0.010	0.120	0.42

Results from Rush Memory and Aging Study, Gamble et al., Management Science, 2015

Mild cognitive impairment and Risky Decision-Making in an Australian cohort

Cognitively Healthy (N = 1002)

MCI sub-types (N=103)

- ***n*** **= 38 aMCI single domain**
- ***n*** **= 31 aMCI multi-domain**
- ***n*** **= 33 naMCI (single/multidomain)**

Hypotheses

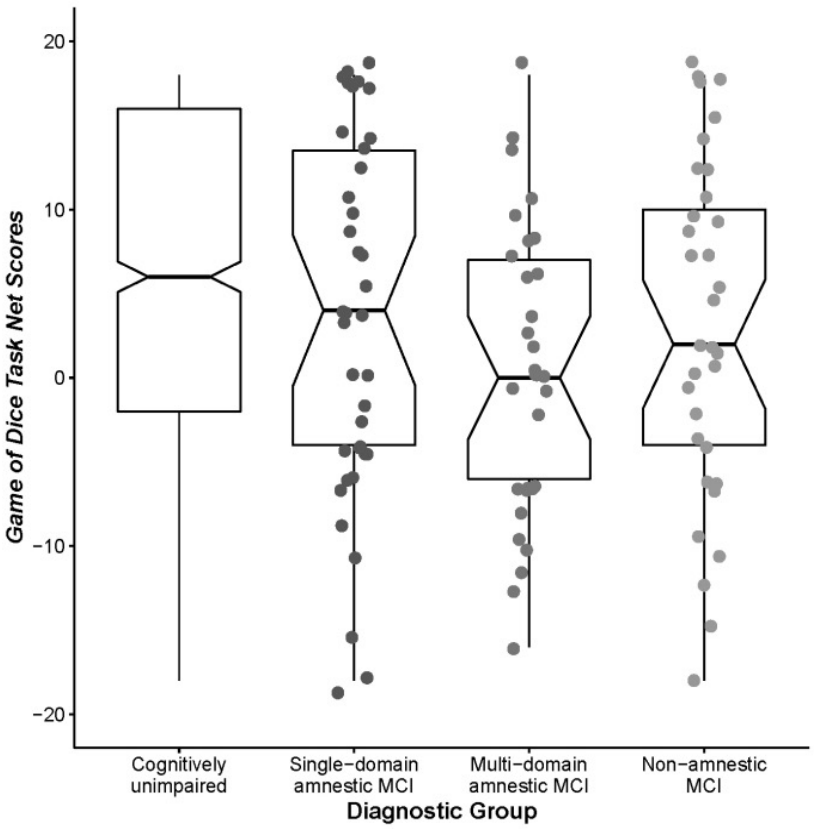
1. Participants with MCI will show decision-making impairment on the Game of Dice Task
2. Decision-making on Game of Dice Task will be associated with measures of executive function
3. *(Exploratory): Investigate whether decision-making performance differs by MCI sub-type*

Sinclair, C., Eramudugolla, R., Cherbuin, N., Mortby, ME, Anstey, KJ. The impact of mild cognitive impairment on decision-making under explicit risk conditions: Evidence from the Personality and Total Health (PATH) Through Life Longitudinal Study, PATH study, in press, *J Int Neuropsych Soc*

Impact of cognitive impairment on decision-making

Game of Dice Task scores	Cognitively unimpaired (N=1002)	Mild cognitive impairment (MCI, N=103)	*p* value	Effect size r^2
Net score (-18 to 18)	5.10 (10.6)	2.56 (9.97)	.011	0.08
Single number choices	2.71 (3.75)	3.85 (3.87)	<.001	0.12
Strategy changes	4.46 (3.53)	5.50 (3.42)	.003	0.09

- **H1:** People with MCI had lower Game of Dice performance scores (*p*'s < .011, r^2 = .08-.12)
- **H2:** Among those with MCI, Game of Dice Task net score associated with Executive Function (Spearman's ρ = .25, *p* = .016)
- **Exploratory H3:** People with multi-domain aMCI had significantly lower performance scores than cognitively unimpaired (*p*'s .001 - .03)



Summary

- Cognitive decline occurs in later life but there is large variation in individual trajectories
- About 20% of adults over 70 have mild cognitive impairment depending on criteria used
- Cognitive decline and mild cognitive impairment reduce skills needed for optimal financial decision making

Overall conclusion

Sub-optimal financial decision-making due to cognitive decline is an individual and societal risk that needs to be managed – options appear to be policy, education, decision-support, and product design