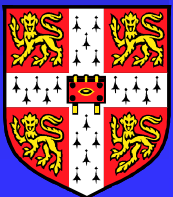


Word finding problems in ageing: how does the brain cope?

Meredith Shafto & Lorraine K. Tyler



University of
Cambridge



Preserved and impaired language abilities in old age: The interaction of atrophy and activity

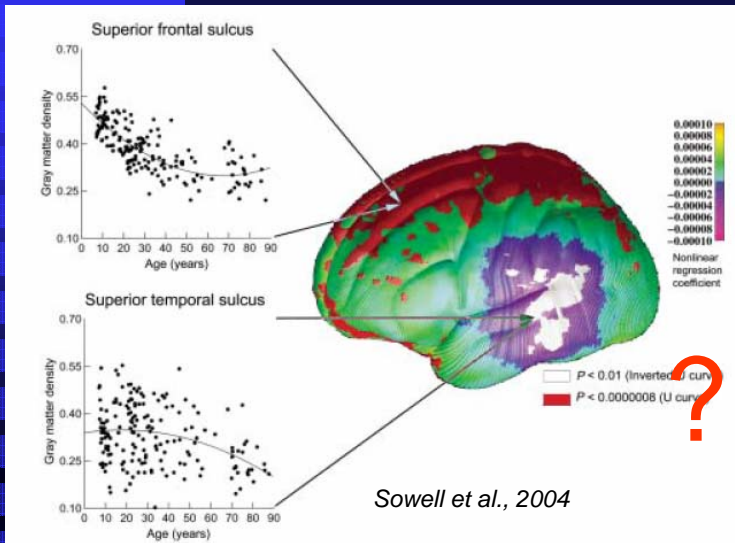
Meredith Shafto & Lorraine K. Tyler



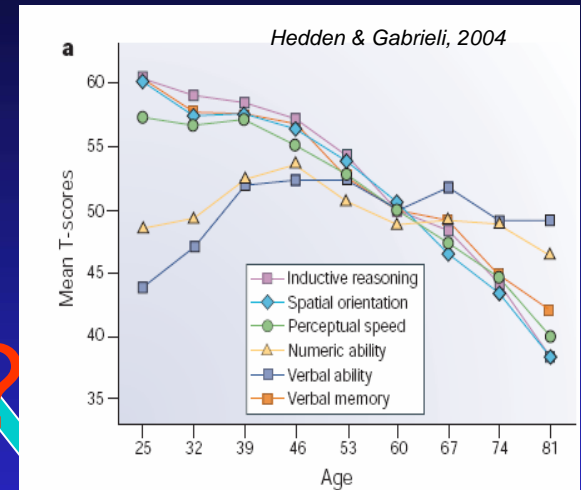
University of
Cambridge



Brain-behaviour relationships



Age-related
cognitive
decline



Wide-spread
atrophy

Neural
activity

What are the neu
underpinnings of lan
performance in old

Inefficiency?
Dedifferentiation?
Atrophy-related?
Compensation?

Why Language?

- Language is important
 - ◆ Important **everyday** skill
 - ◆ Efficacy related to **cognitive health**
 - ◆ **Older adults** worry
- Implications for ageing brain
 - ◆ **Left-lateralized** gives recruitment potential
 - ◆ Relatively well-defined **models**
 - ◆ **Variability**: some spared and some impaired tasks



Language production: Word Finding Failures

Word finding failures in old age

- Tip-of-the-tongue states (TOTs): Temporary inability to produce a well-known word, accompanied by a strong feeling of knowing
- TOTs increase in old age (*Burke et al 1991*)

TOT State retrieval involves:



Age-related increase in TOTs linked to atrophy in regions important for phonological retrieval?

TOTs: Faces

- 46 participants, aged 19-88
- 68 Famous faces, pre-tested for TOT susceptibility



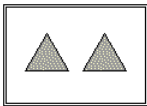
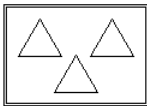

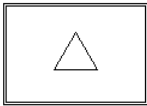

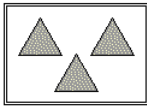



**Named
Don't Know
TOT**

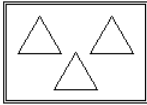
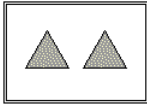

Author of a diary
documenting life as a
Jewish child during
WWII.

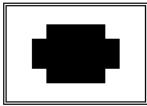
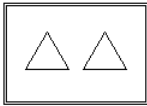
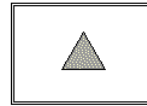
Ravens matrices

- Nonverbal intelligence task
- Performance declines with age

Which answer fits in the missing space to complete the pattern?

1  2  3 

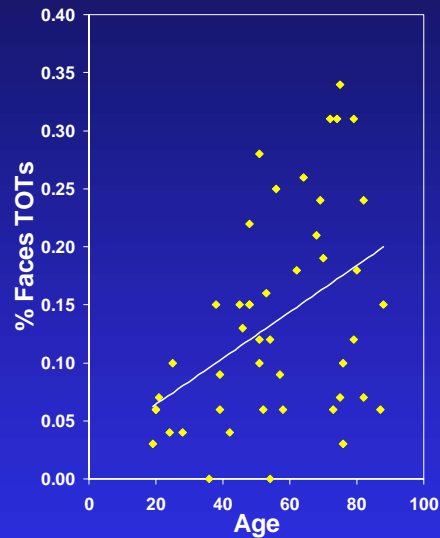
4  5  6 



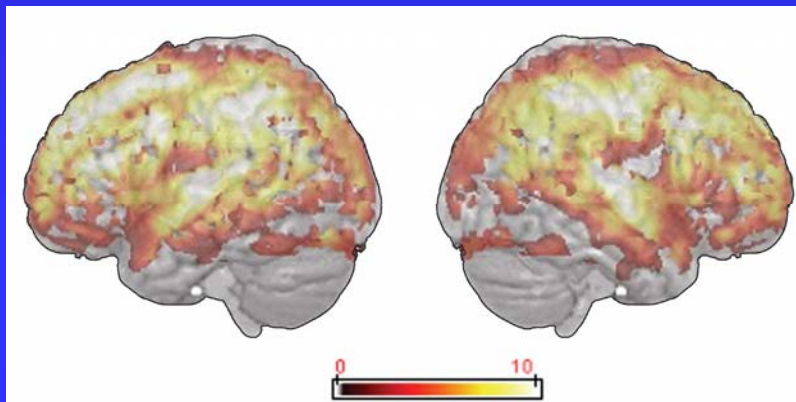
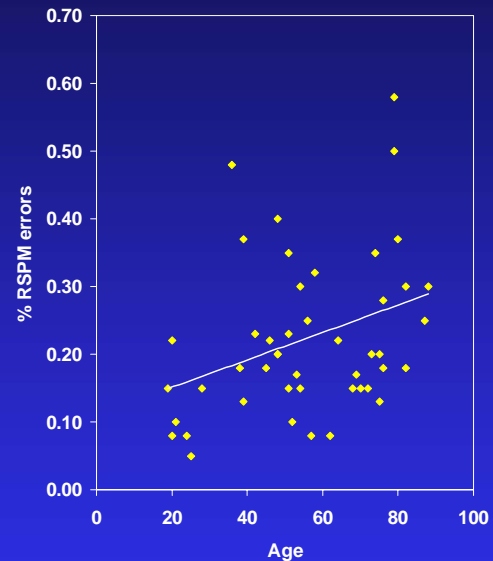
Complete
the
pattern

