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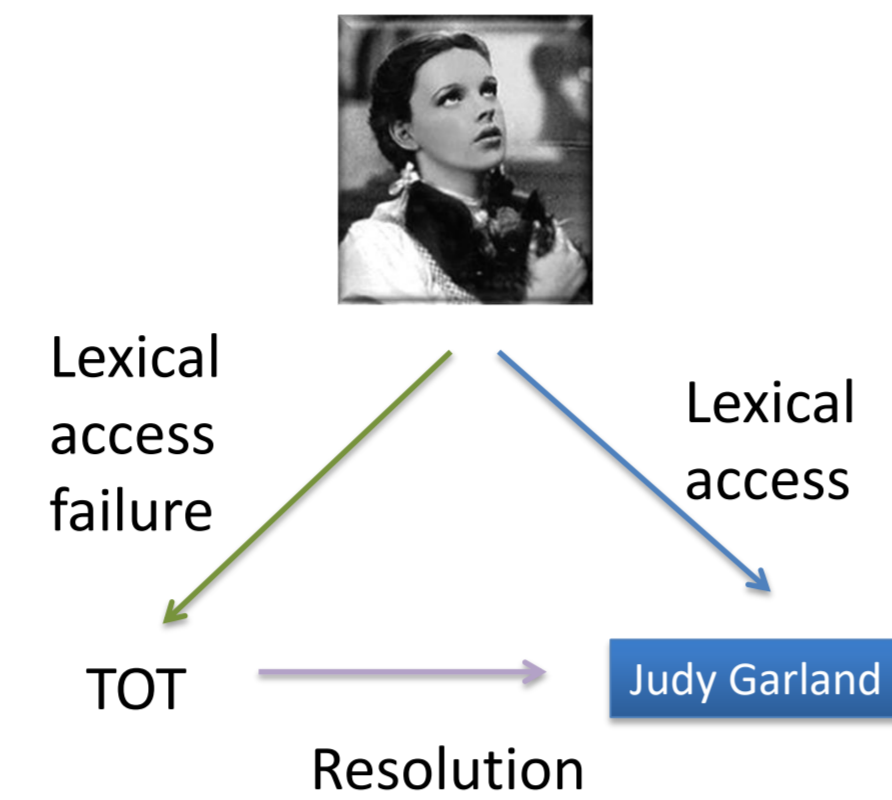
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Introduction

Tip-of-Tongue states (TOTs):

- Temporary word finding failures for familiar words, increase with age
- Previous evidence suggests TOTs reflect **language-specific** lexical access deficit¹
- TOT resolution may rely on **domain-general** processes^{2,3}
- Older adults worry their TOTs reflect **domain-general** cognitive decline⁴

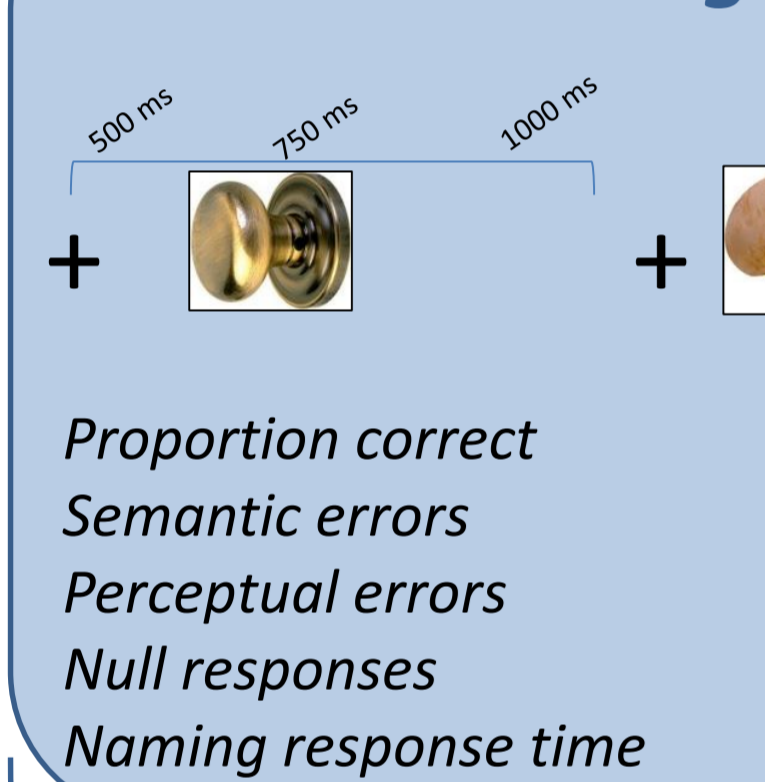


Do **language-specific** and **domain-general** processes predict TOTs differently across the lifespan?

