A brief period of postnatal visual deprivation permanently alters visual motion processing in early visual regions

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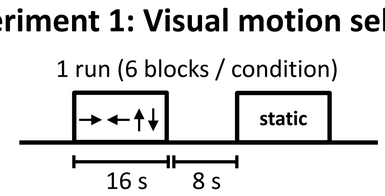
Introduction

- Is visual input early in life necessary for the normal development of the visual system [1]?
- We know that a brief and transient postnatal period of visual deprivation triggers permanent deficits in visual motion processing [2,3,4].
- We used fMRI to study the alteration of the visual motion network in adults with a history of early visual deprivation due to congenital bilateral cataracts.

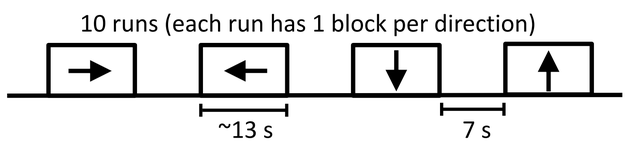
Methods

Participants:
- cataract-reversal patients (n=15; period of visual deprivation ± SD= 71± 48 days)
- Age-matched visually normal controls (n=17)

Experiment 1: Visual motion selectivity



Experiment 2: Motion-direction decoding



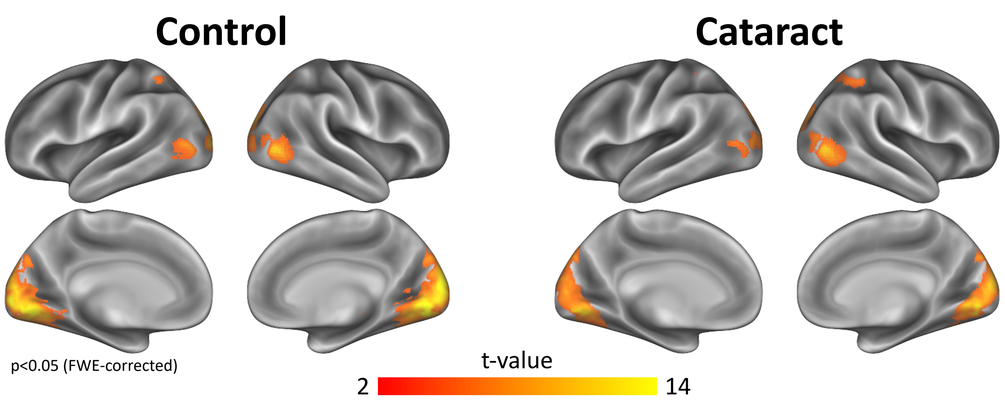
Experiment 3: Resting-state [Independent experiment: 1 run of 9 minutes]

Participants:
- Subsample of 11 cataract-reversal patients (period of visual deprivation ± SD= 138 ± 50 days)
- Age-matched visually normal controls (n=15)