Effect of Age

- Age correlated with TOT rate

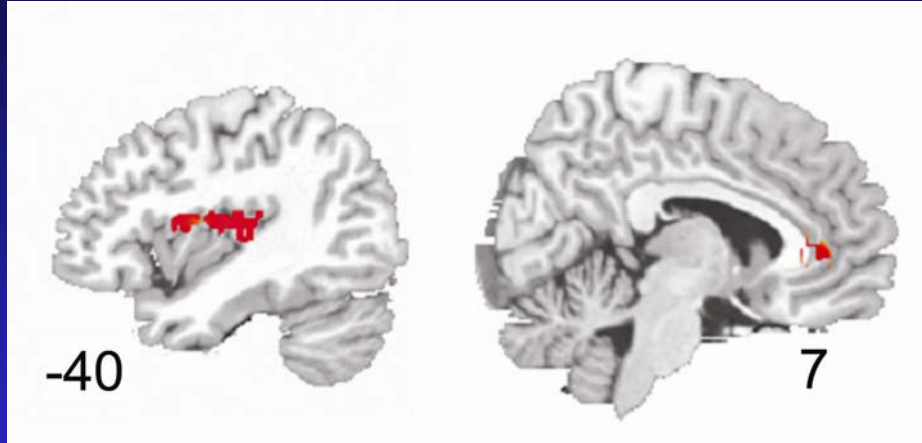


- Age correlated with Ravens errors

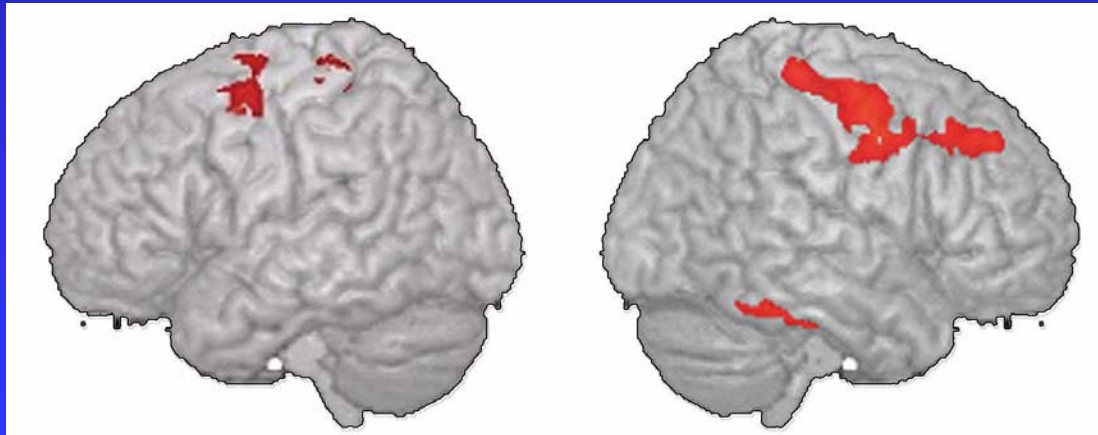


- Age correlated with grey matter

Performance and grey matter



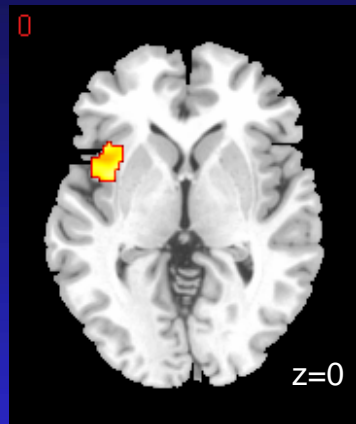
- TOT rate correlated with grey matter in insula



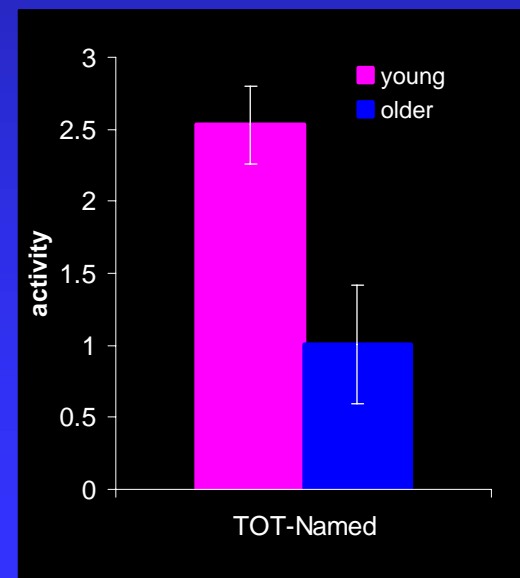
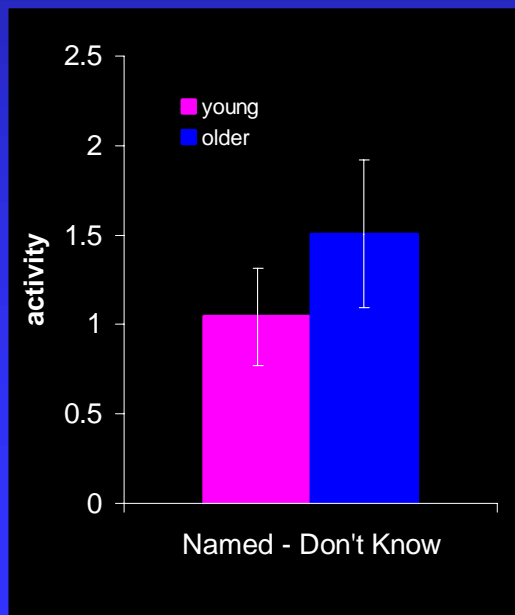
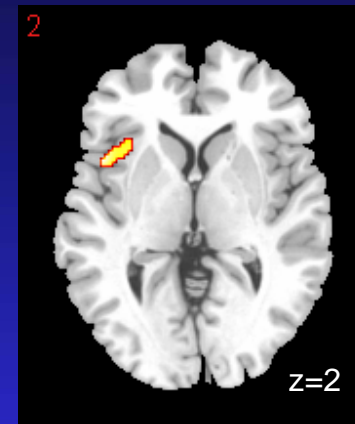
- Ravens (non verbal) correlated with age but not insula grey matter