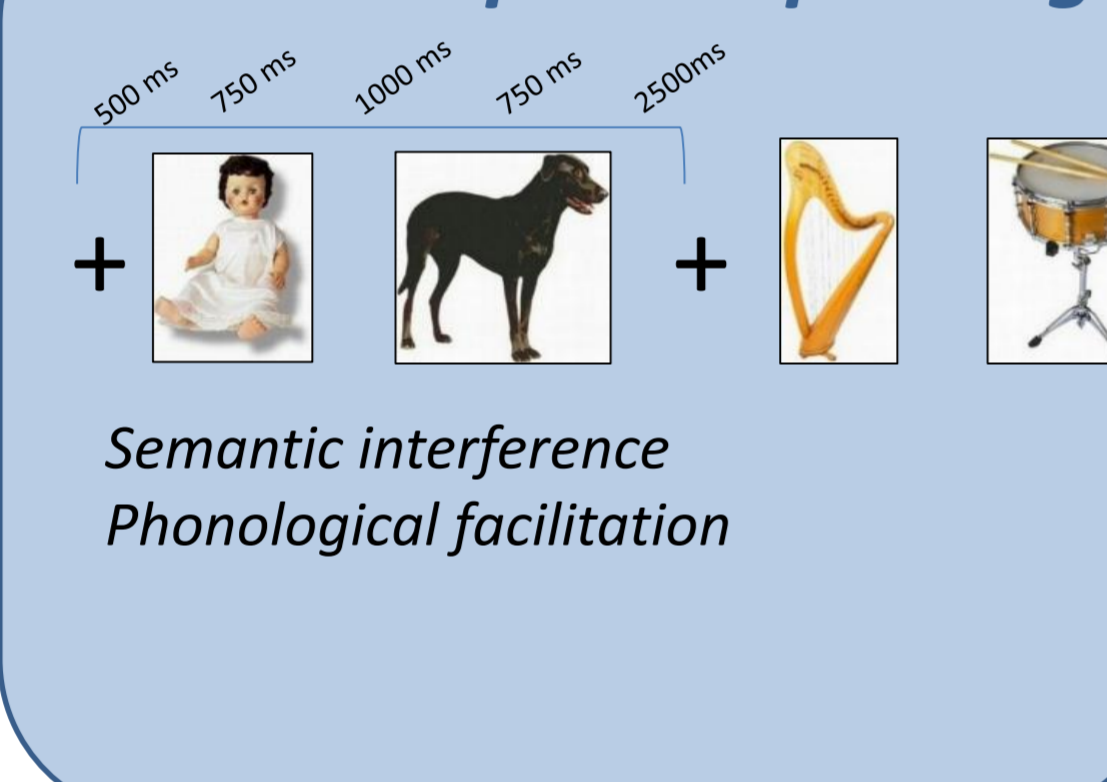
Method

Behavioural tasks and measures

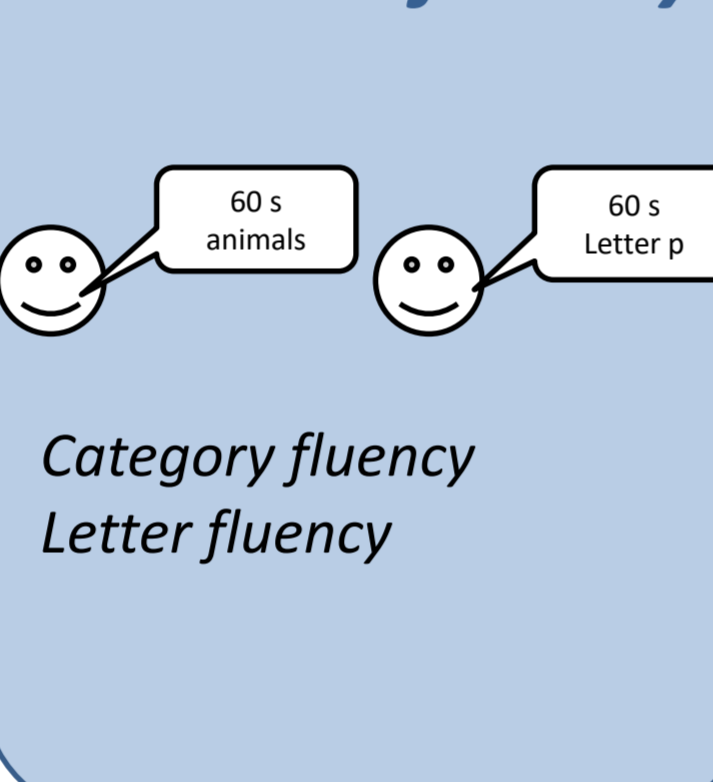
1. Picture naming



2. Picture -picture priming



3. Verbal fluency



PCA components

4. Tip-of-the-tongue (TOT)



Participants

- Cam-CAN cohort, population-based recruitment⁵
- N=577 (N=534 for MRI)
- Age 18-88 (M=54.4, SD=18.4)
- 290 males, 287 female

MRI details

*T1-weighted sequence GRAPPA; repetition time (TR) = 2,250 ms; echo time (TE) = 2.99 ms; inversion time (TI) = 900 ms; flip angle $\alpha = 9^\circ$; field of view (FOV) = 256 x 240 x 192 mm³; resolution = 1 mm isotropic; accelerated factor = 2; acquisition time of 4 min 32 s

*Co-registered T1 and T2 images were used in a multi-channel segmentation (SPM12 Segment, based on "New Segment" in SPM8[®]) routine in order to extract probabilistic maps of 6 tissue classes: GM, WM, cerebrospinal fluid (CSF), bone, soft tissue, and residual noise.

*Native-space GM images for all participants submitted to DARTEL⁷ to create group template images. The group template was then normalized to the MNI template, and normalization parameters were applied to each individual participant's images.

*Individual normalized images were smoothed (10mm FWHM Gaussian kernel)

Results : Word production factors

PCA with production measures:

	Accuracy	Fluency	Priming	Semantic errors	Correct naming	Perceptual errors	Letter fluency	Category fluency	Naming RTs	Phonological facilitation	Semantic interference	Null responses
Accuracy	34.5%	0.87	-0.83	0.80	0.06	-0.25	0.10	0.06	-0.09	0.38		
Fluency	15%	-0.16	0.36	0.04	0.84	0.77	-0.58	-0.01	0.03	-0.44		
Priming	12.9%	-0.09	0.31	0.14	-0.02	0.07	-0.02	0.72	0.65	-0.45		

Three production factors:

1. Accuracy
2. Fluency
3. Priming

Interpreting factors:

