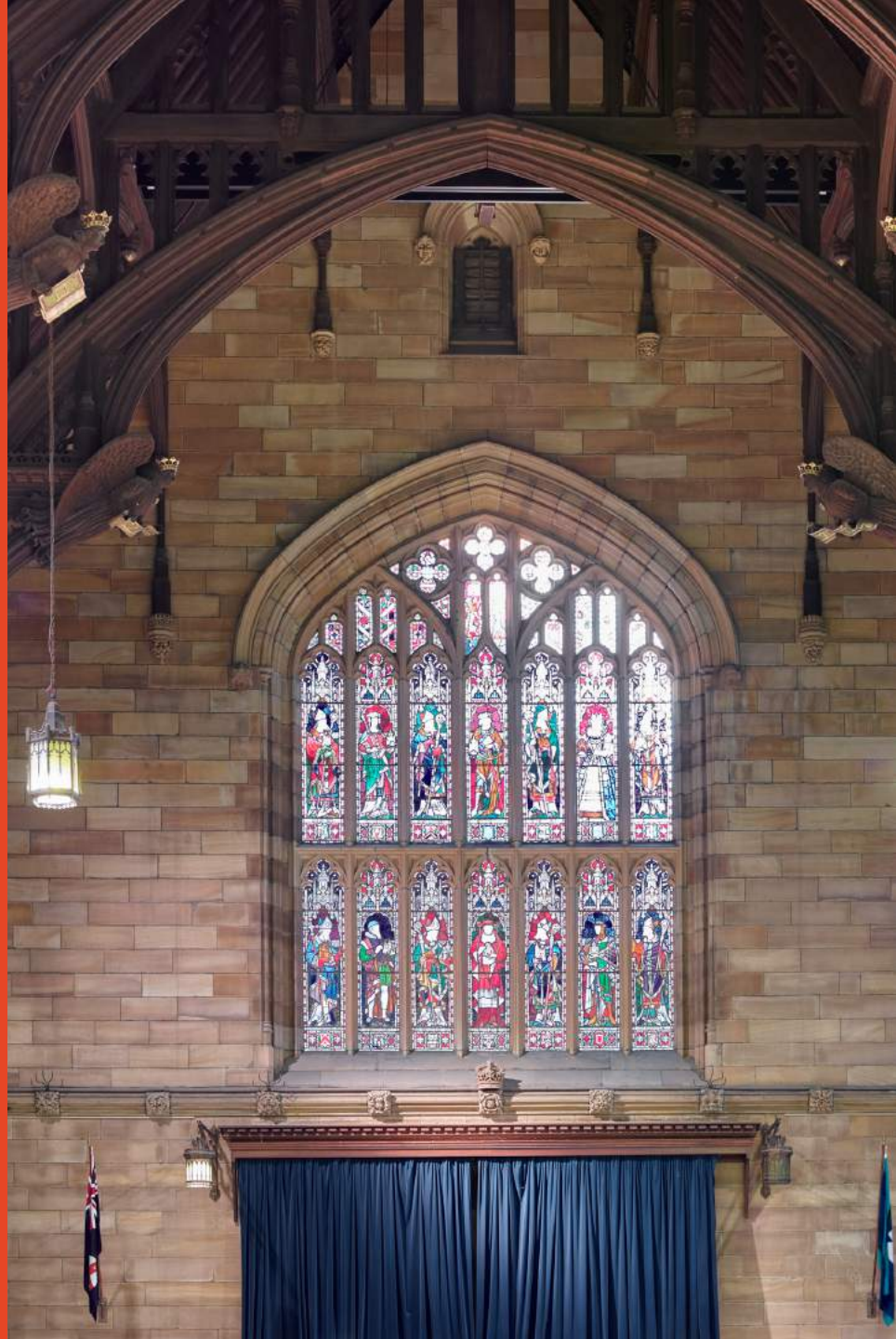
Visuospatial short-term and working memory in primary progressive aphasia

Presented by
David Foxe
School of Psychology

Supervisors
Professor Olivier Piguet
Associate Professor Muireann Irish

THE UNIVERSITY OF SYDNEY



Primary progressive aphasia (PPA)

semantic variant

↓ naming (anomia)

↓ word comprehension

✓ fluent

TDP-43 pathology (frontotemporal dementia)

nonfluent variant

agrammatic, halting effortful speech

± articulatory errors, groping, distorted sounds

Tau pathology (frontotemporal dementia)

logopenic variant

↓ naming (anomia)

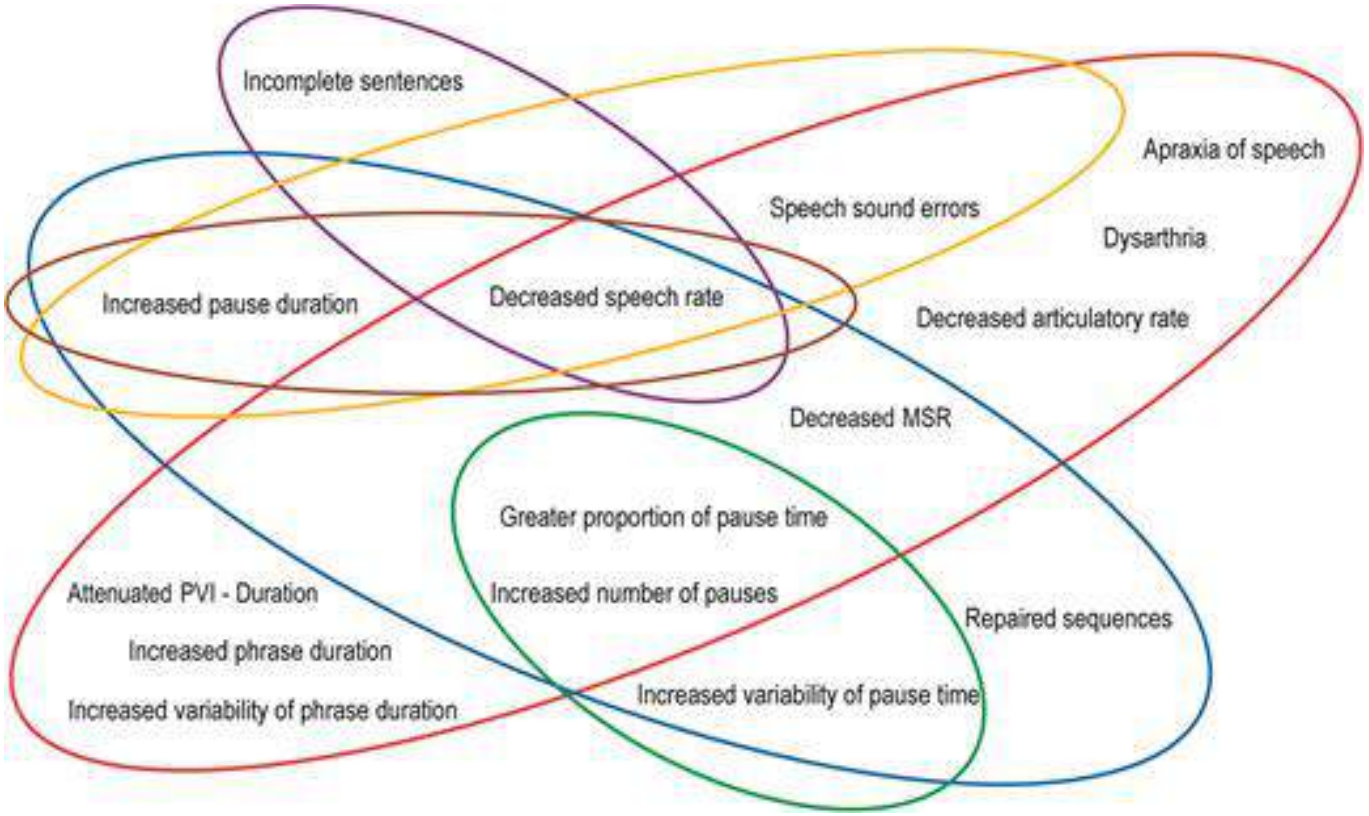
↓ phrase repetition

phonological errors

Amyloid pathology (Alzheimer's disease)

Image credit goinggentleintothatgoodnight.com[1]

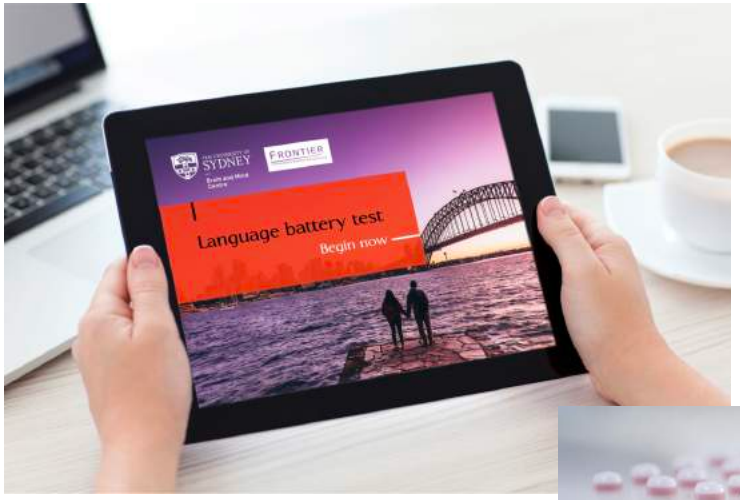
Problems diagnosing PPA



PPA - Semantic variant (purple), nonfluent variant (red), logopenic variant (blue)