Region of interest: L insula

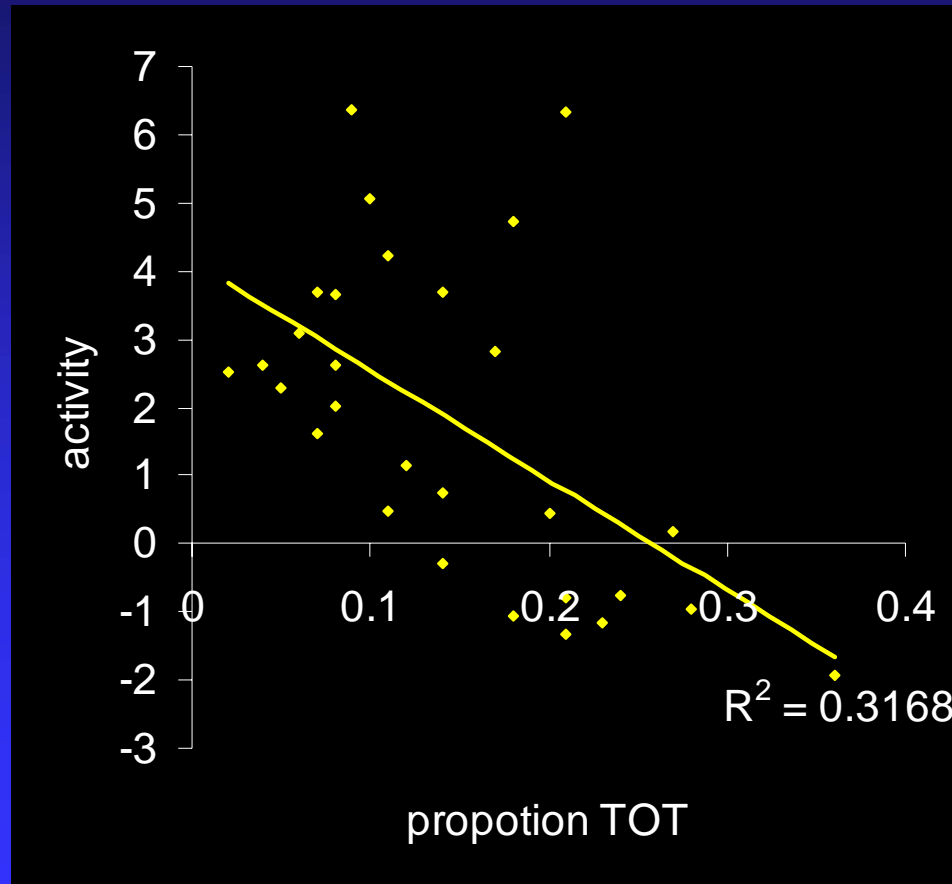
Named-Don't Know



TOT-Named

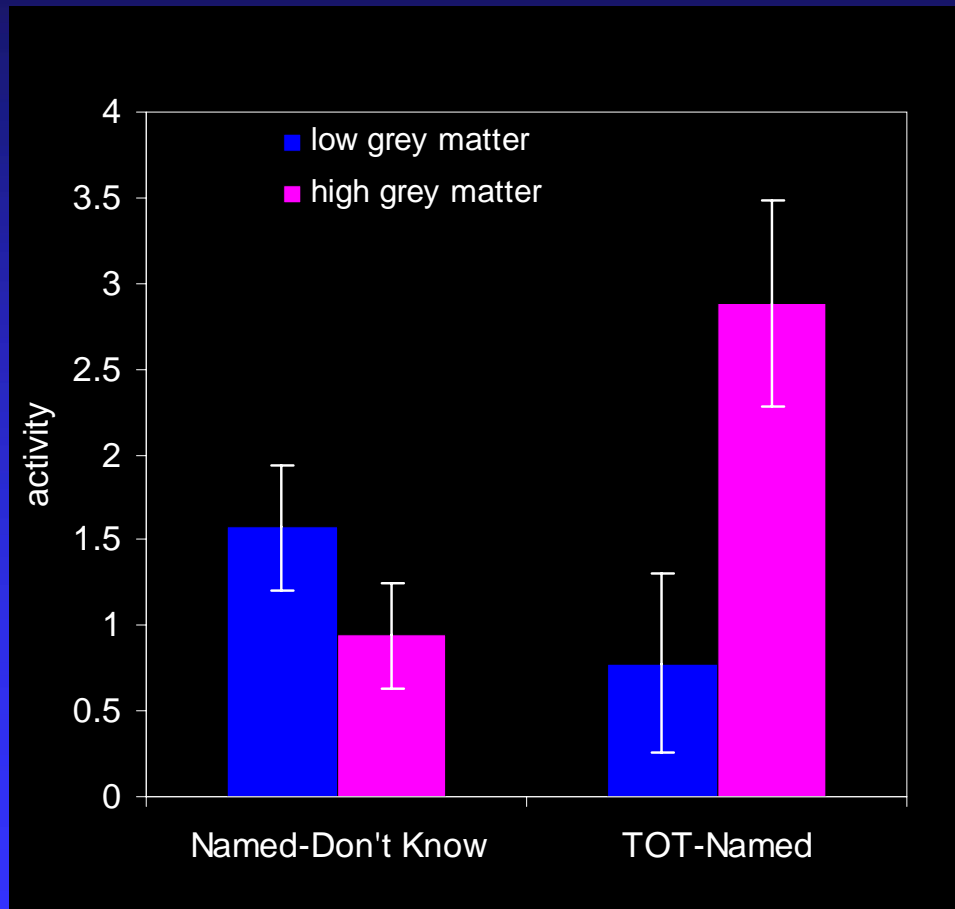


TOT “boost” and TOT rates





- Larger “boost” affiliated with fewer TOTs across all participants

Structure and function

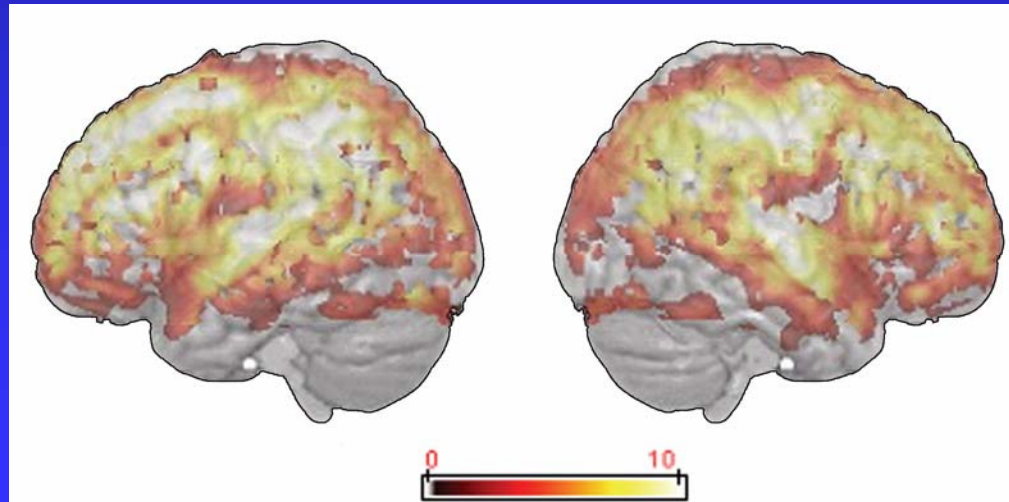


- High grey matter group younger than low grey matter group
- Grey matter loss didn't affect activity during successful naming
- Larger "boost" affiliated with fewer TOTs across all participants

Summary

- Atrophy explanation for age-related increase in TOTs 
- Specific Atrophy-activity-performance links 
- Regional atrophy linked to changes in activity and performance
- Phonology: TOT vs RPM
- “Difficulty”: TOT vs Named

