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# Functional connectivity in dementia with Lewy bodies: What can the resting state show about visual hallucinations in this disease?

**Luis R. Peraza[1], Marcus Kaiser[2], Michael Firbank[1,3], John O'Brien[1,3], John-Paul Taylor[1,3]**

1) Institute for Ageing and Health, Newcastle University, Campus for Ageing and Vitality, Newcastle upon Tyne, UK.
2) School of Computing Science, Newcastle University, Claremont Tower, Newcastle upon Tyne, UK.
3) Wolfson Research Centre, Campus for Ageing and Vitality, Newcastle upon Tyne, UK.

## 1) Introduction

Dementia with Lewy bodies (DLB) is a neurodegenerative disease characterised by intra-neuronal alpha-synuclein inclusions called Lewy bodies (LBs). Core symptoms of DLB include parkinsonism, fluctuating cognition, and visual hallucinations (VHs) with the latter two symptoms often demonstrating co-association.

One interactive model of VH is the perception and attention (PAD) model [1] which proposes that disturbances in the lateral frontal cortex-ventral visual stream (i.e. temporal cortex as shown in Fig. 1) and decreased visual perception are conditions for the manifestation of VHs. In DLB, LB pathology in the ventral visual stream has been associated with VH in DLB [2] and visuo-perceptual dysfunction has been associated with abnormalities in dorsal visual stream [3].

In the present study we use resting state networks (RSNs) to provide a new perspective on the dynamic interaction of these visual streams in DLB patients.

## 2) Methods

In this preliminary study 16 patients diagnosed with DLB and 12 healthy controls (HC) matched for age and years of education, had resting state fMRI acquired. To infer RSNs from both groups, concatenated Melodic implemented in FSL was run. 22 ICs were identified as RSNs such as the DMN (I and II), lateral/medial visual networks (VNs), and left/right dorsal visual stream networks (DVSNs) [4].
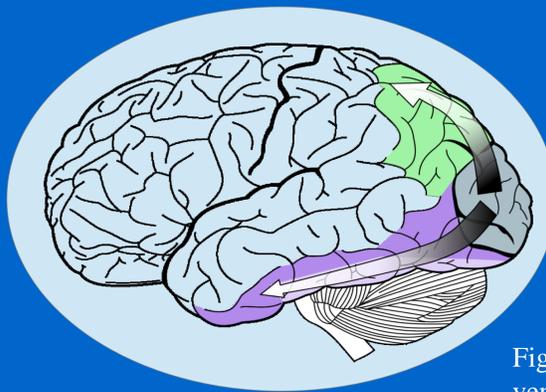
These RSNs were chosen for a second processing step of dual regression (DR) [5] which performs a spatial GLM between the RSN maps and the brain volume. Corrections for age, sex and grey matter atrophies were also applied as covariates in the design matrix.



Fig. 1. The PAD model proposes a dysfunction in the ventral (temporal) stream and decreased visual perception as conditions for the onset of VHs.