Poole et al. (2017). J Speech Lang Hear Res.[2]

Ways to improve the accuracy of a PPA diagnosis



Savage et al. (2013). Dement Geriatr Cogn Disord[3]

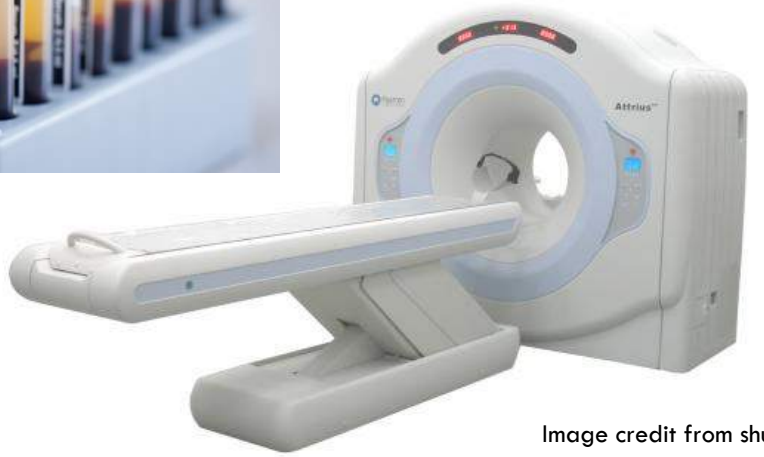


Image credit from shutterstock.com

Ways to improve the accuracy of a PPA diagnosis

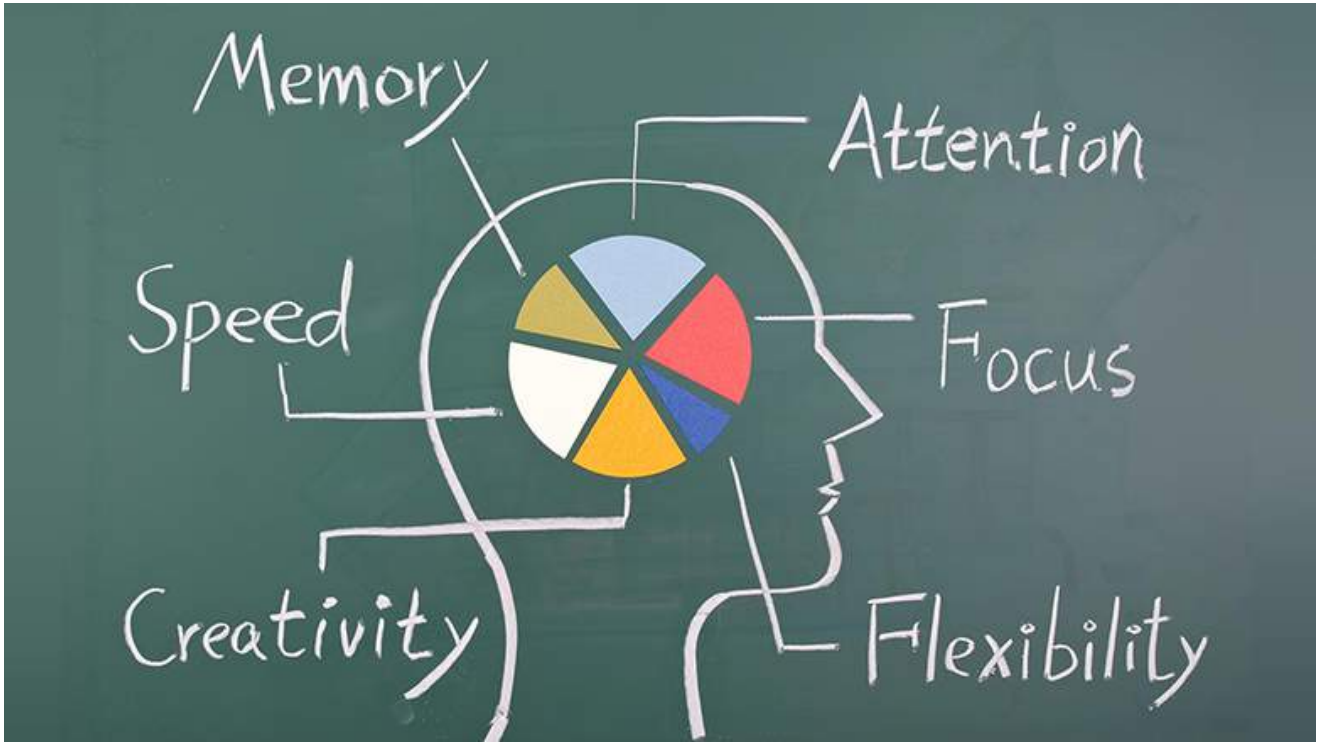
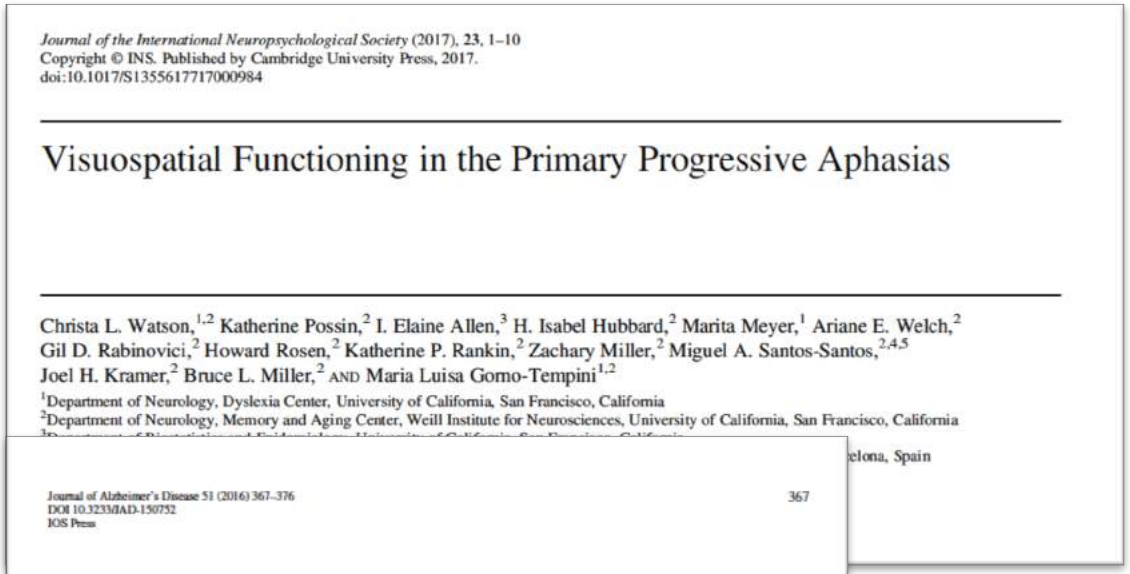


Image credit brainwellness-ny.com

Non-verbal cognitive profile of PPA



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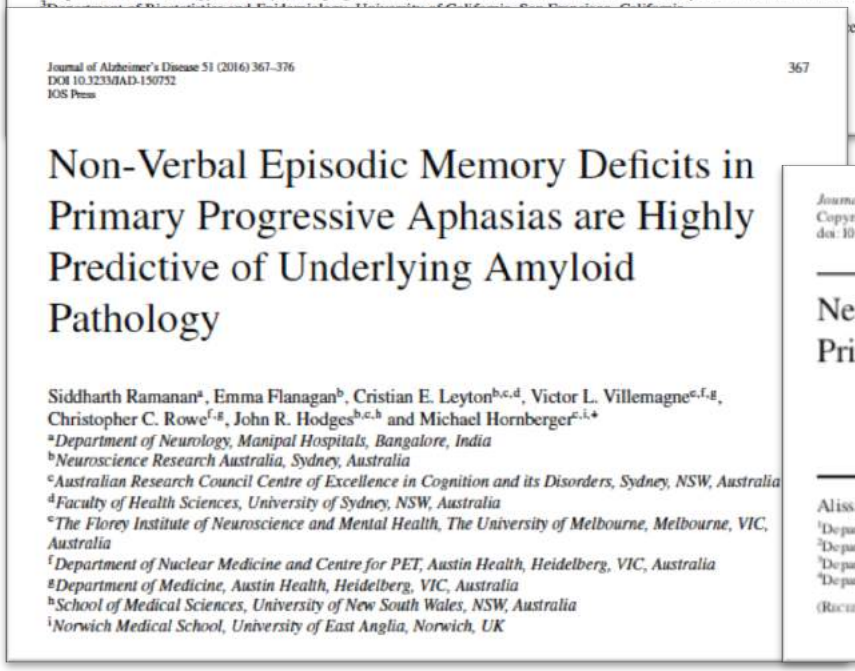
Visuospatial Functioning in the Primary Progressive Aphasias

Christa L. Watson,[1,2] Katherine Possin,[2] I. Elaine Allen,[3] H. Isabel Hubbard,[2] Marita Meyer,[1] Ariane E. Welch,[2] Gil D. Rabinovici,[2] Howard Rosen,[2] Katherine P. Rankin,[2] Zachary Miller,[2] Miguel A. Santos-Santos,[2,4,5] Joel H. Kramer,[2] Bruce L. Miller,[2] AND Maria Luisa Gorno-Tempini[1,2]

[1]Department of Neurology, Dyslexia Center, University of California, San Francisco, California
[2]Department of Neurology, Memory and Aging Center, Weill Institute for Neurosciences, University of California, San Francisco, California