Language comprehension: Listening to sentences



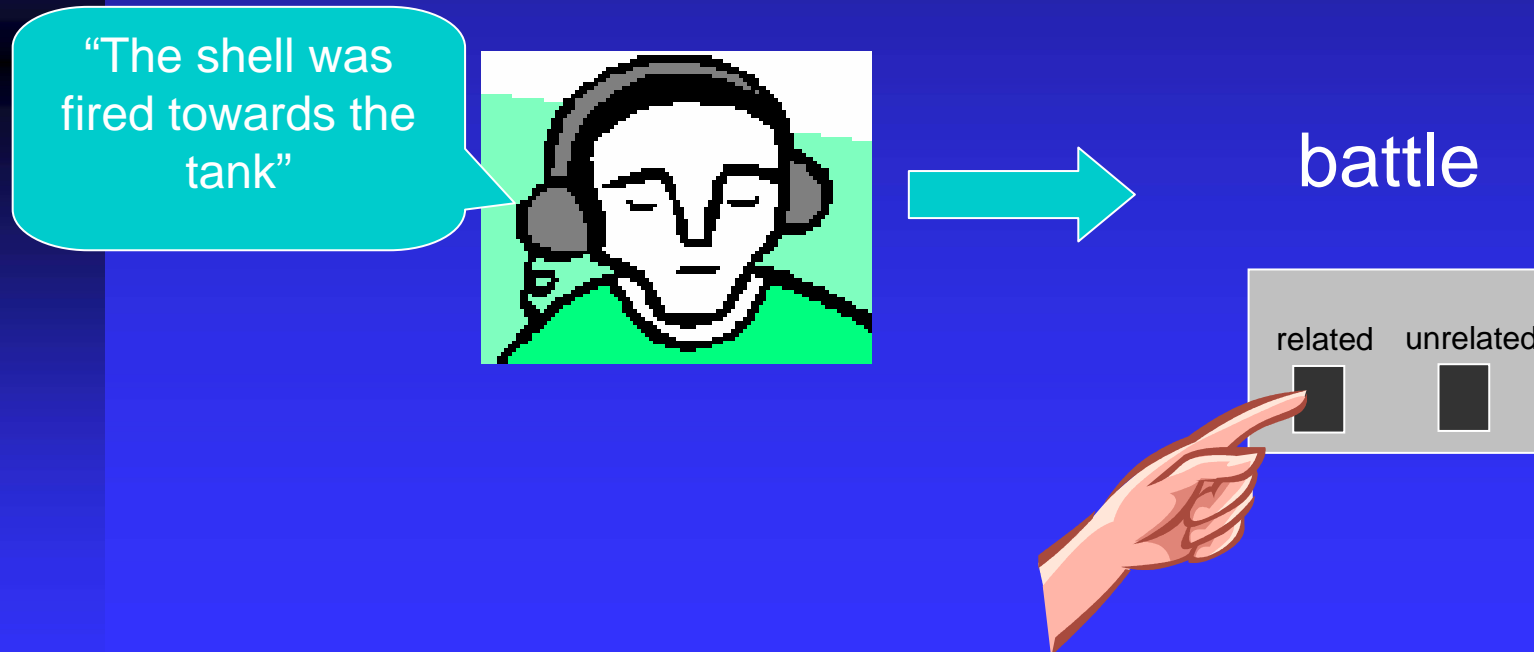
Sentence comprehension

- Semantic ambiguity:
 - ◆ The *shell* was *fired* towards the *tank*
 - ◆ Overall meaning of sentence *not* ambiguous
 - ◆ Comprehension involves selecting the contextually appropriate meanings
- Ambiguous sentences require additional processing in regions important for selecting meaning:
 - ◆ Left inferior frontal gyrus (LIFG)
 - ◆ Left middle temporal gyrus (LMTG)
 - ◆ LIFG-LMTG network



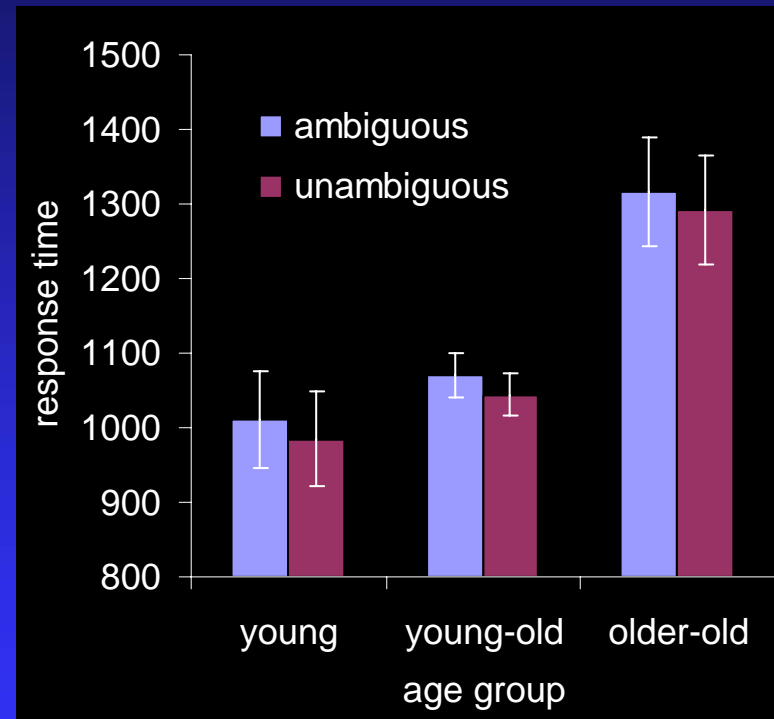
Sentence comprehension task

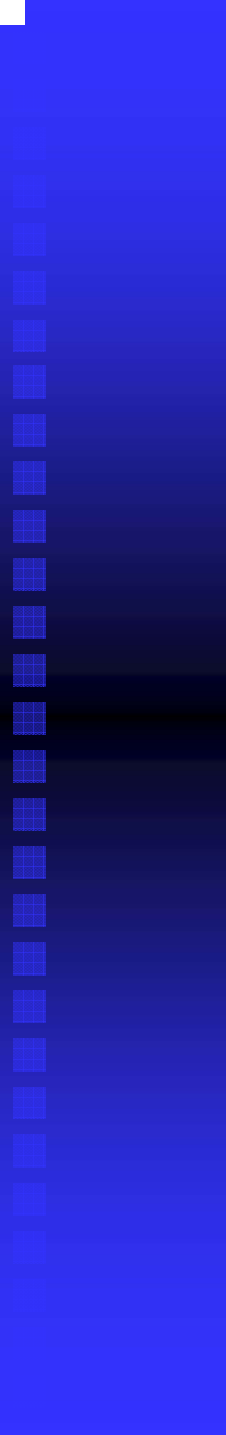
- Participants in 3 groups:
 - ◆ Young (18-27), young-old (49-68), older-old (70-85)
- Sentences with or without ambiguous words
- Probe task: word related to sentence meaning?



Behavioural results

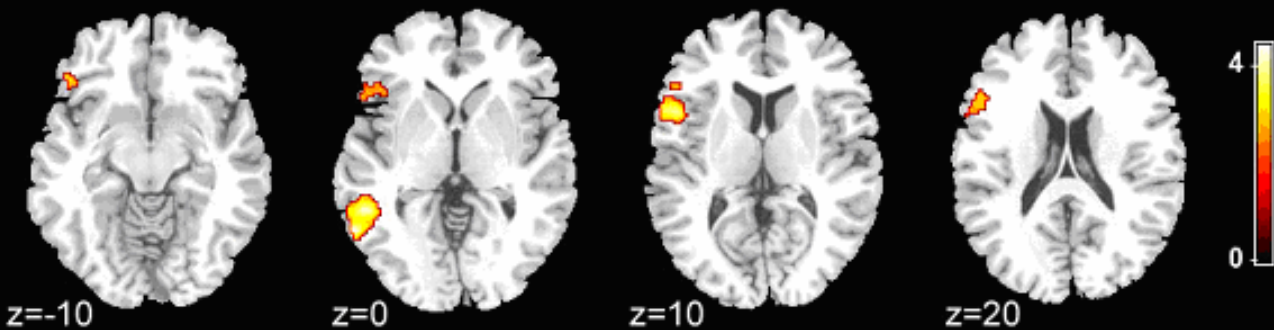
- Age effect: only older-old slower
- Ambiguous vs unambiguous: no RT difference



