THE WORLD IN NUMBERS

QUANTITATIVE COGNITION IN BRAINS AND MACHINES

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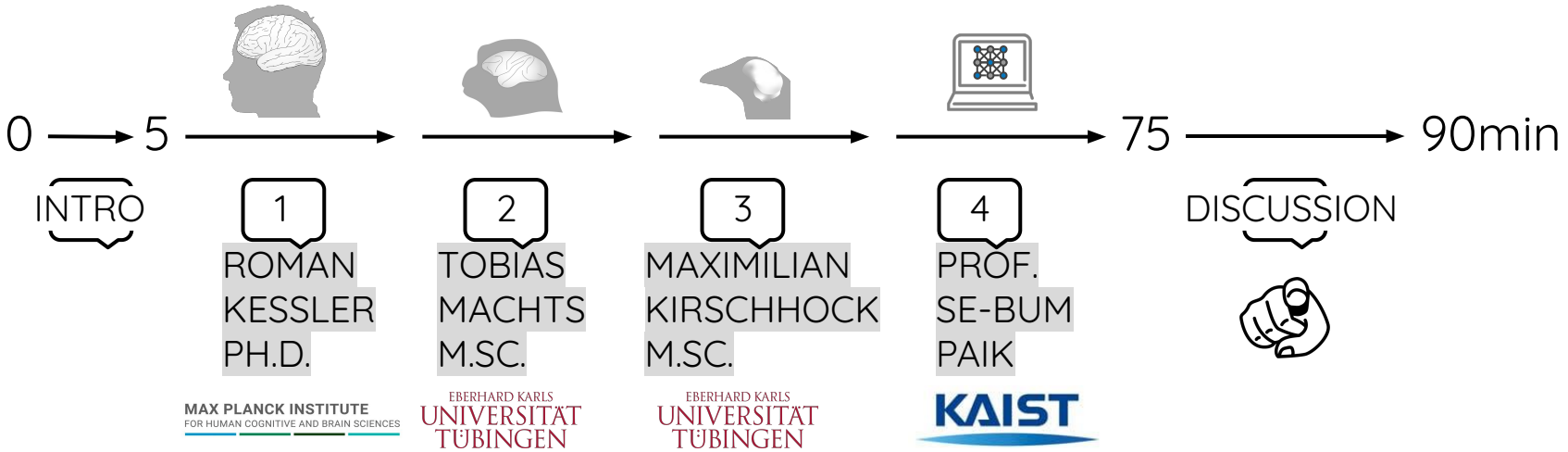
SCHEDULE & SPEAKERS