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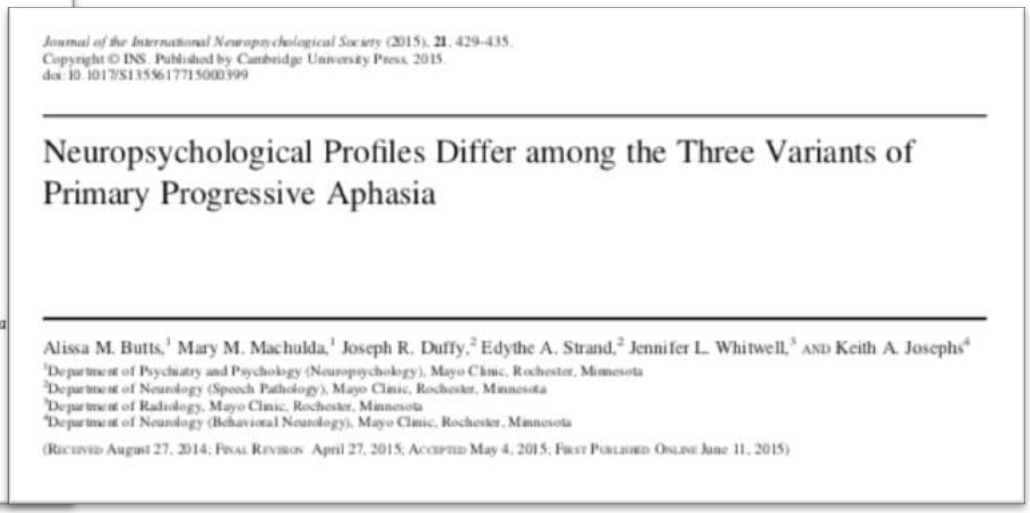
Non-Verbal Episodic Memory Deficits in Primary Progressive Aphasias are Highly Predictive of Underlying Amyloid Pathology

Siddharth Ramanan[a], Emma Flanagan[b], Cristian E. Leyton[b,c,d], Victor L. Villemagne[e,f,g], Christopher C. Rowe[f,g], John R. Hodges[b,c,h] and Michael Hornberger[c,i,*]
[a]*Department of Neurology, Manipal Hospitals, Bangalore, India*
[b]*Neuroscience Research Australia, Sydney, Australia*
[c]*Australian Research Council Centre of Excellence in Cognition and its Disorders, Sydney, NSW, Australia*
[d]*Faculty of Health Sciences, University of Sydney, NSW, Australia*
[e]*The Florey Institute of Neuroscience and Mental Health, The University of Melbourne, Melbourne, VIC, Australia*
[f]*Department of Nuclear Medicine and Centre for PET, Austin Health, Heidelberg, VIC, Australia*
[g]*Department of Medicine, Austin Health, Heidelberg, VIC, Australia*
[h]*School of Medical Sciences, University of New South Wales, NSW, Australia*
[i]*Norwich Medical School, University of East Anglia, Norwich, UK*



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Neuropsychological Profiles Differ among the Three Variants of Primary Progressive Aphasia

Alissa M. Butts,[1] Mary M. Machulda,[1] Joseph R. Duffy,[2] Edythe A. Strand,[2] Jennifer L. Whitwell,[3] AND Keith A. Josephs[4]
[1]Department of Psychiatry and Psychology (Neuropsychology), Mayo Clinic, Rochester, Minnesota
[2]Department of Neurology (Speech Pathology), Mayo Clinic, Rochester, Minnesota
[3]Department of Radiology, Mayo Clinic, Rochester, Minnesota
[4]Department of Neurology (Behavioral Neurology), Mayo Clinic, Rochester, Minnesota

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- Nonverbal tests distinguish PPA variants
- Possible neuroanatomical explanation: integrity of the parietal lobe
- Limited studies. No imaging studies

Non-verbal cognitive profile of PPA

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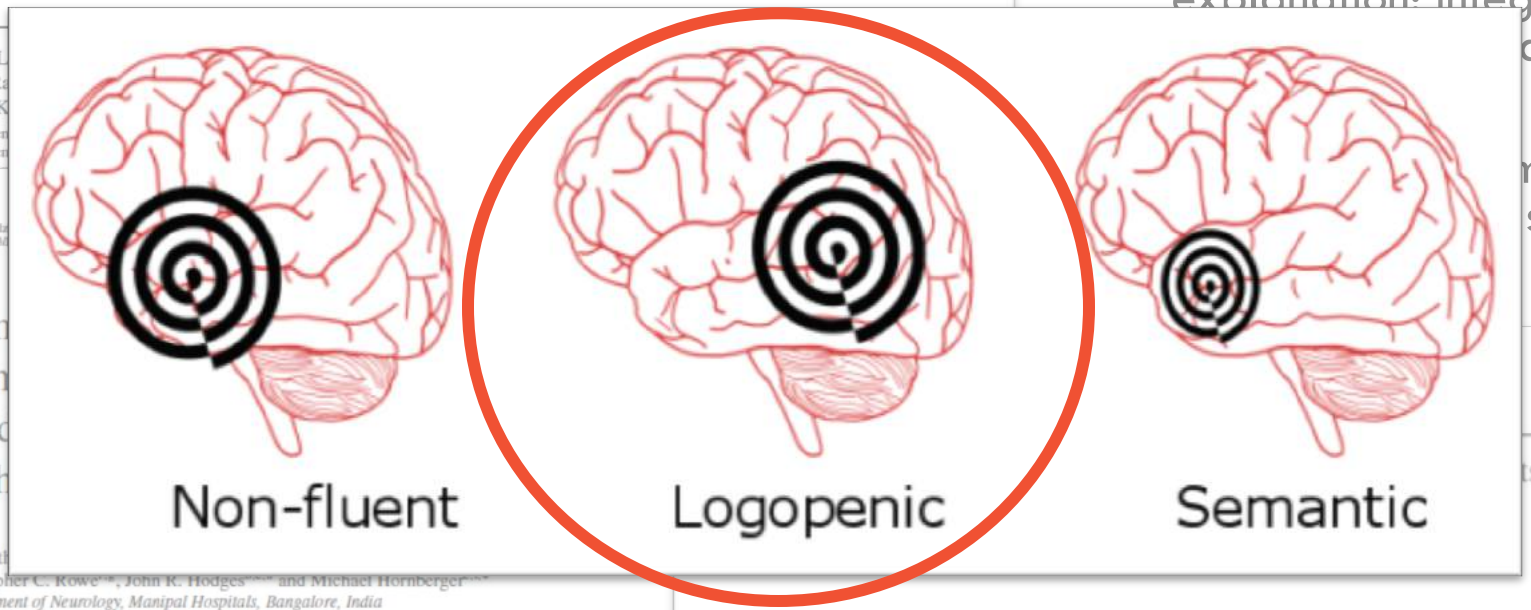

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Christopher C. Rowe[a,*], John R. Hodges[c,d,e] and Michael Hornberger[c,d,e]
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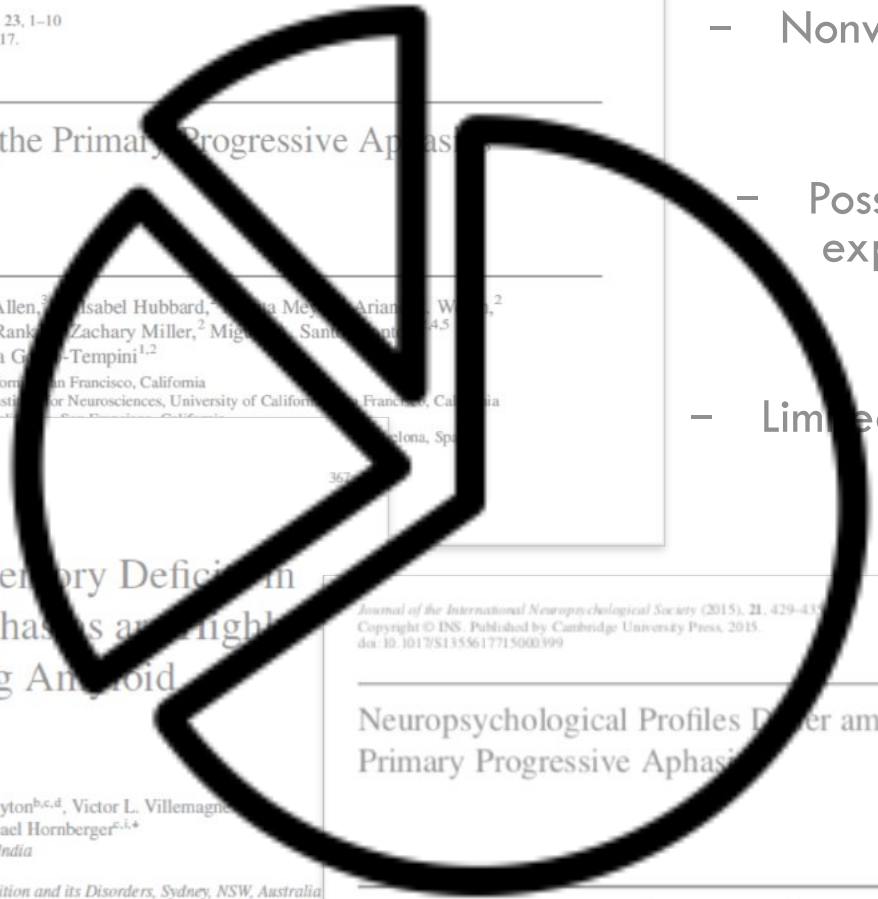
Non-verbal cognitive profile of PPA