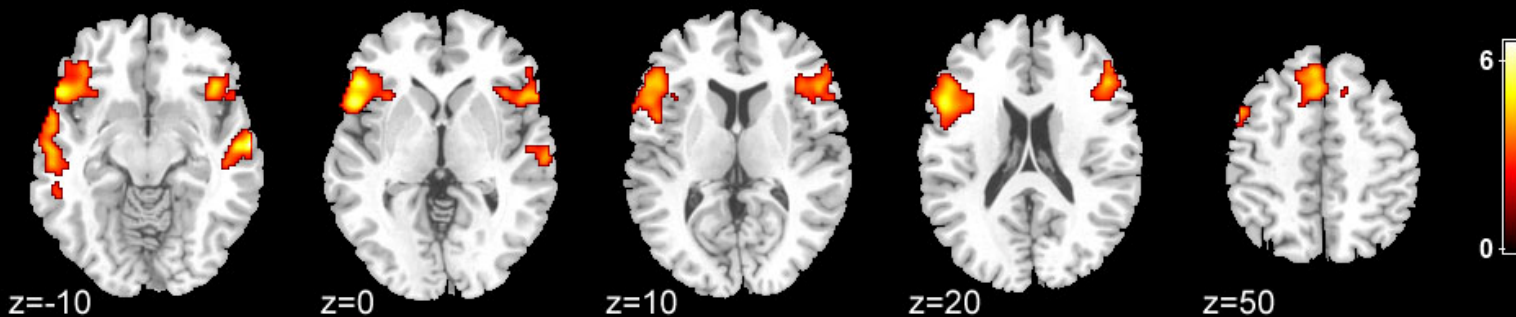


Imaging results: Ambiguous-Unambiguous

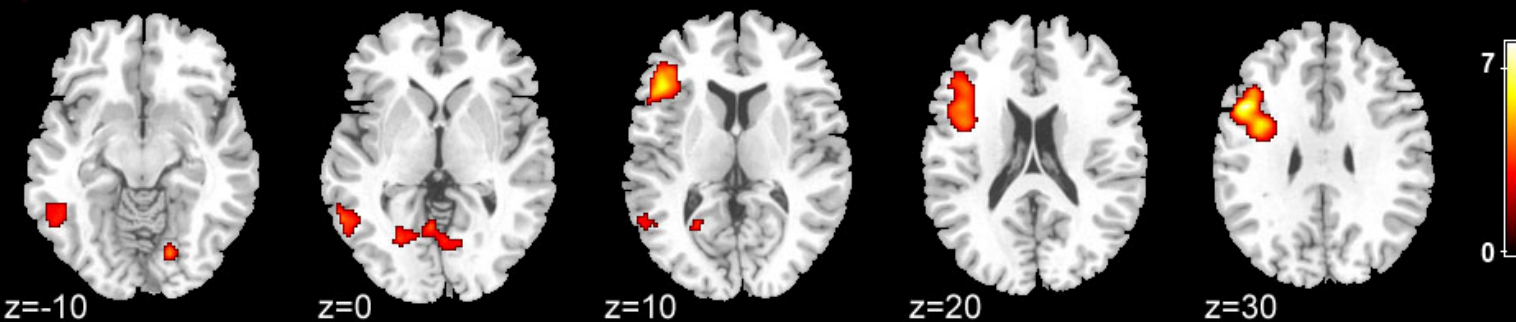
Young ambiguous-unambiguous



Young-old ambiguous-unambiguous



Old-old ambiguous-unambiguous

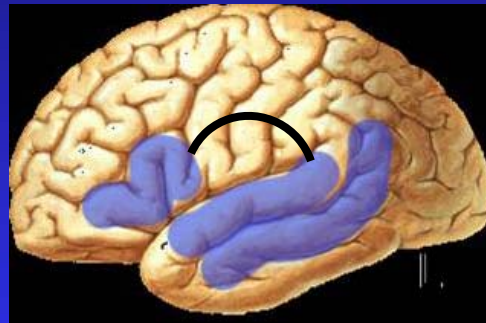


Reason for laterality shifts?

■ Continued grey matter atrophy?



- Mixed grey matter - activity correlation
- No grey matter – RT correlation

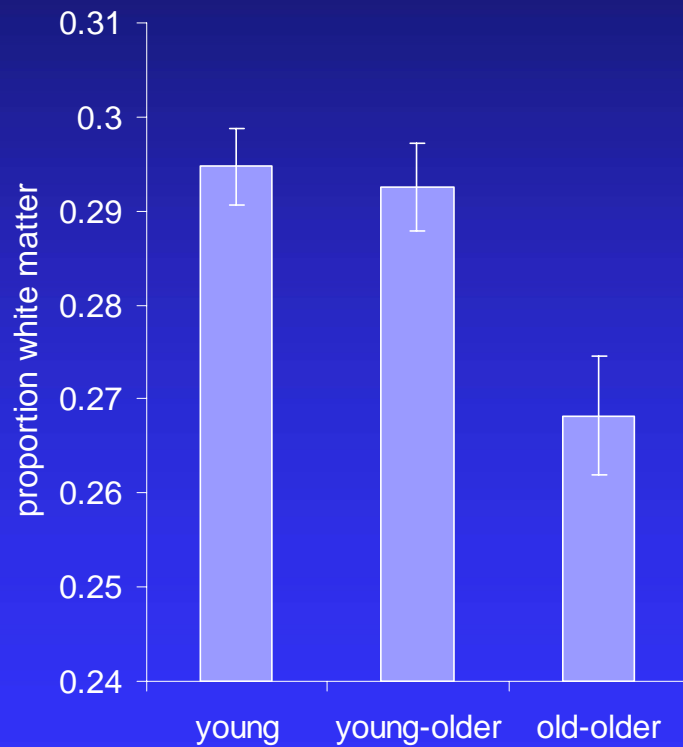


■ Interactions between regions?

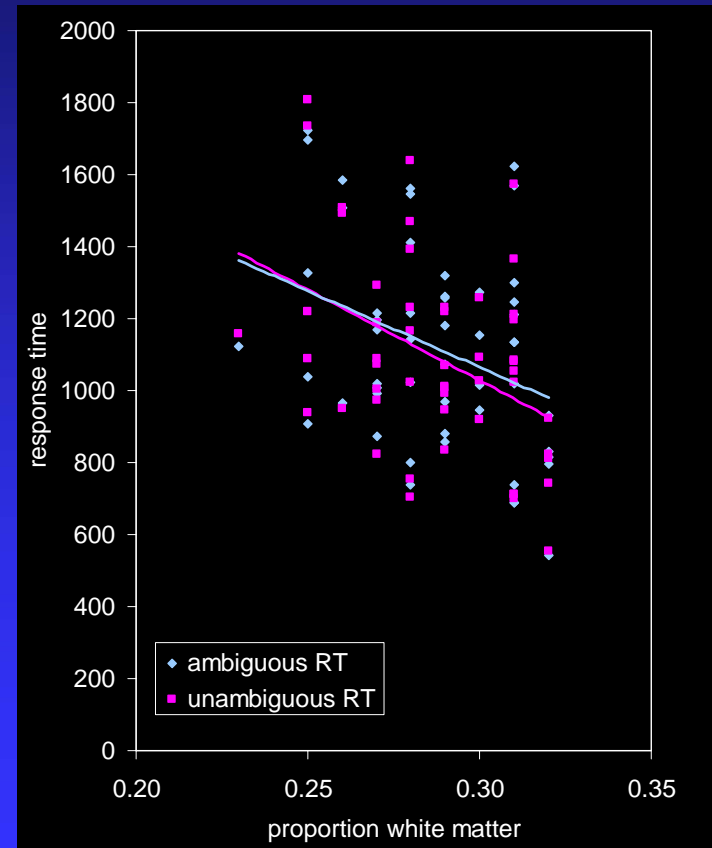


- IFG-MTG correlations – functional network
- No IFG-MTG correlation for old-older




Importance of connections?