SKEIDELAB

DFG

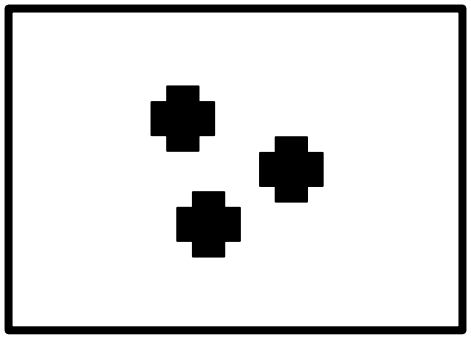
MAX PLANCK INSTITUTE
FOR HUMAN COGNITIVE AND BRAIN SCIENCES

VISUAL AND AUDITORY POPULATION CODING FOR QUANTITY IN **HUMAN CORTICES**

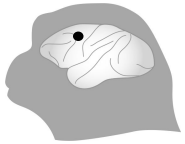
ROMAN KESSLER, ANNE-SOPHIE KIESLINGER & MICHAEL A. SKEIDE

NUMEROSITY PROCESSING

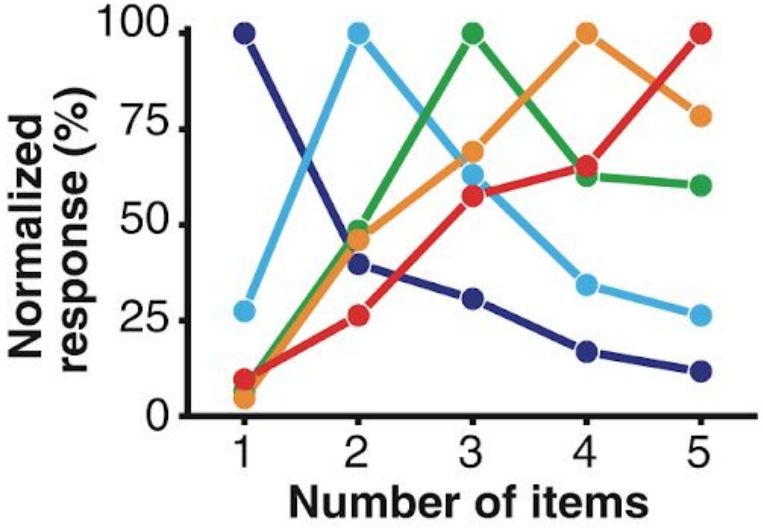
- ability to recognize & compare the **quantity of items in a set**
- single-neuron & population level (fMRI)
- animals & humans



NUMEROSITY TUNING

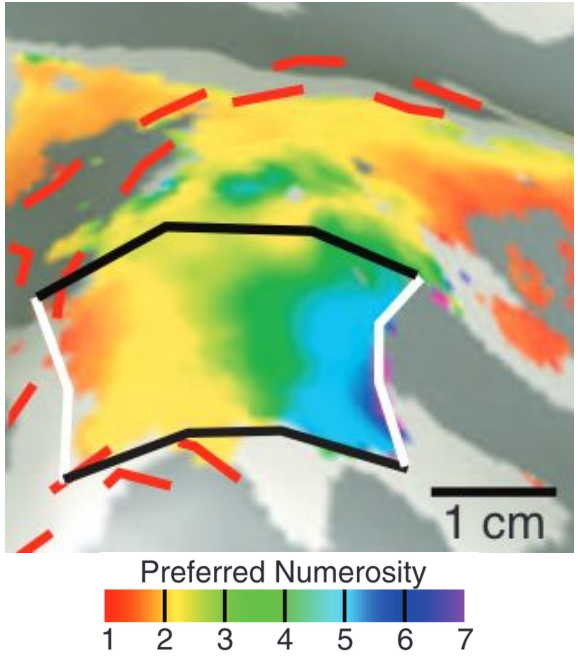


single-neuron level



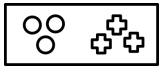
Nieder et al. 2002, Science

population level (fMRI)



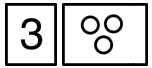
Harvey et al. 2013, Science

NUMEROSITY TUNING



feature-invariant

cross-modal



symbolic & non-symbolic

RESEARCH QUESTIONS

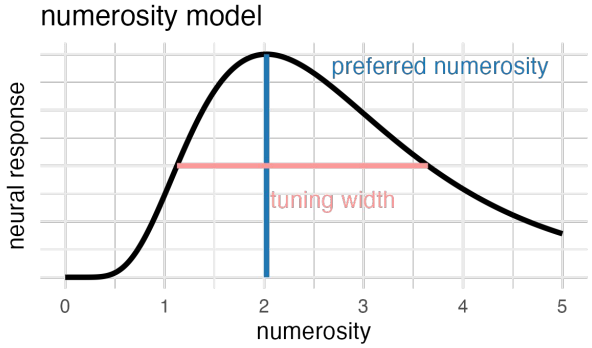
- Can we reproduce **visual** numerotopic maps using fMRI?
- Do numerotopic maps also exist in the **auditory** domain?
- Do maps overlap?
- Are tuning functions similar?