## 3) Results

DR identified two significant RSNs (FWE corrected, pvalue<0.05) which showed significant decrease in functional connectivity (FC) in DLB patients compared with HCs (DLB < HC). These were the medial VN and the left DVSN, which are shown in green at the top and bottom of Fig. 2 respectively. The medial VN showed decreased FC with the medial temporal gyrus while the left DVSN showed decreased FC with the lingual gyrus and calcarine cortices. Correlation analysis with clinical measures found significant correlations (nonparametric permutation test) between the lingual gyrus and the Neuropsychiatric Inventory (NPI) hallucinations subscale and the Clinical Assessment of Fluctuations (CAF) total scores. Results are shown in Fig. 3.
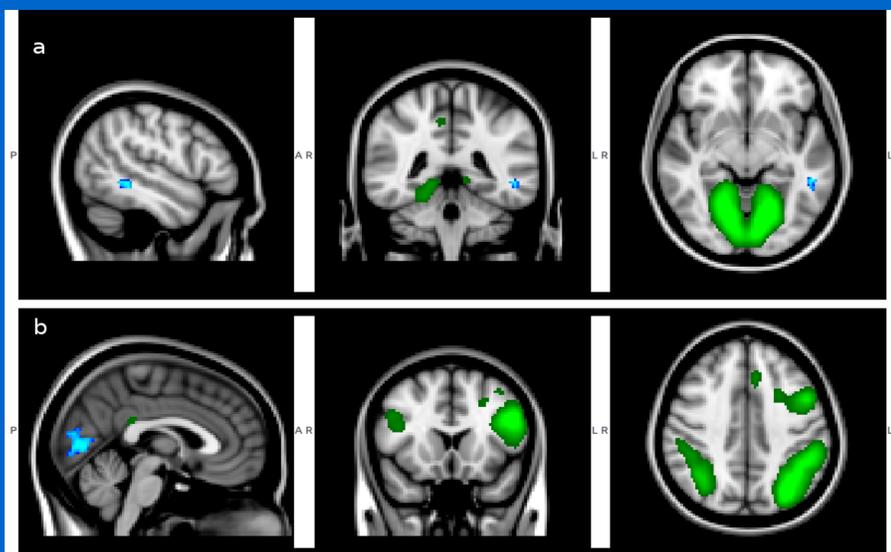


Fig. 2. Medial VN (top) and left DVSN (bottom) shown in green. DR found decreased (DLB < HC) FC in the medial temporal gyrus for the medial VN. For the left DVSN decreased FC was found in the lingual gyrus.



Fig. 3. Correlation analysis between the lingual gyrus cluster from the left DVSN and the NPI hallucinations and CAF total scores showed to be significant. Figure shows normalized image Z-scores vs. clinical measures.
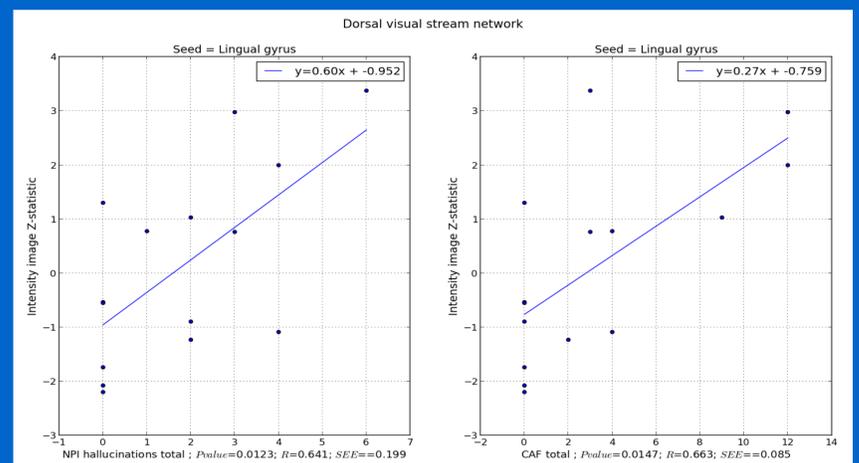
## 4) Discussion

Our results concur with prior evidences showing that LB related neuropathological change in the ventral visual stream is associated with VHs.

In addition we also found disruption of the dorsal visual stream which may suggest that both disruption of the ventral and dorsal visual stream may be necessary for the manifestation of VHs.

The further finding of lower FC between dorsal stream areas and the visual cortex (lingual gyrus) not only for VHs but also with fluctuations in cognition and attention (assessed by the CAF score) in DLB, highlights the potential importance of parietal cortex in the aetiology of this symptom as well as VH in DLB.

## 5) Conclusion

In DLB, VHs are particularly common and often can be highly distressing to the patient although their aetiology is poorly understood. Our results suggest that dysfunction in both the ventral and dorsal visual streams may be required for the manifestation of VH in DLB.

Further work needs to be carried out to explore precisely how dysfunction in these networks dynamically interact to give rise to VH and understand the co-associated role of fluctuations in cognition and attention.

### References

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