White matter proportion

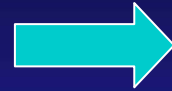


Summary

- Preserved performance may be underpinned by neural flexibility  ■ Younger-older adults had different activity pattern during sentence comprehension
- Both grey and white matter may be relevant for performance  ■ E.g., response time correlates with white not grey matter volume
- Future issues for understanding the nonlinear effects  ■ Grey matter: Role of differential hemispheric atrophy
 - White matter: Role of specific connective integrity

Conclusions

Age-related atrophy impacts language processes



Not every aspect of language

Performance may be maintained by neural recruitment



Limited by process and neural deterioration

Acknowledgements

Lorraine Tyler

Emmanuel Stamatakis

Deborah Burke

Phyllis Tam



Word Retrieval



Visual processing



Semantic Retrieval

Cross & Burke, 2004



Lexical selection



Phonological retrieval



TOT onset:
Phonological Retrieval failure

James & Burke, 2000

“Colin Firth”



Word finding failures in old age

- Tip-of-the-tongue states (TOTs):
 - ◆ Temporary inability to produce a well-known word, accompanied by a strong feeling of knowing and, often, frustration
- TOTs increase in old age (*Burke et al 1991*)
 - ◆ Naturalistic diary study
 - ◆ Experimentally induced:
- What process has failed?
 - ◆ **Meaning** is retrieved
 - ◆ **Sound** retrieval has failed



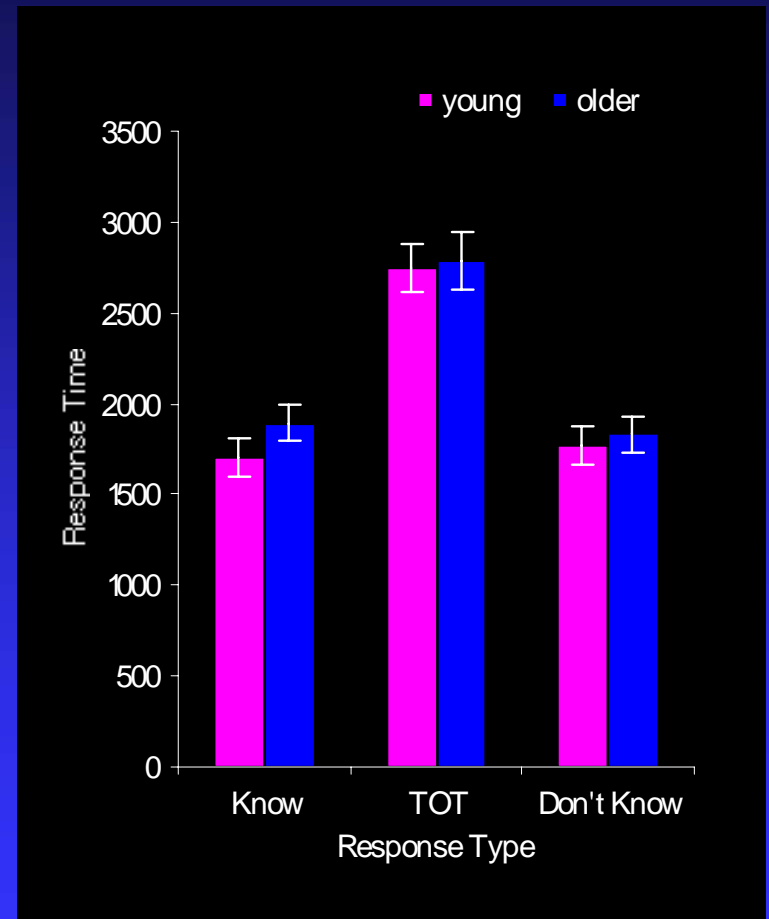
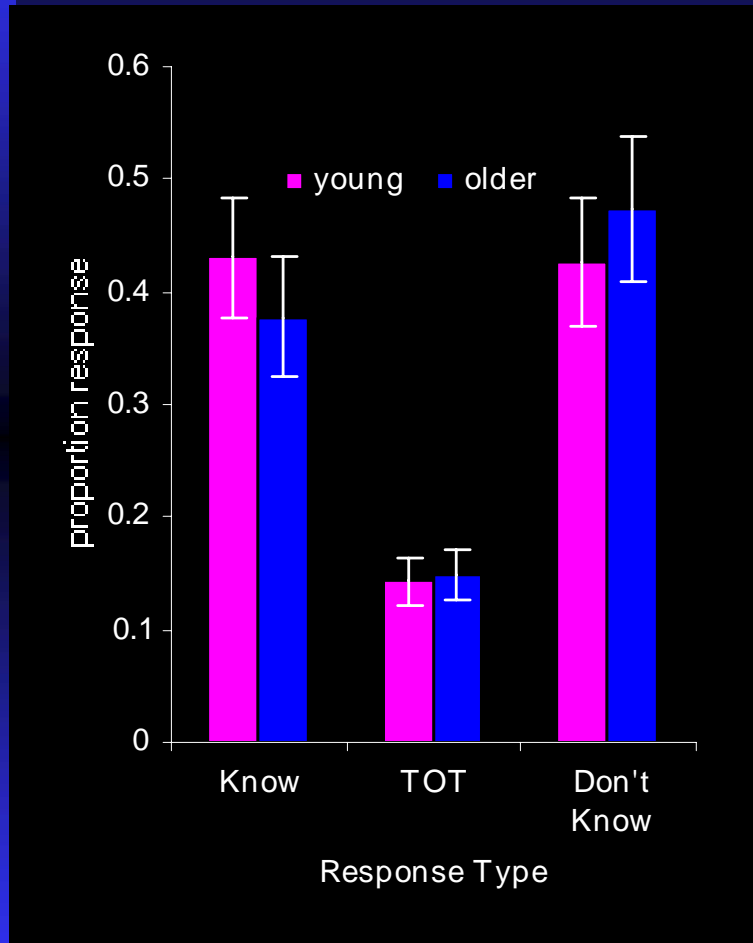
<p>What is a TOT?</p>	<ul style="list-style-type: none"> ·Temporary inability to produce a well-known word or name ·TOTs are resolvable – not permanent retrieval failures ·Increase in old age
<p>Importance of <i>phonology</i> (sound information)</p>	<ul style="list-style-type: none"> ■Sound (phonology) of name inaccessible while meaning (semantic) information about person available ■Sometimes partial sound information about word available (e.g., initial phoneme or number of syllables) ■Cueing with words that share some sounds can help resolve
<p>TOTs in old age</p>	<ul style="list-style-type: none"> ·Older adults have more TOTs - source of concern for older adults worried about their memory abilities ·Older adults have less partial information ·Older adults take longer to resolve ·...But older adults benefit as well as younger from cueing

Relating structure and function

If age-related increases in TOTs are due to atrophy in regions important for phonological retrieval:

- All participants: TOT-specific activity in phonological retrieval regions
- Older adults: Differential TOT-specific activity
- Relation of TOT-specific activity to grey matter