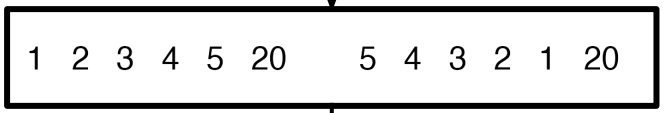
EXPERIMENTAL DESIGN

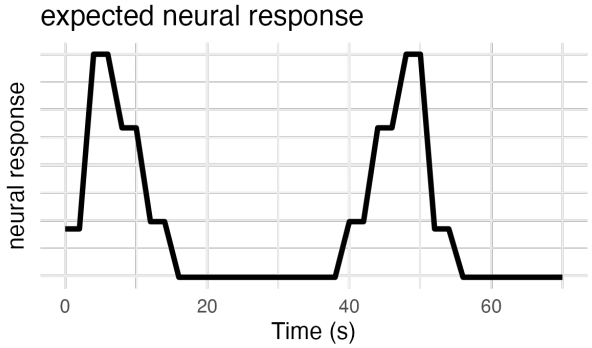
visual

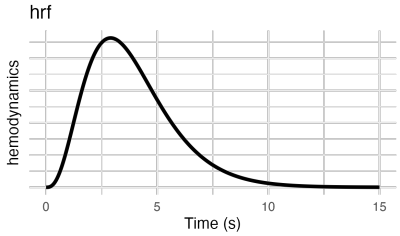
auditory

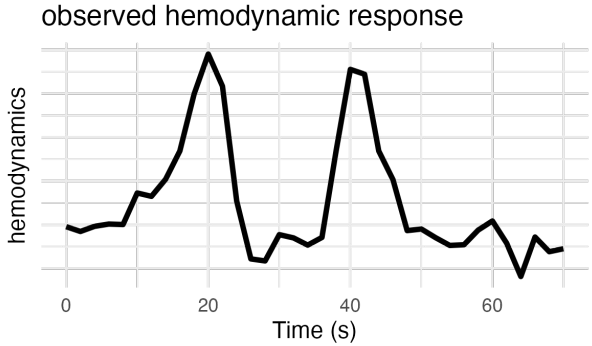
NUMEROSITY MODELING

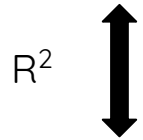