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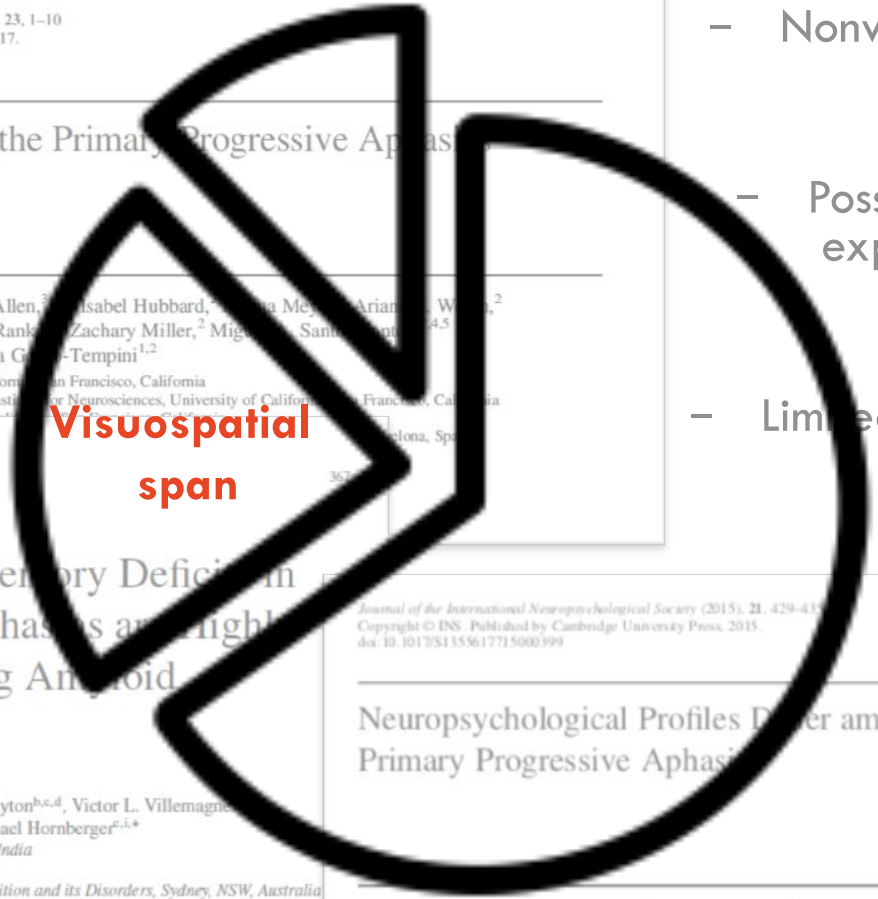
Non-verbal cognition

Non-verbal cognitive profile of PPA



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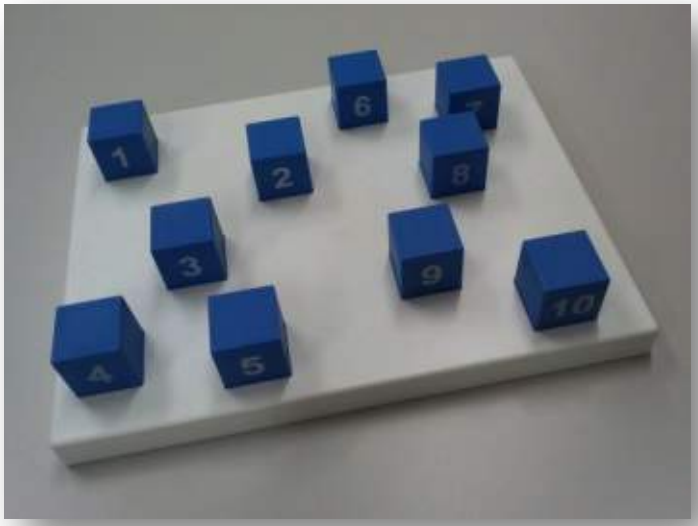
Visuospatial short-term and working memory

- Short-term memory – temporary memory trace over a few seconds
- Working memory – short-term memory + executive processes
- Short-term and working memory – foundational to learning, long-term memory and executive skills (Baddeley, 2012, Annu Rev Psychol)[4]

Spatial Span (visuospatial)



Digit Span (verbal)

1. 5 9 0
2. 4 8 6 1
3. 7 3 0 9 4
4. 2 4 9 6 5 8
5. 1 4 6 8 2 4 5
6. 3 9 2 1 5 7 6 0
7. 6 2 5 7 3 9 1 8 4
8. 0 6 3 8 9 4 1 7 2 5

Research aims

- Compare the visuospatial short-term and working memory profiles of the PPAs

- Explore the neural correlates (grey matter intensity) underlying performance differences

Methods

- Participants: 33 lv-PPA, 26 nfv-PPA, 31 sv-PPA, 58 typical Alzheimer's disease (AD) and 45 healthy controls

- Short-term and working memory tests: Spatial Span and Digit Span Forward and Backward tests from the WMS-III (Wechsler, 1997)[5]

- Core battery of neuropsychological tests

- 3T MRI brain scans

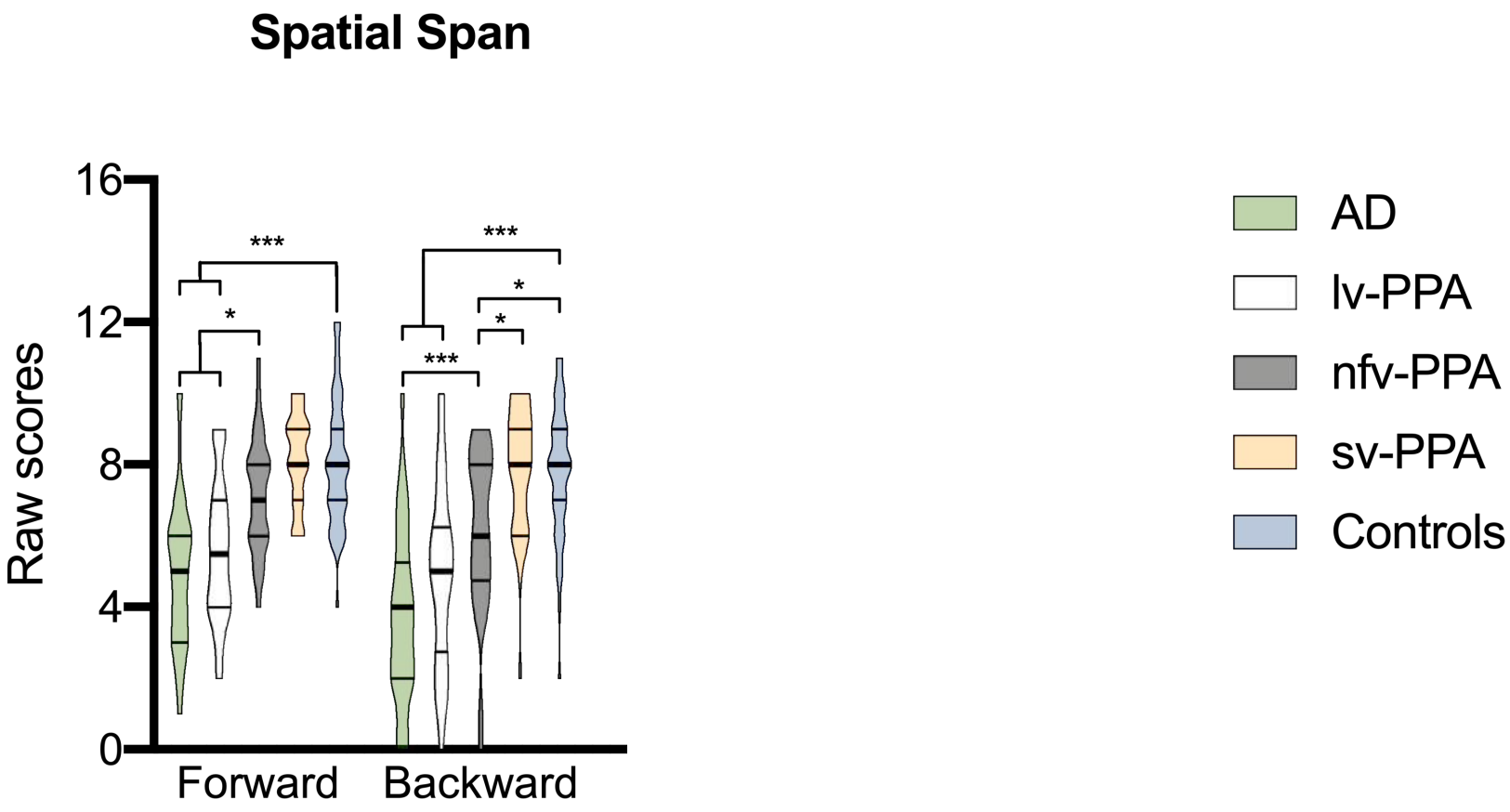
- Voxel-based morphometry (VBM) imaging analyses using SPM in Matlab