Behavioural results

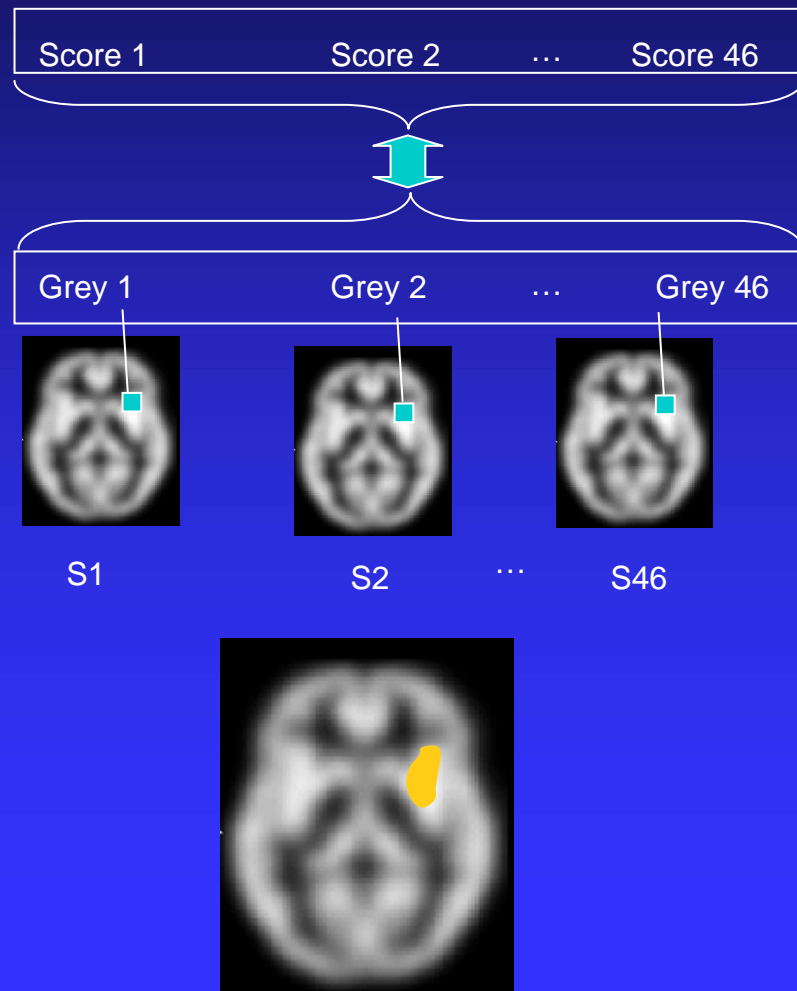


VBM analyses: overview

- Segmented, smoothed **grey matter** probability images used in analyses

- Each analysis: correlates grey matter probability with behavioural scores **voxel-by-voxel** across subjects

- Output gives voxels with **significant correlations** of grey matter probability and variable of interest





Imaging Results: Know-Don't Know & TOT-Know

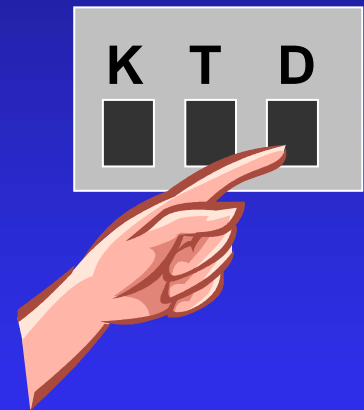
Relating structure and function

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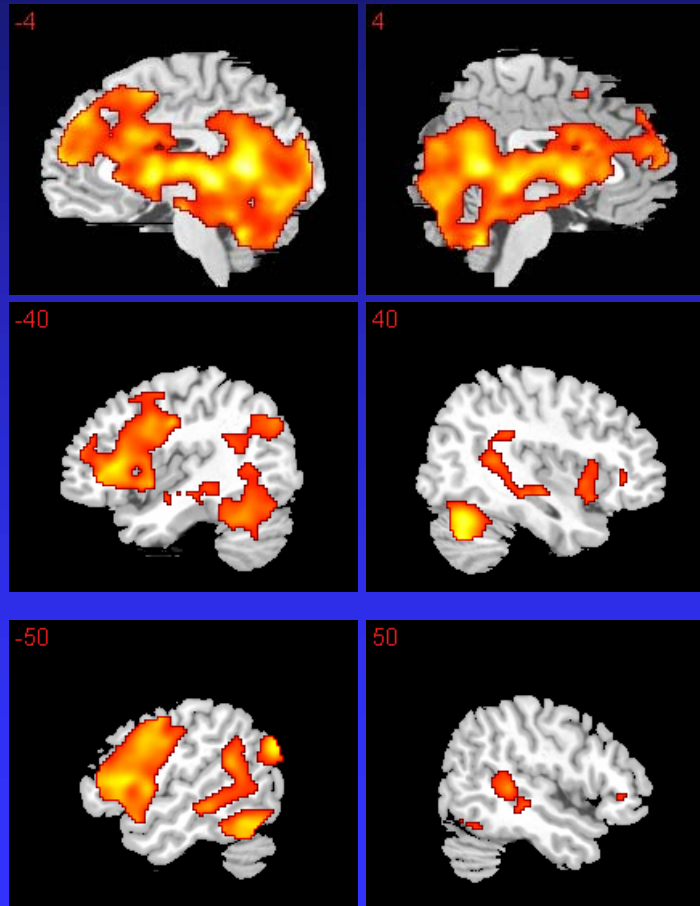
- All participants: TOT-specific activity in phonological retrieval regions
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- Relation of TOT-specific activity to grey matter

fMRI TOT

- 200 Famous faces, pre-tested for TOT susceptibility



Know – Don't Know



- Reason why ym may recruit whole right hemi network
 - ◆ Rh declines less quickly than LH