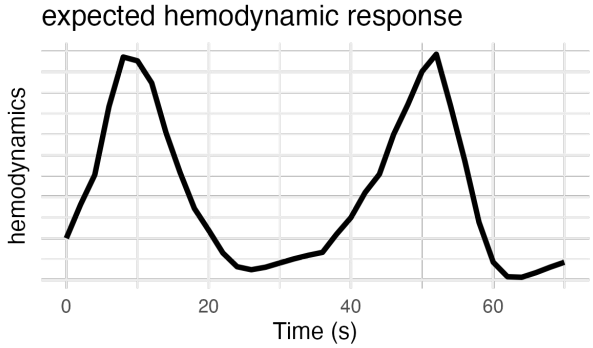






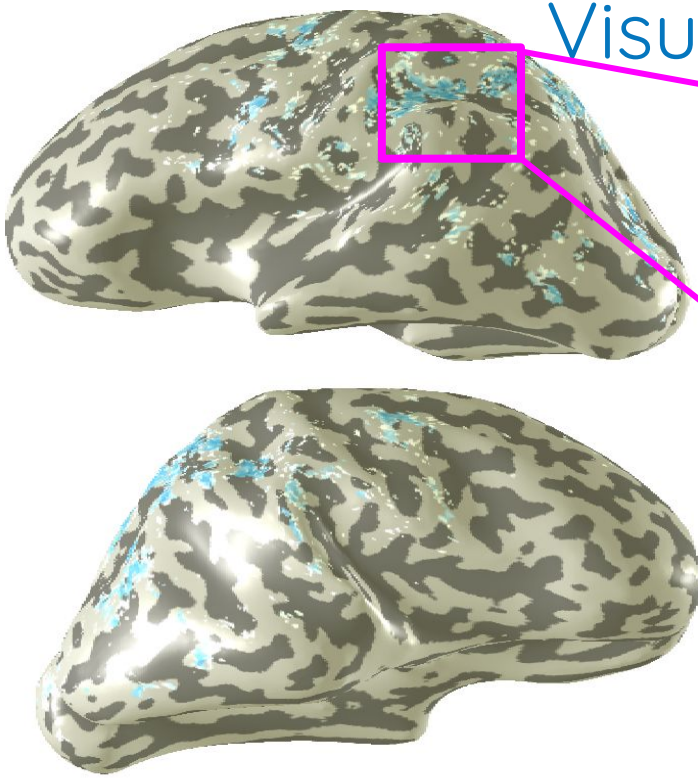


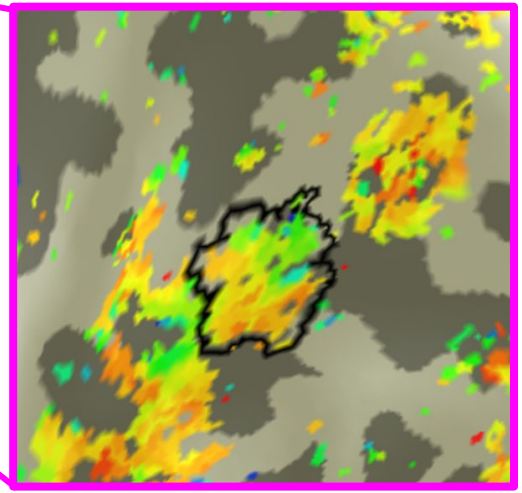


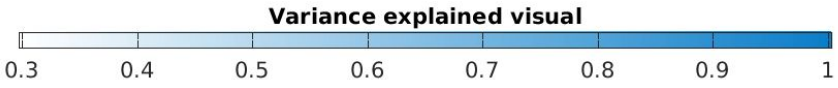


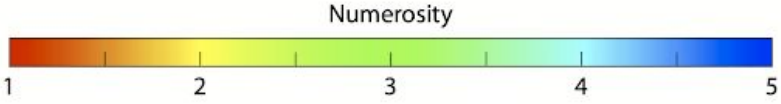
PRELIMINARY RESULTS

Visual numerosity

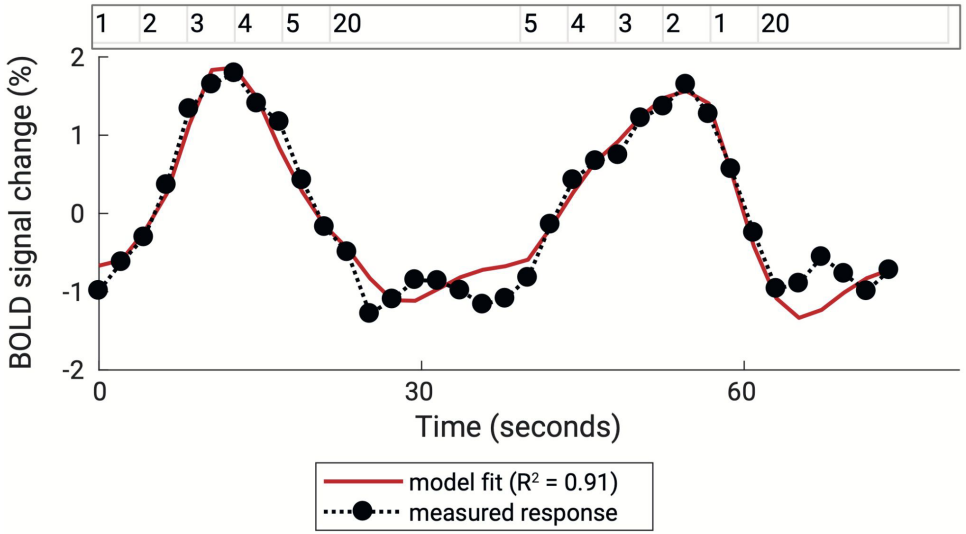