Demographics and disease severity

	AD	lv-PPA	nfv-PPA	sv-PPA	Controls	F	p	Post hoc test (Sidak corrected)
Sex (m : f)	35:23:00	14:19	13:13	23:08	24:21	7.59	.108	
Age (y)	64.9 (8.4)	65.5 (7.9)	66.4 (10.3)	63.8 (5.8)	67.5 (5.4)	1.28	.281	
Education (y)	12.8 (3.1)	12.3 (3.3)	13 (2.8)	12.7 (3.5)	13.9 (2.4)	1.66	.161	
Disease duration (y)	4.1 (2)	3.8 (2.3)	4 (0.5)	4.9 (0.3)	N/A	1.57	.200	
CDR-FTLD (24)	6.2 (2.7)	4.6 (2.5)	3.4 (1.9)	6.3 (3.9)	N/A	7.05	< .001	sv-PPA & AD > nfv-PPA lv-PPA = nfv-PPA
ACE-III Total (100)	64.8 (16.2)	58.3 (18)	79.1 (12.8)	64.1 (18.5)	94.6 (3.3)	41.36	< .001	Patients < Controls lv-PPA = sv-PPA = AD < nfv-PPA

- Clinical Dementia Scale for frontotemporal lobar degeneration (CDR-FTLD) = Measure of functional capacity
- Addenbrooke's Cognitive Examination-III (ACE-III) = General cognitive screen

Visuospatial and verbal span



	AD	lv-PPA	nfv-PPA	sv-PPA
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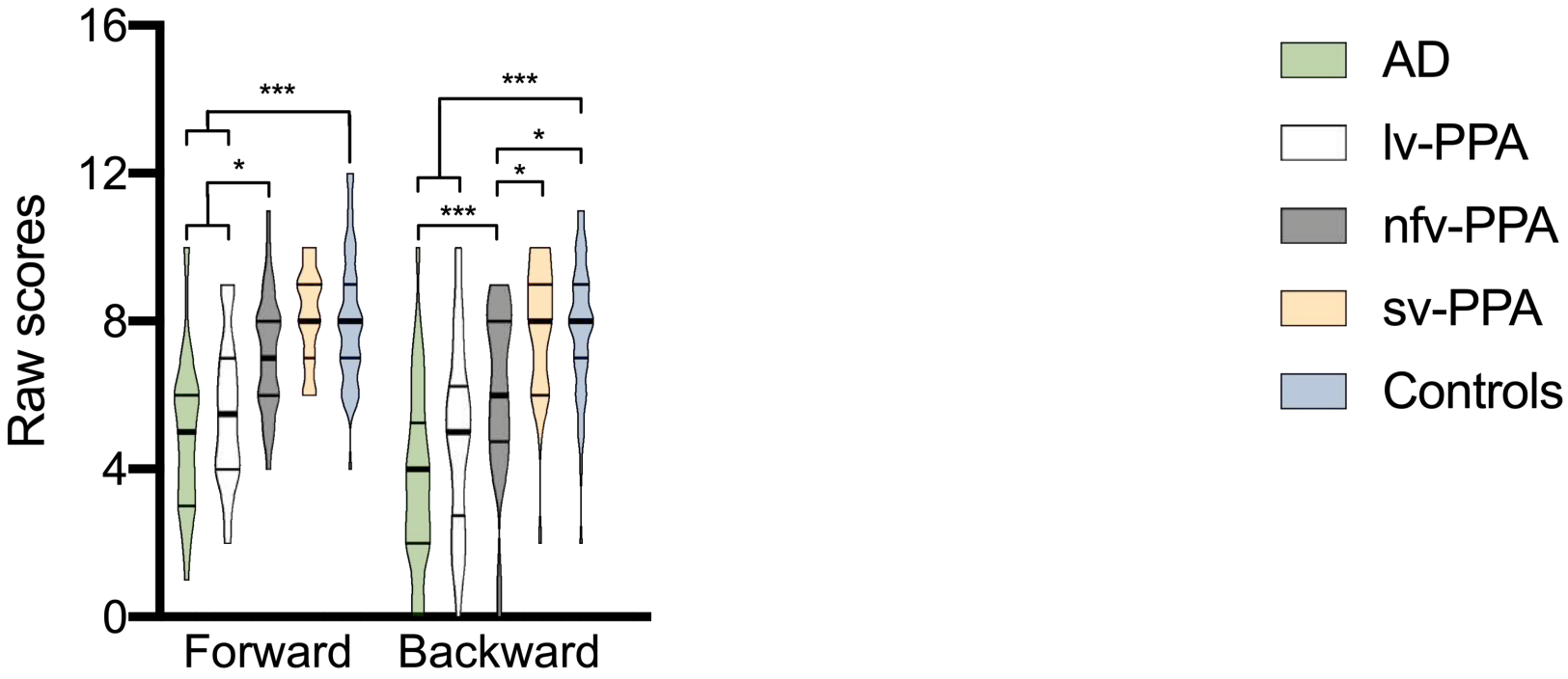
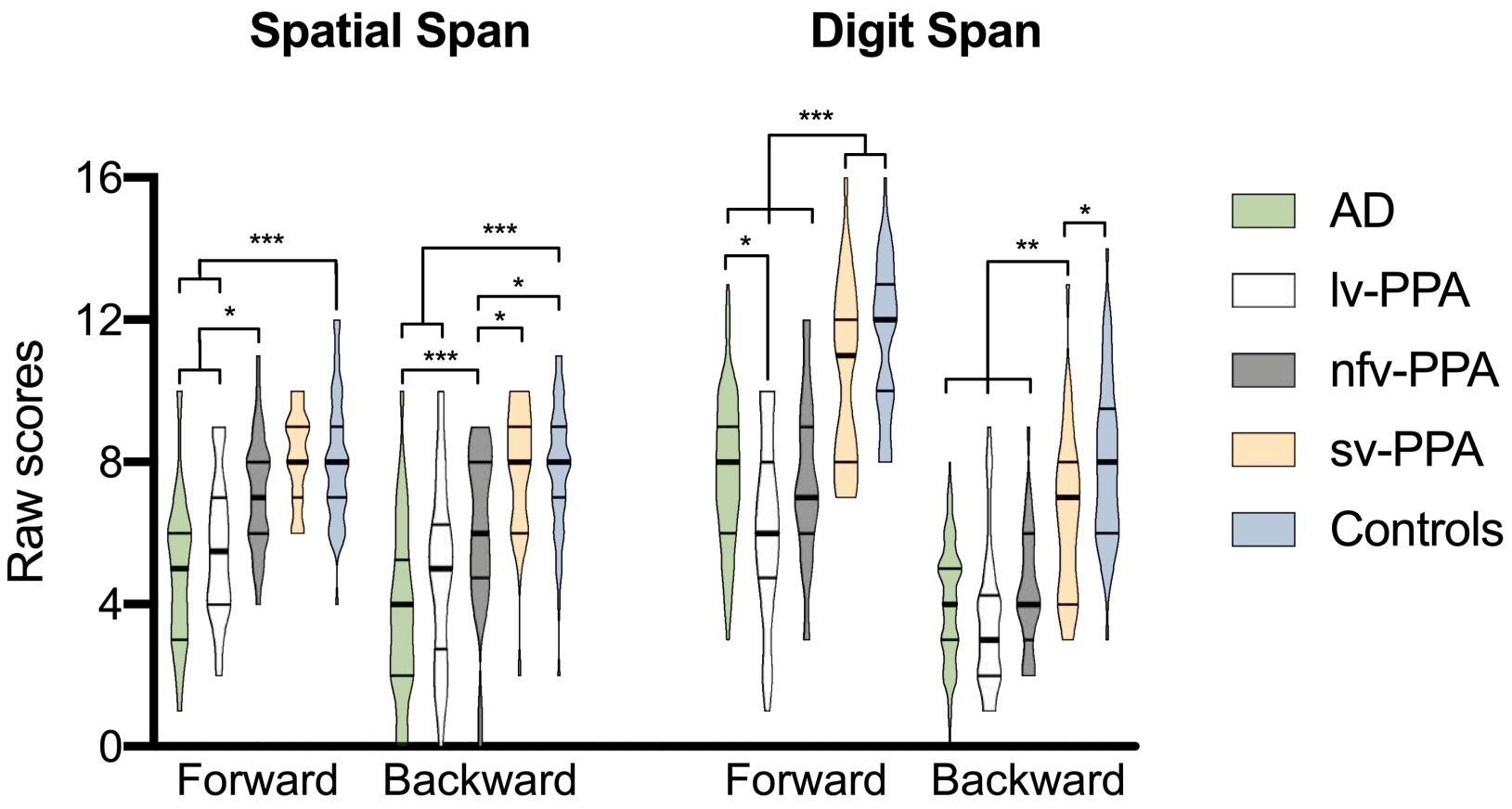
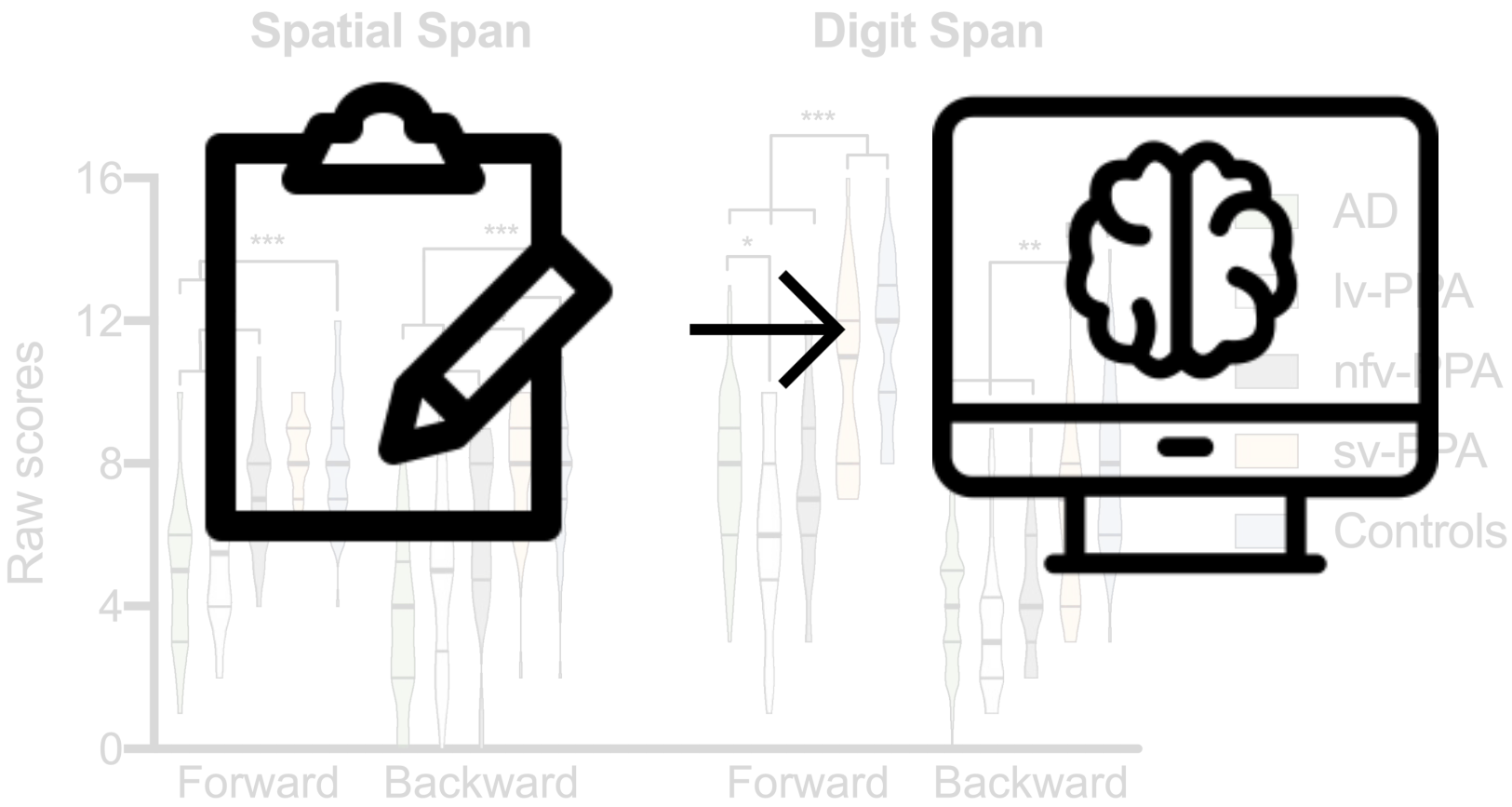
Spatial Span