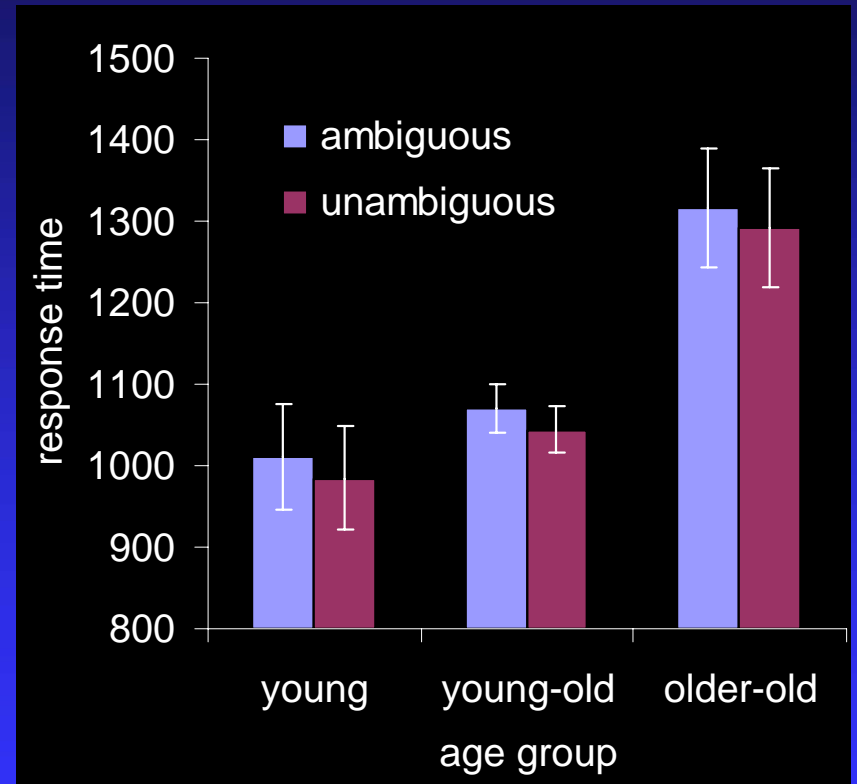
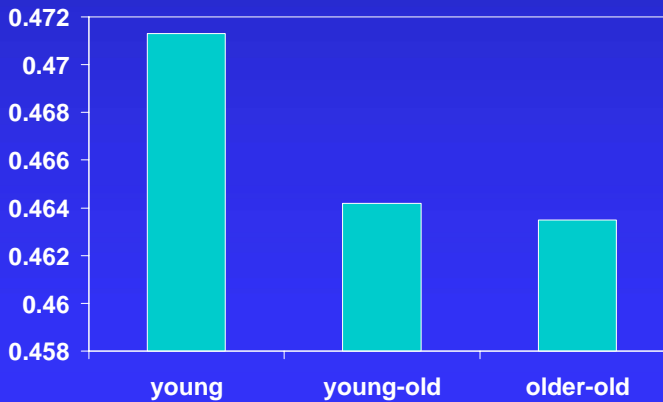
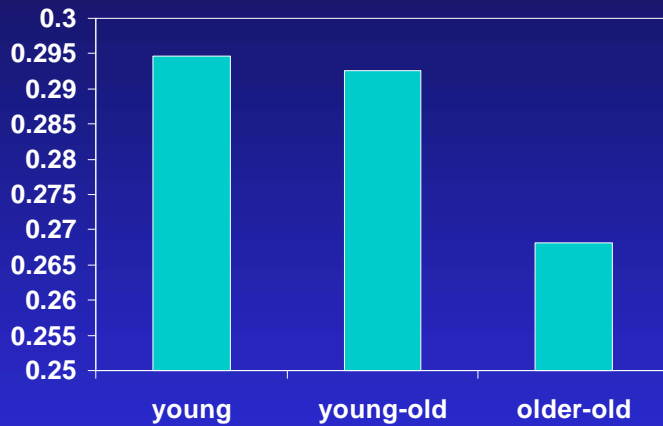
Report			
age_3split		LIFG_GM	RIFG_GM
youngest21	Mean	.476881	.501086
	N	21	21
	Std. Deviation	.0156138	.0156408
YM	Mean	.438700	.468769
	N	16	16
	Std. Deviation	.0214932	.0295630
OM	Mean	.427700	.455160
	N	15	15
	Std. Deviation	.0291242	.0403261
Total	Mean	.450946	.477894
	N	52	52
	Std. Deviation	.0307776	.0346265

Report

gm_prop

age_3split	Mean	N	Std. Deviation
discarded	.4713	5	.01637
youngest21	.4713	21	.01916
YM	.4642	16	.02770
OM	.4635	15	.05057
Total	.4673	57	.03177

Importance of connections?

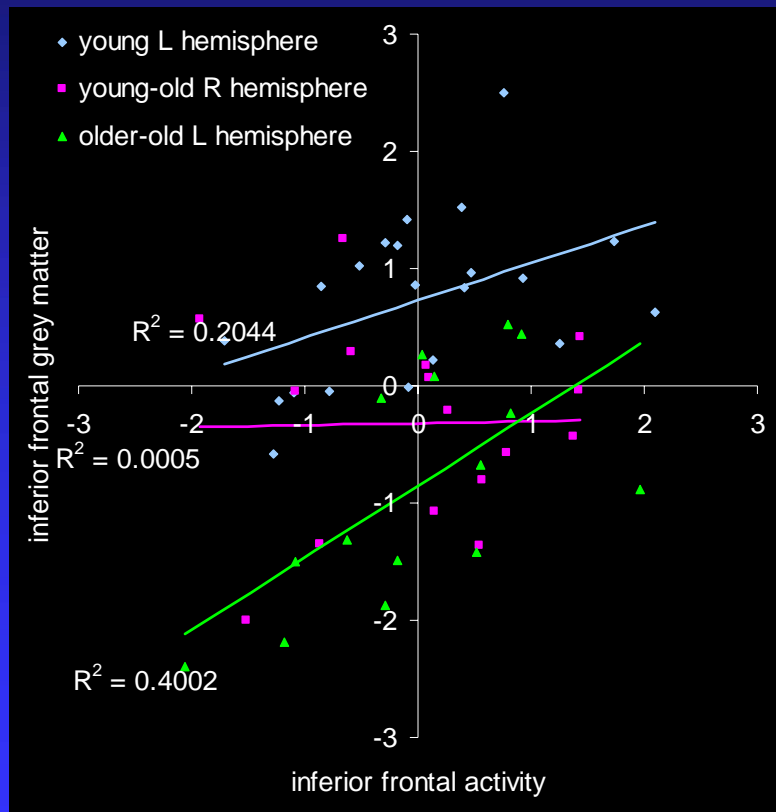


Relating structure and function

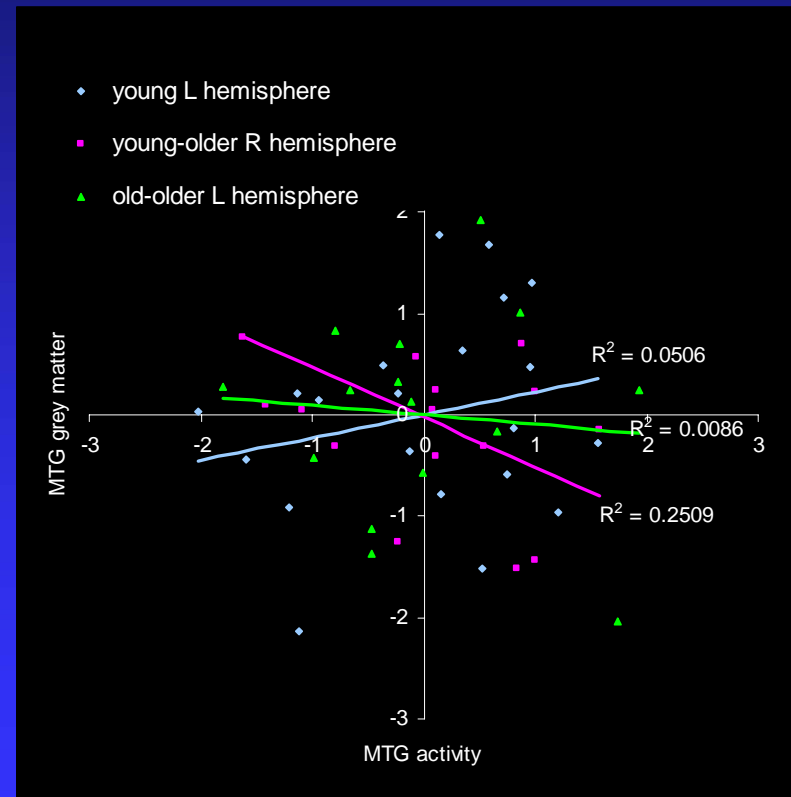
- Age-related neural atrophy should affect neural activity during TOTs
- Contrasts of interest:
 - ◆ Know-Don't Know
 - ◆ TOT-Know
- Region of interest;
 - ◆ L insula region of interest

Grey matter and activity

Inferior frontal



Middle temporal



Correlations: IFG-MTG

- Strong correlations between 2 regions for young and young-old
- Weaker, non-significant effect for older-old