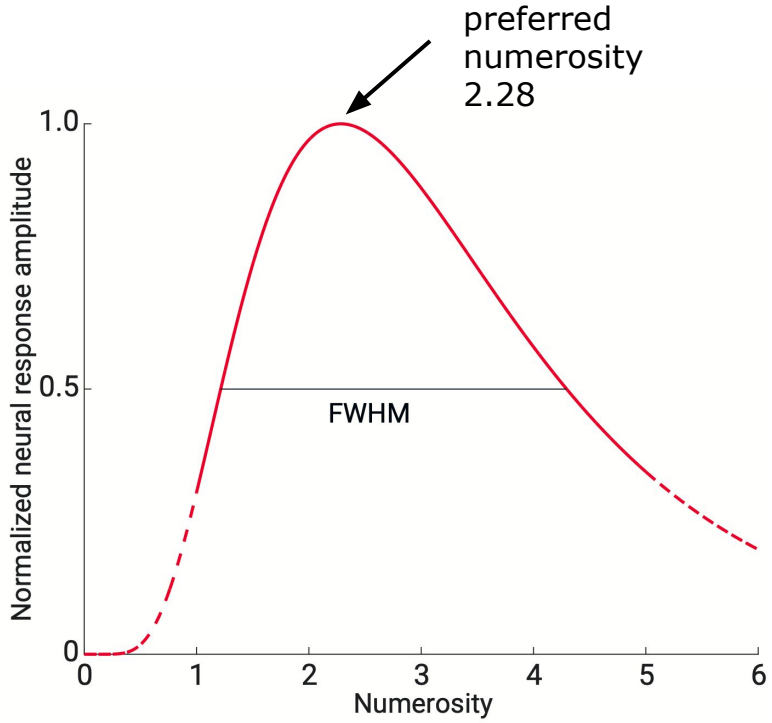




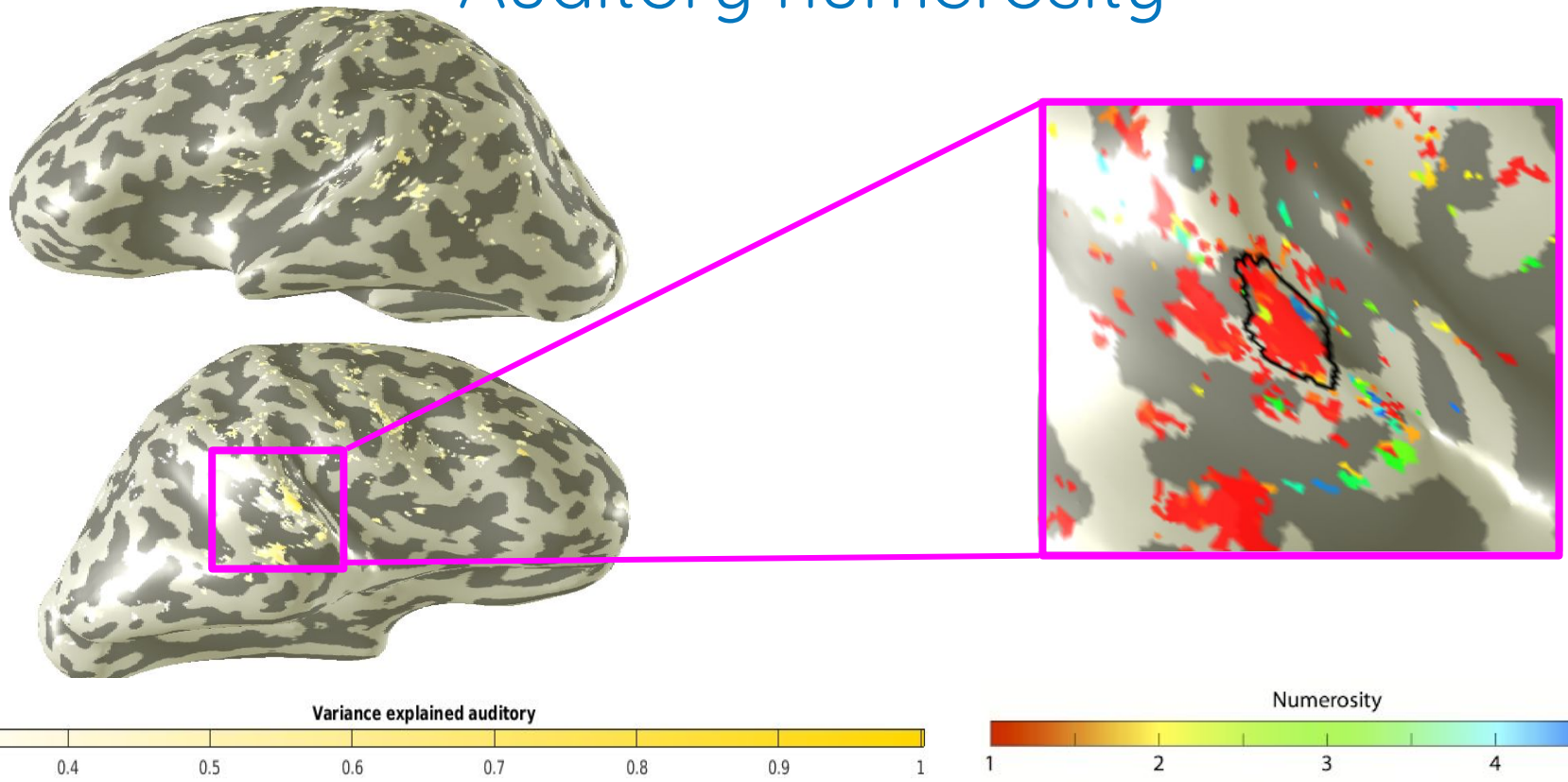


PRELIMINARY RESULTS
Visual numerosity

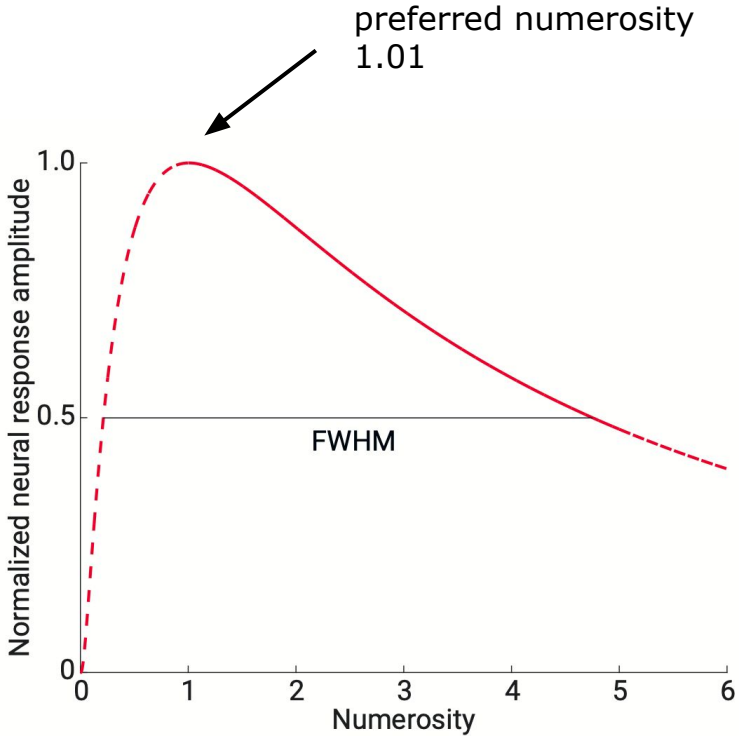




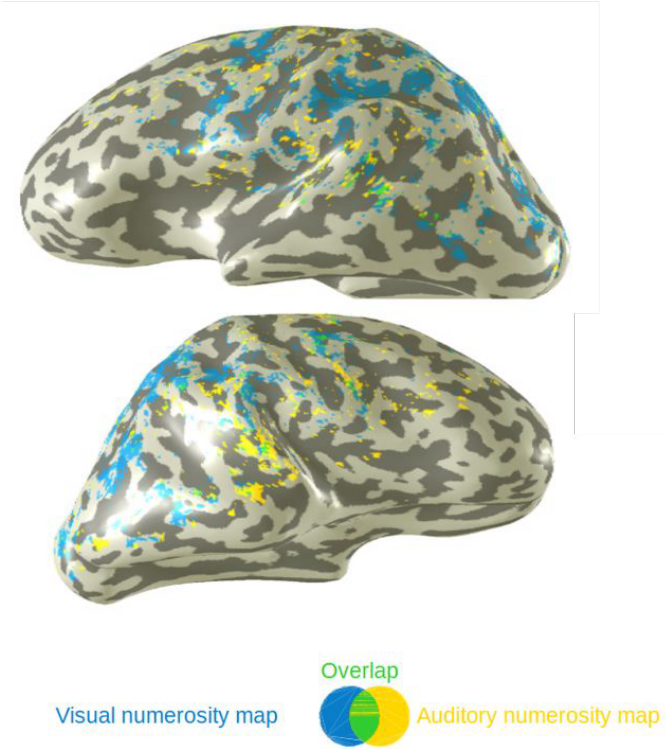
PRELIMINARY RESULTS
Auditory numerosity

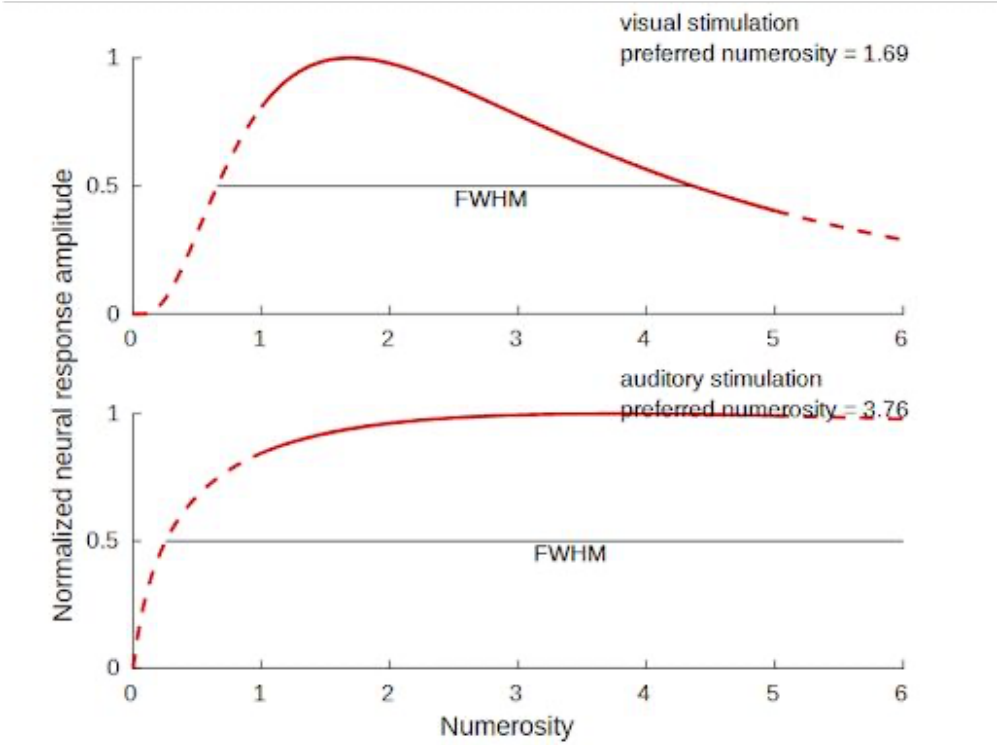


PRELIMINARY RESULTS
Auditory numerosity



PRELIMINARY RESULTS
Numerosity representation across modalities





PRELIMINARY CONCLUSION

- Evidence for numerotopic maps for population coding of **visual** stimuli.
- No evidence yet for **auditory** numerotopic maps.
- Modality-specific tuned voxels are mostly anatomically separated.

PERSPECTIVE

- Simultaneous congruent / incongruent presentation across modalities
- Tuning / Representation of **symbolic** numbers
- **Developmental trajectory** of population receptive fields for numerosities