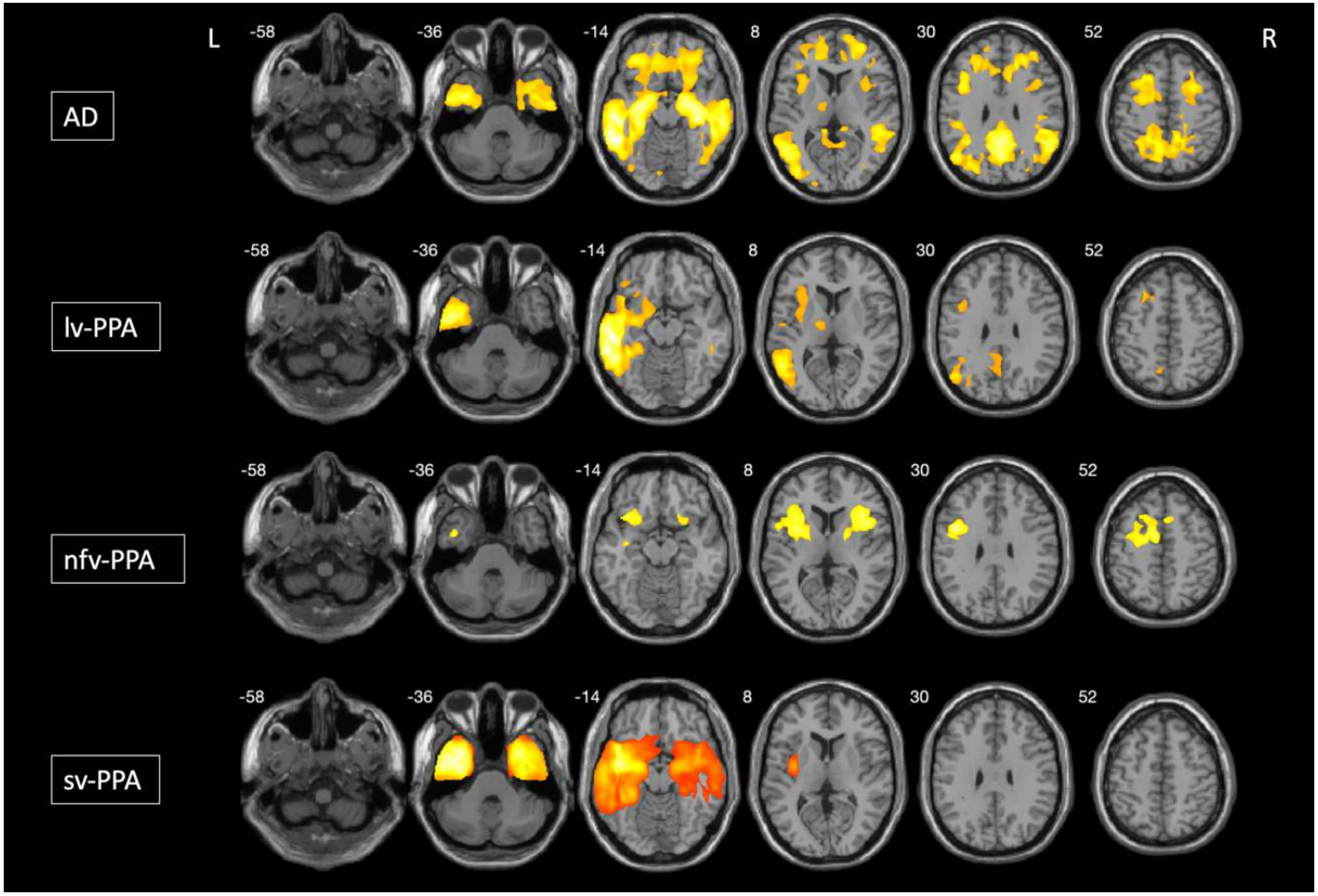
Visuospatial and verbal span



Visuospatial and verbal span

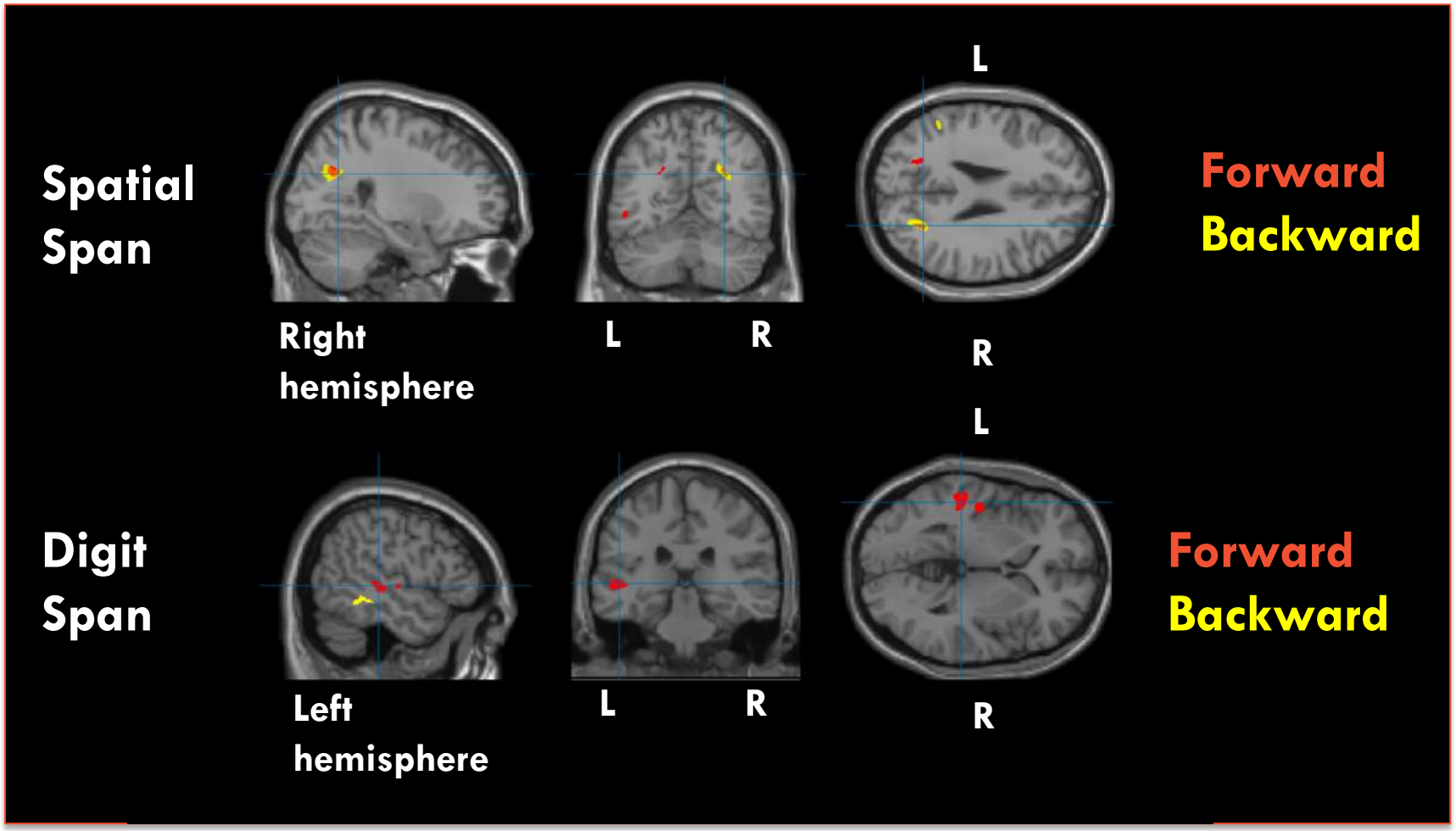


Brain atrophy – patients versus controls



Threshold FWE .01, 50 voxels

Neural correlates of Span performance and grey matter intensity: all patients combined