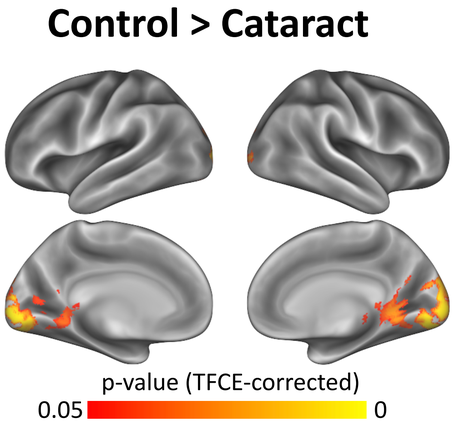
Results

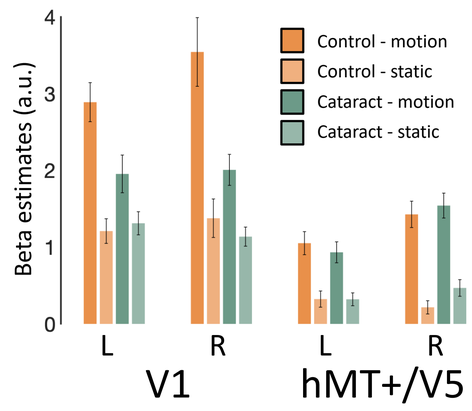
Experiment 1

Motion > Static

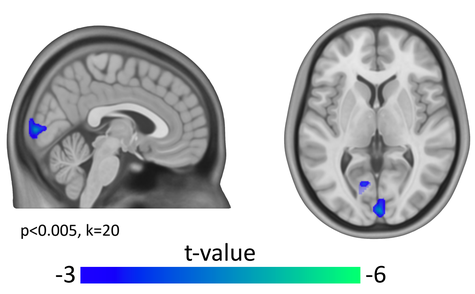


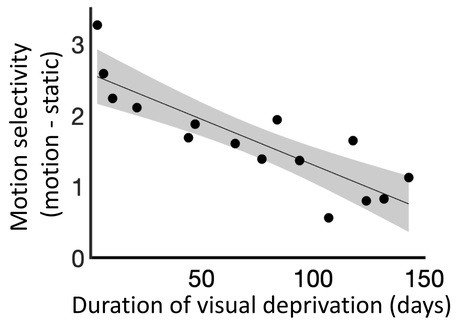
Control > Cataract





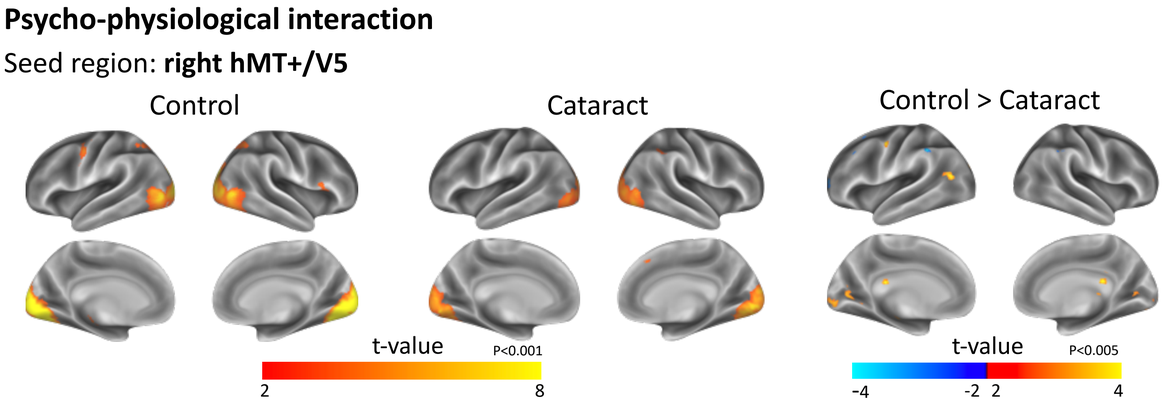
Correlation between motion selectivity and the period of visual deprivation