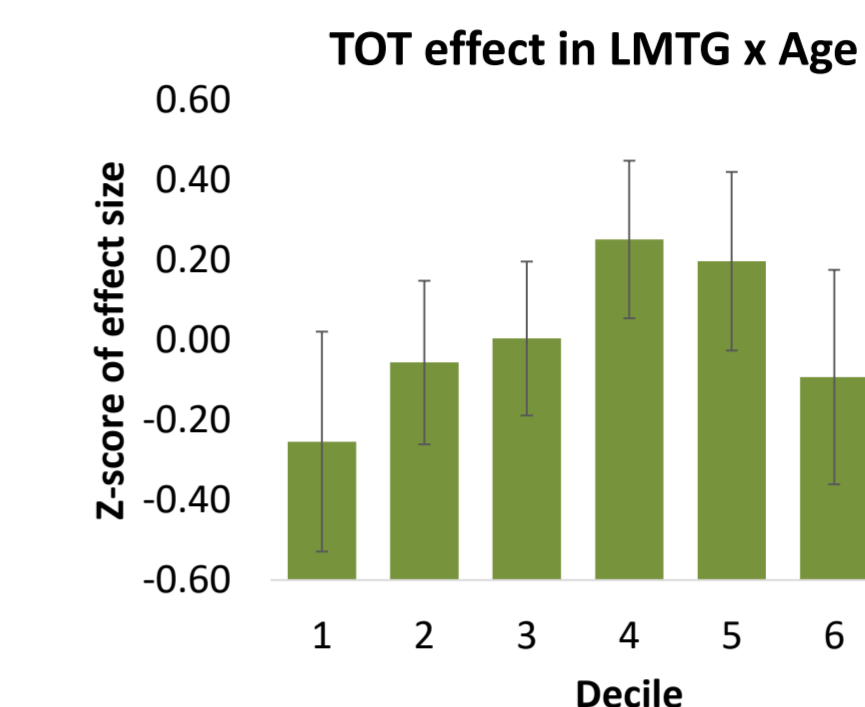
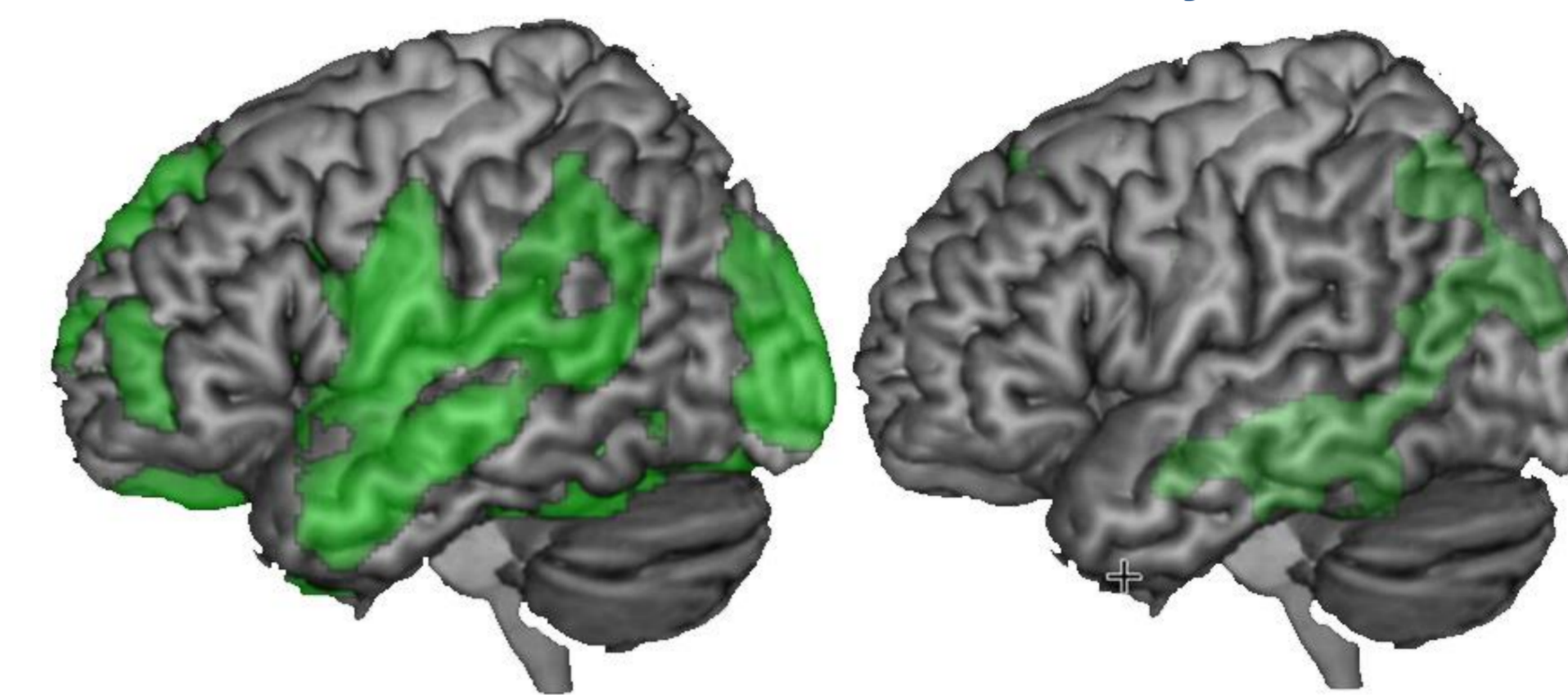
- All 3 factors related to TOTs
- Accuracy and Fluency related to domain-general fluid intelligence