* Note crosshairs are aligned

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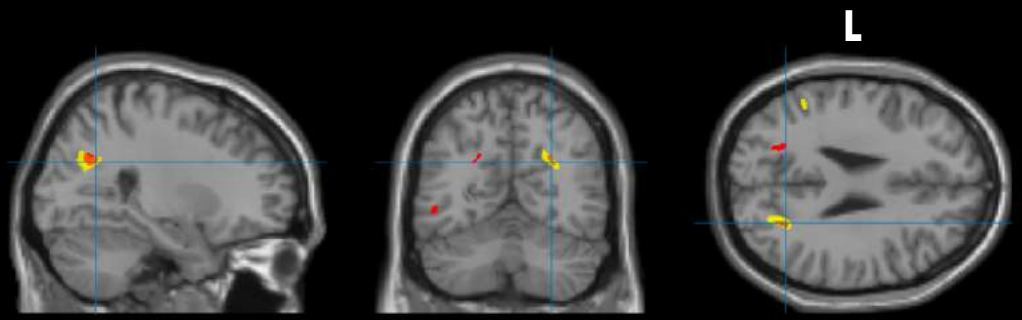
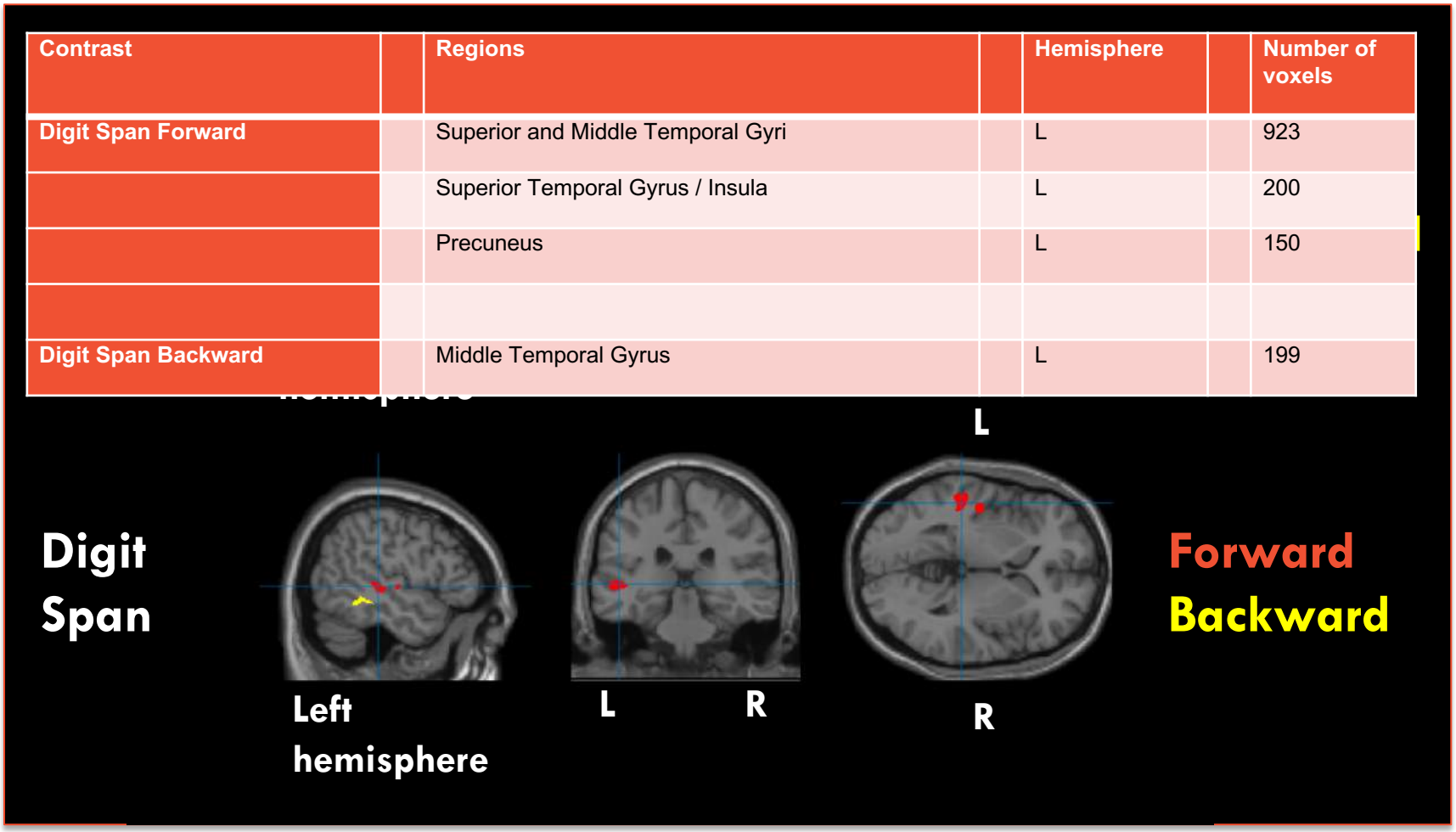


Forward
Backward

Contrast	Regions	Hemisphere	Number of voxels
Spatial Span Forward	Middle Occipital Gyrus	L	1130
	Precuneus	L	303
	Parietal and Superior Occipital Region	R	218
	Superior Temporal Gyrus	L	201
	Angular Gyrus	R	90
	Middle and Inferior Temporal Gyri	L	79
	Precuneus	R	72
Spatial Span Backward	Occipital Superior / Cuneus / Precuneus	R	1319
	Middle Occipital Gyrus	L	346
	Supramarginal Gyrus	L	111
	Inferior and Middle Temporal Gyri	L	97

Neural correlates of Span performance and grey matter intensity: all patients combined

Contrast	Regions	Hemisphere	Number of voxels
Digit Span Forward	Superior and Middle Temporal Gyri	L	923
	Superior Temporal Gyrus / Insula	L	200
	Precuneus	L	150
Digit Span Backward	Middle Temporal Gyrus	L	199



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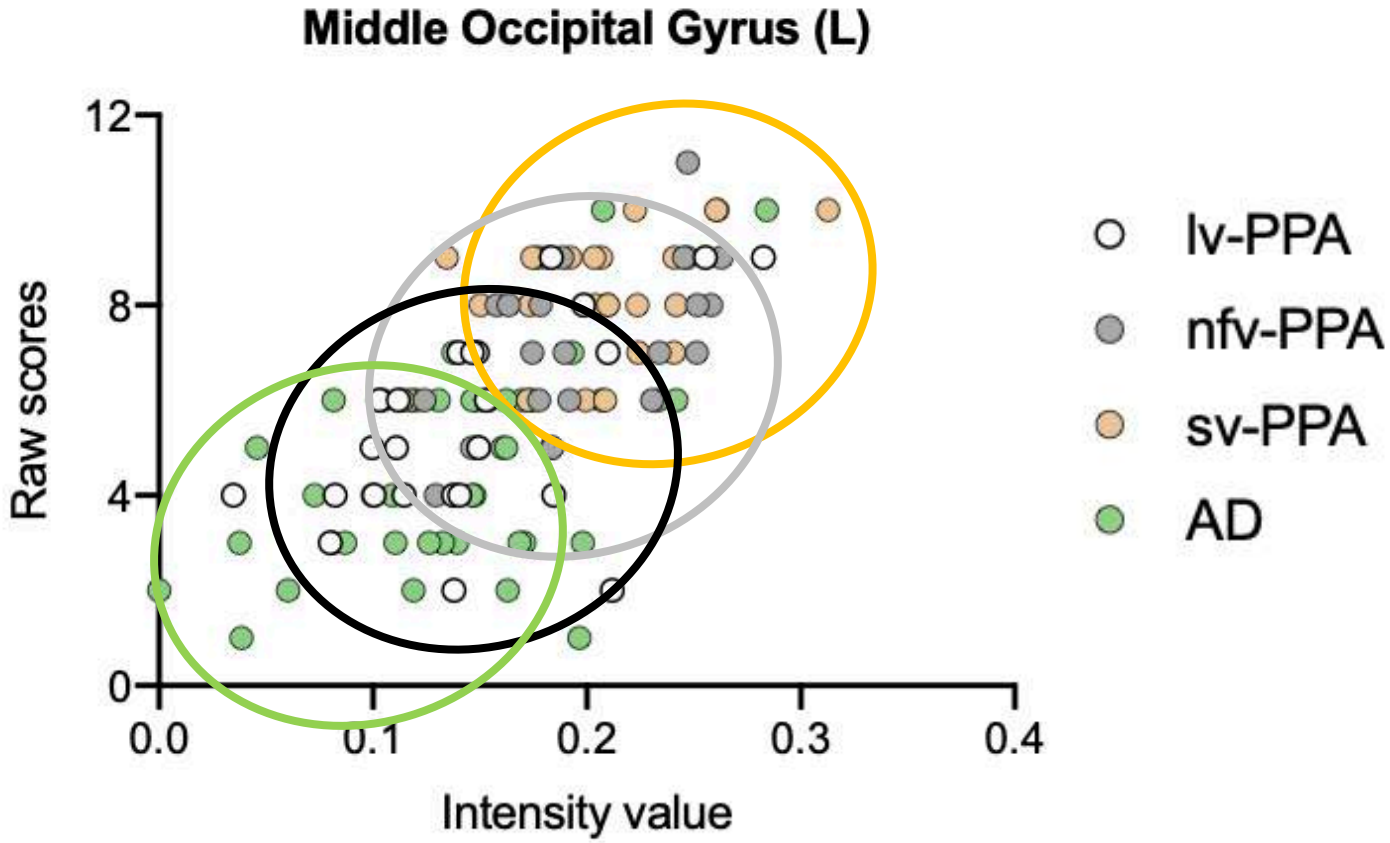
Threshold FWE .05, 50 voxels