Psycho-physiological interaction

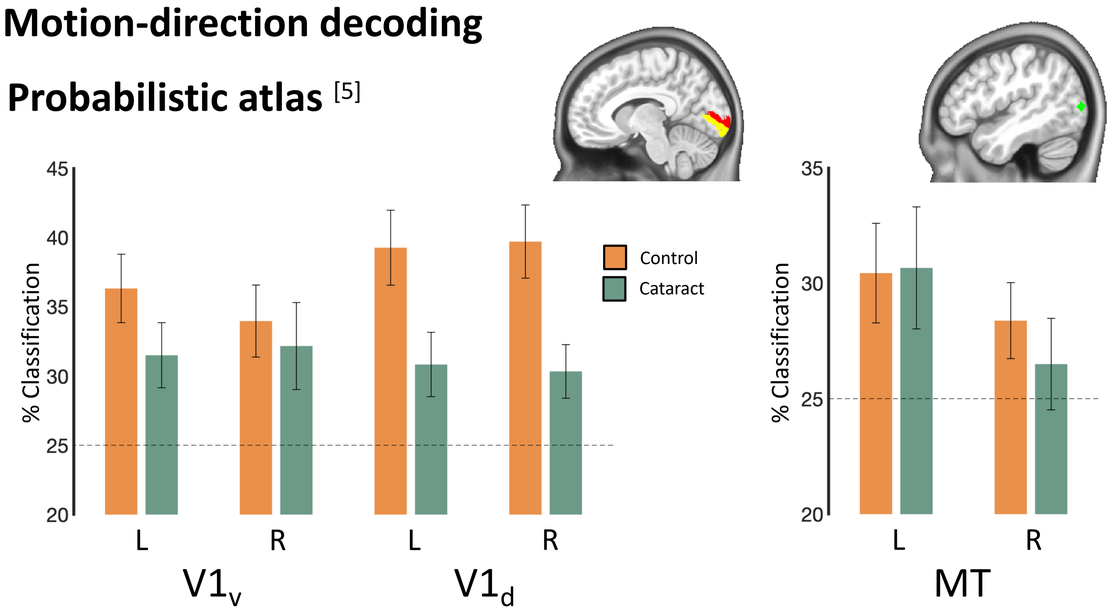
Seed region: **right hMT+/V5**



Experiment 2

Motion-direction decoding

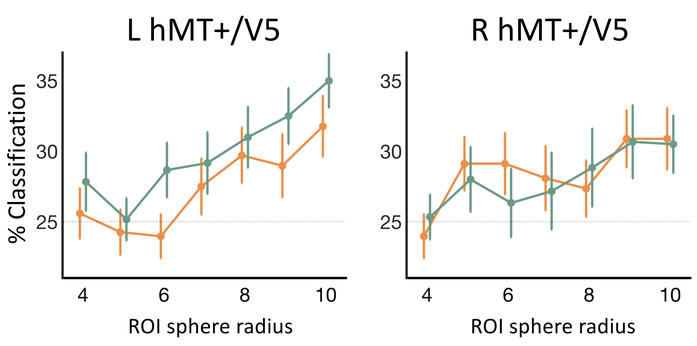
Probabilistic atlas [5]

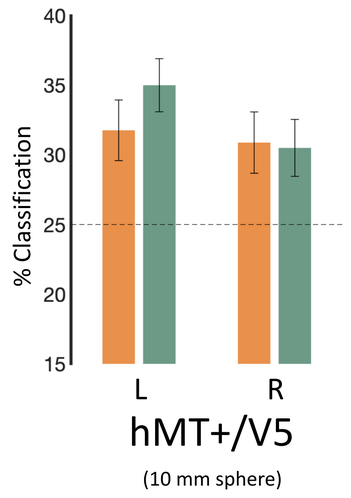


Is there a difference between the groups in hMT+/V5?

Functionally-defined hMT+/V5 (from experiment 1)

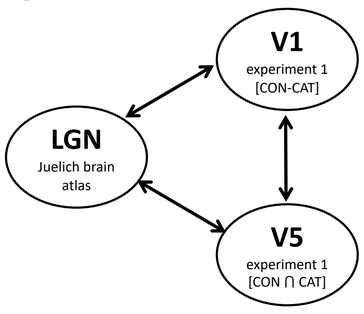
hMT+/V5 was defined from the conjunction analysis.
Control [Motion > Static] ⋂ Cataract [Motion > Static]



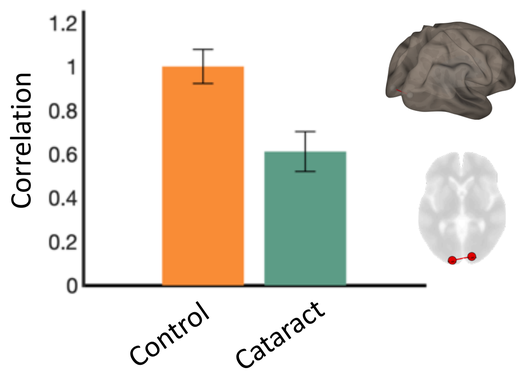


Experiment 3

Resting-state



Inter-hemispheric V1 connectivity



Conclusion

- When processing visual motion, cataract-reversal patients (compared to matched controls) showed:
  - Less recruitment of early visual areas, which also correlated with the duration of early visual deprivation.
  - Less connectivity between hMT+/V5 and V1.
  - Less motion-direction information in early visual areas.
- Reduced inter-hemispheric resting state connectivity for V1 in cataract-reversal patients.
- A brief period of early visual deprivation has a region-specific impact on the visual motion network with V1 being permanently affected while hMT+/V5 shows resilience.

References

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Acknowledgments

FREEDOM TO RESEARCH

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