	TOTs	Fluid Int.
Accuracy	.056	-1.1
Fluency	-.076	1.3
Priming	-.019	.247

Multiple regr. Beta values, controlling for age, gender, education

Results: Age and Grey matter

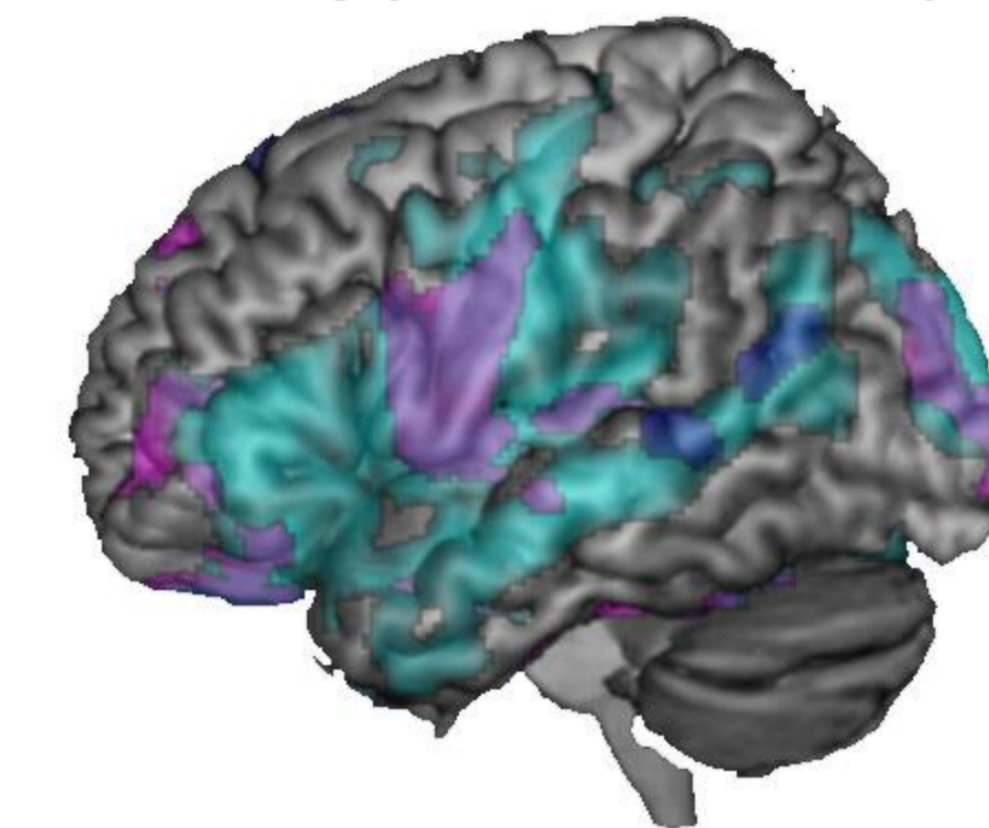
TOTs & Grey matter



TOTs most strongly related to grey matter in middle age

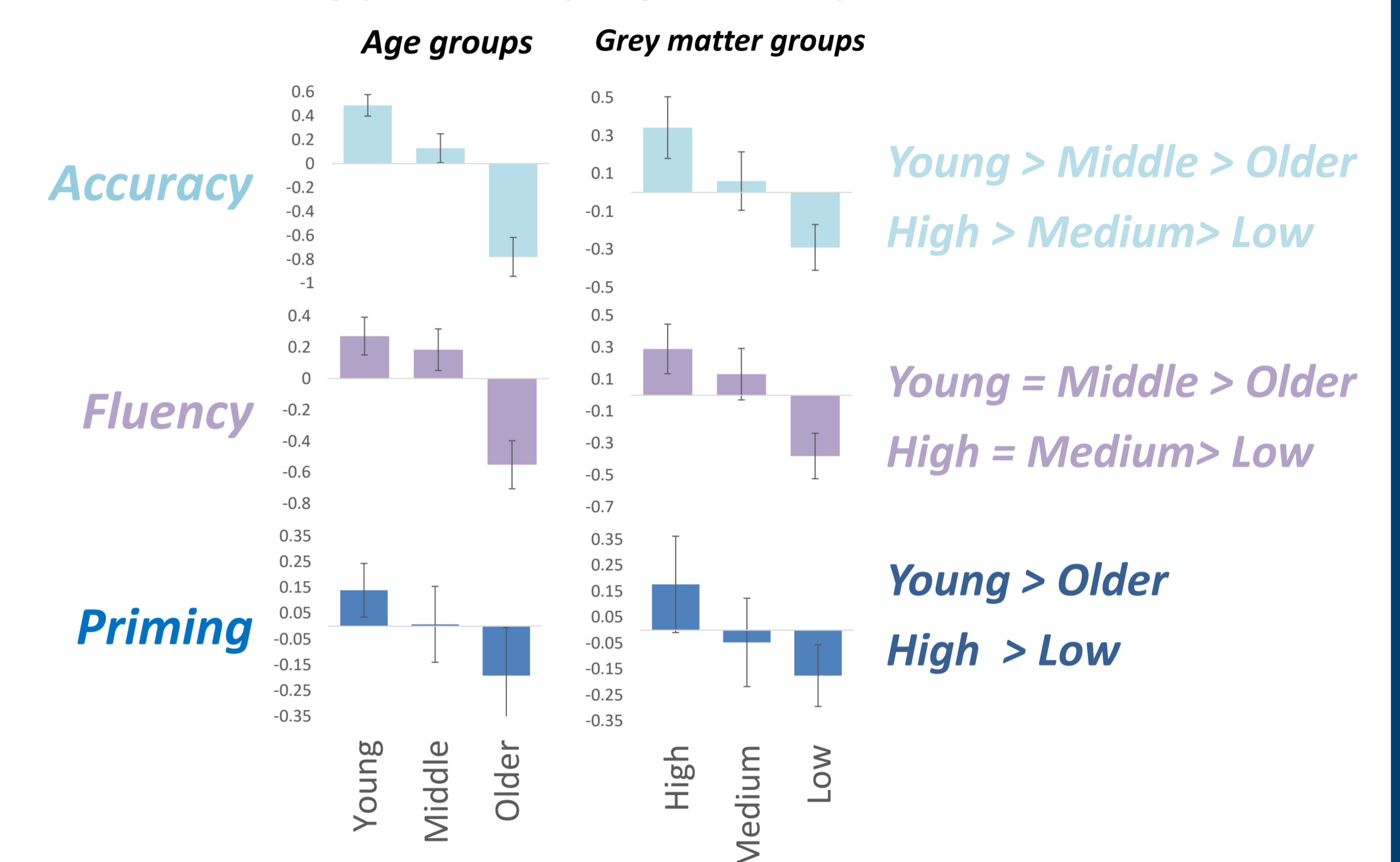
Interaction with age primarily in temporal language rather than frontal domain-general regions

Naming factors & Grey matter



Accuracy
Fluency
Priming

Naming factors by Age & Grey matter



Factors & TOTs x Age

	Younger	Middle	Older
Accuracy	-.045	-.073	-.049
Fluency	-.051	-.079	-.078
Priming	.009	-.008	-.038

Multiple regr. Beta values, controlling for age, gender, education

Factors & TOTs x Grey matter

	High	Middle	Lower
Accuracy	-.030	-.065	-.082
Fluency	-.054	-.088	-.065
Priming	.006	-.010	-.043

Multiple regr. Beta values, controlling for age, gender, education

TOTs predicted by Accuracy and Fluency across the lifespan and a range of grey matter levels
TOTs predicted by Priming only in older group and lowest grey matter group

Summary

- TOTs → domain-general and language-specific processes
- Factors relate differently to age and grey matter
 - General factors widely predictive of TOTs
 - Priming factor only related to TOTs for older adults or low grey matter
- Supports language-specific model of older adults' TOTs

References

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3. Shafto, Meredith A., et al. "Word retrieval failures in old age: the relationship between structure and function." *Journal of Cognitive Neuroscience* 22.7 (2010): 1530-1540.
4. Reese, Celinda M., Katie E. Cherry, and Lisa E. Norris. "Practical memory concerns of older adults." *Journal of Clinical Geropsychology* 5.4 (1999): 231-244.
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6. Ashburner, John, and Karl J. Friston. "Unified segmentation." *Neuroimage* 26.3 (2005): 839-851.
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