Comparing patient groups on grey matter loss on clusters of interest

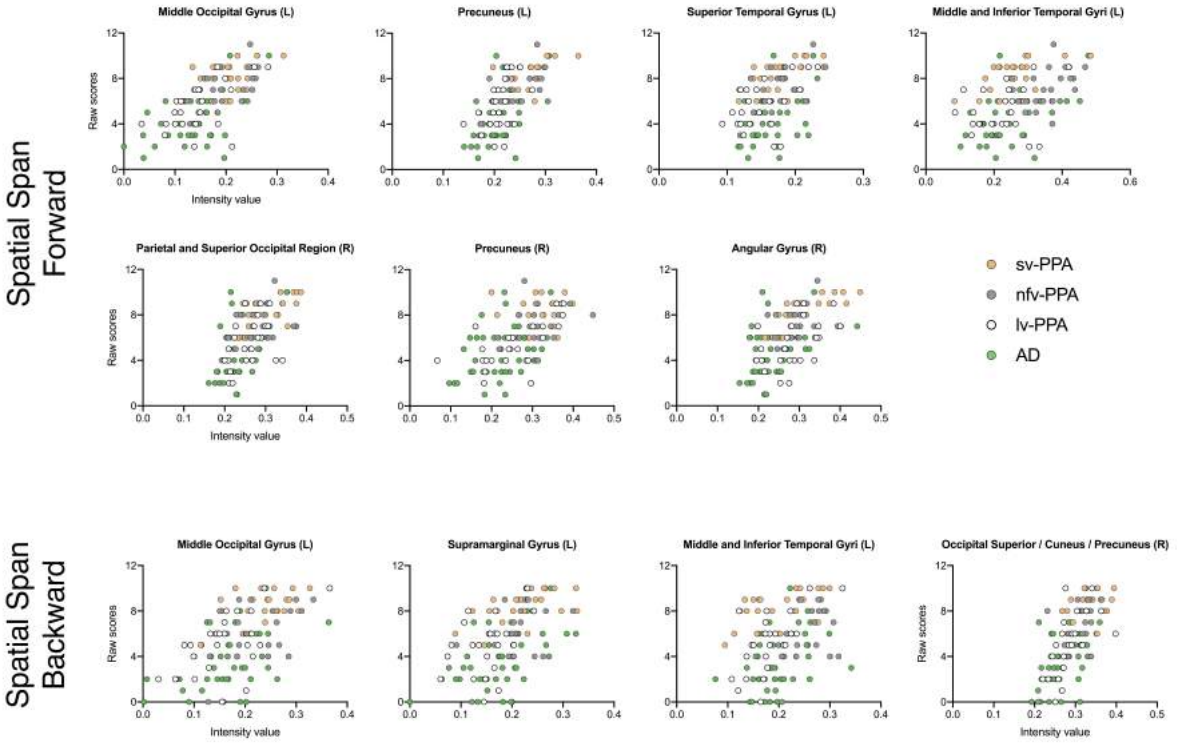
Spatial Span Forward (SSF)



Mean grey matter intensity of SSF cluster 1

Comparing patient groups on grey matter loss on clusters of interest

Spatial span clusters: AD < lv-PPA < nfv-PPA < sv-PPA



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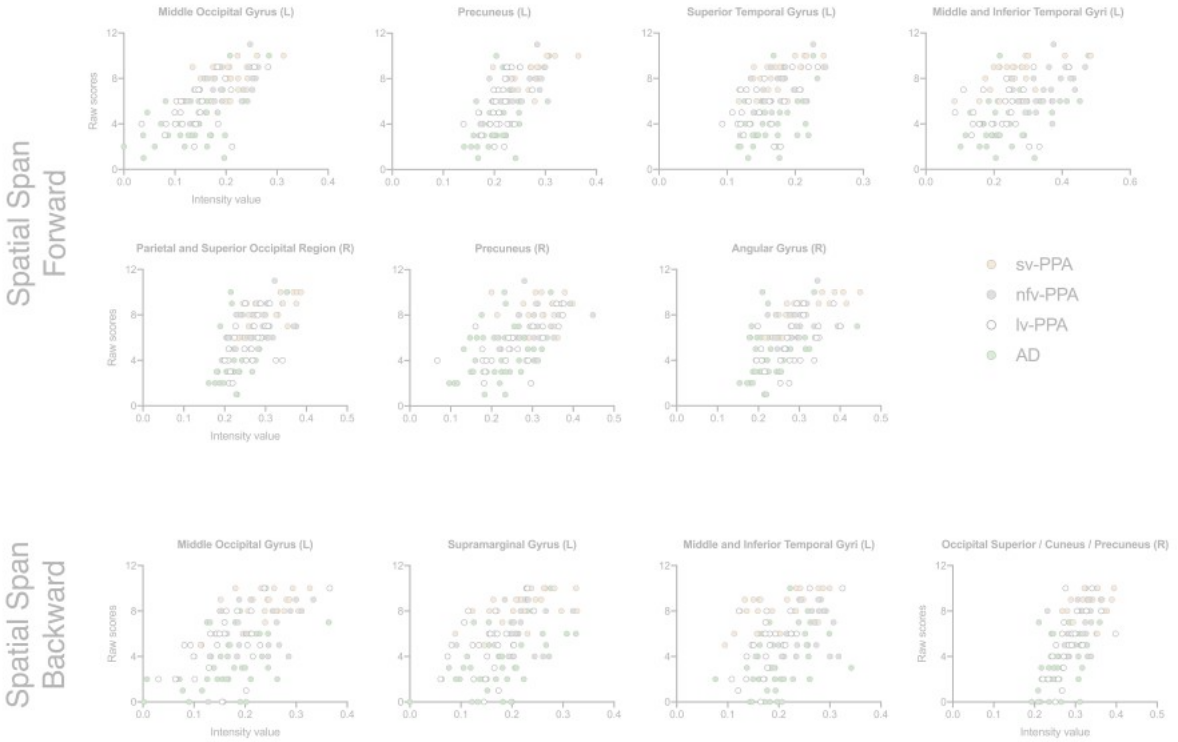
Spatial span clusters: AD < lv-PPA < nfv-PPA < sv-PPA



Digit span clusters: lv-PPA < AD < nfv-PPA < sv-PPA

Conclusion

Behavioural findings

- Spatial Span — lv-PPA < nfv-PPA and sv-PPA
- Spatial Span — performance is intact in sv-PPA

Imaging findings

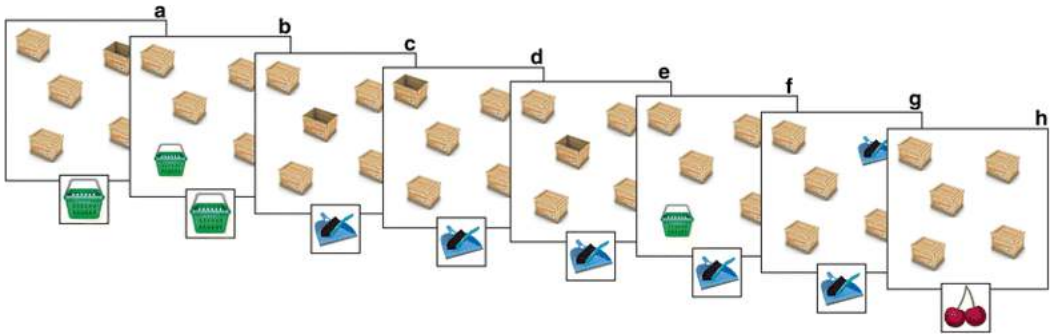
- Spatial Span performance x grey matter intensity in all patients combined — clusters in temporo-parieto-occipital brain regions in both hemispheres
- Comparing mean grey matter intensity in Spatial Span clusters of interest — AD & lv-PPA < nfv-PPA & sv-PPA

What's next

Behav Res
DOI 10.3758/s13428-017-0966-7

The Box Task: A tool to design experiments for assessing visuospatial working memory

Roy P. C. Kessels[1,2,3,4] · Albert Postma[5,6]



Thank you

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Professor Olivier Piguet

Associate Professor Muireann Irish

The Frontier Frontotemporal Dementia Research Group

The patients and carers for their generous contribution to this study

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