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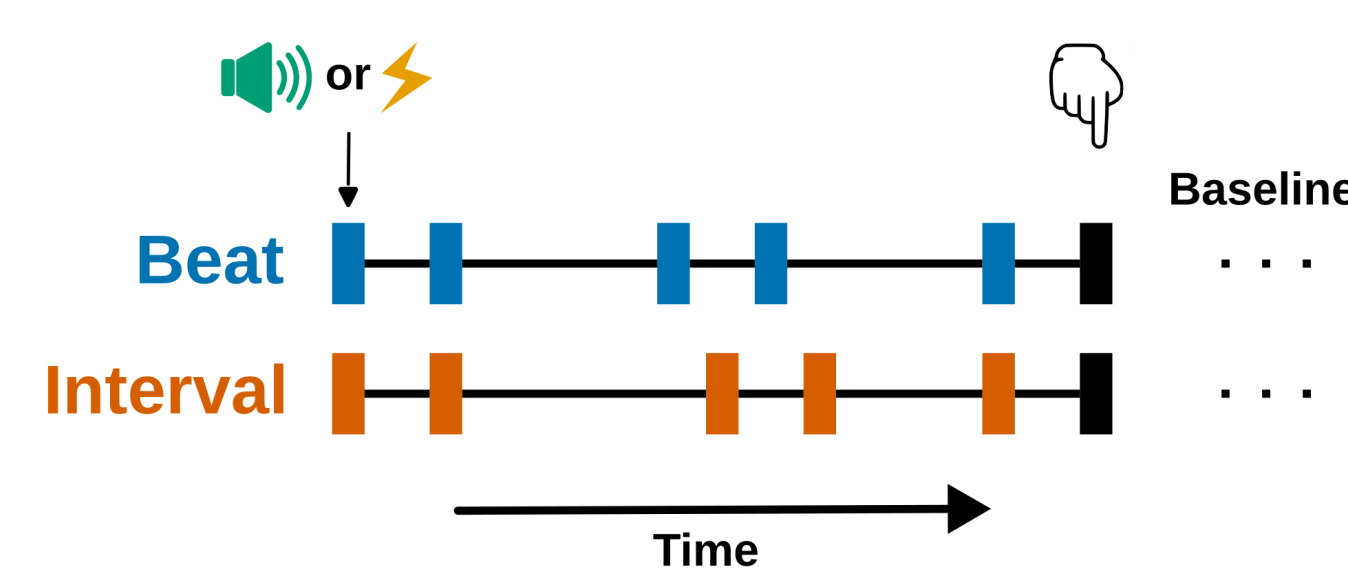
## Background and Motivations

- Temporal Prediction is the anticipation of the timing of future events based on the temporal regularities of past events and it is key to attentional-orienting processes.
- Neuropsychological studies suggest the contribution of the Basal Ganglia and the Cerebellum to the formation of temporal predictions, depending on the periodicity of the events. [1,2,3]
- **Periodic Events = Beat Condition** → Basal Ganglia  
**Aperiodic Events = Interval Condition** → Cerebellum
- Contributions of the cortex depend on the sensory modality of the events (e.g. **Audio** or **Visual**).

## Six Tasks

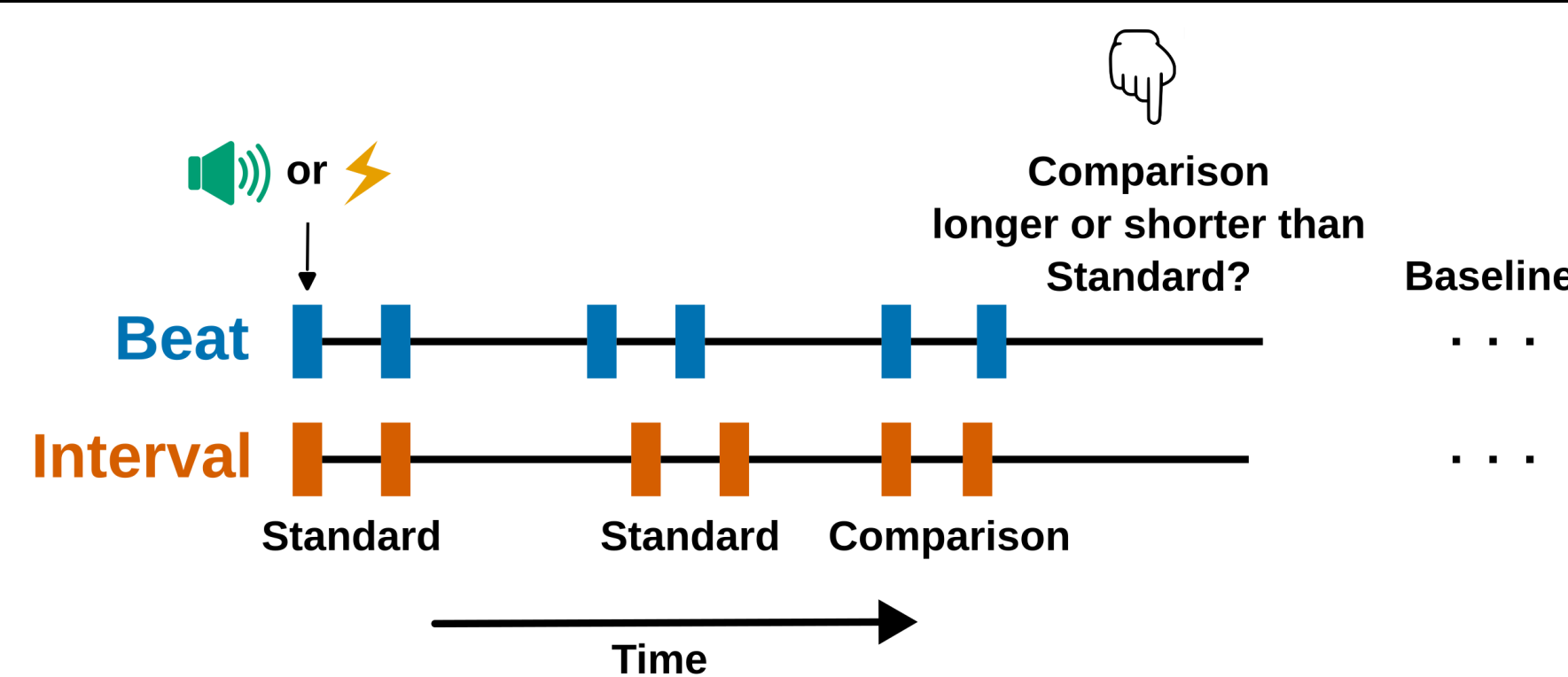
### Production

×2: Audio and Visual



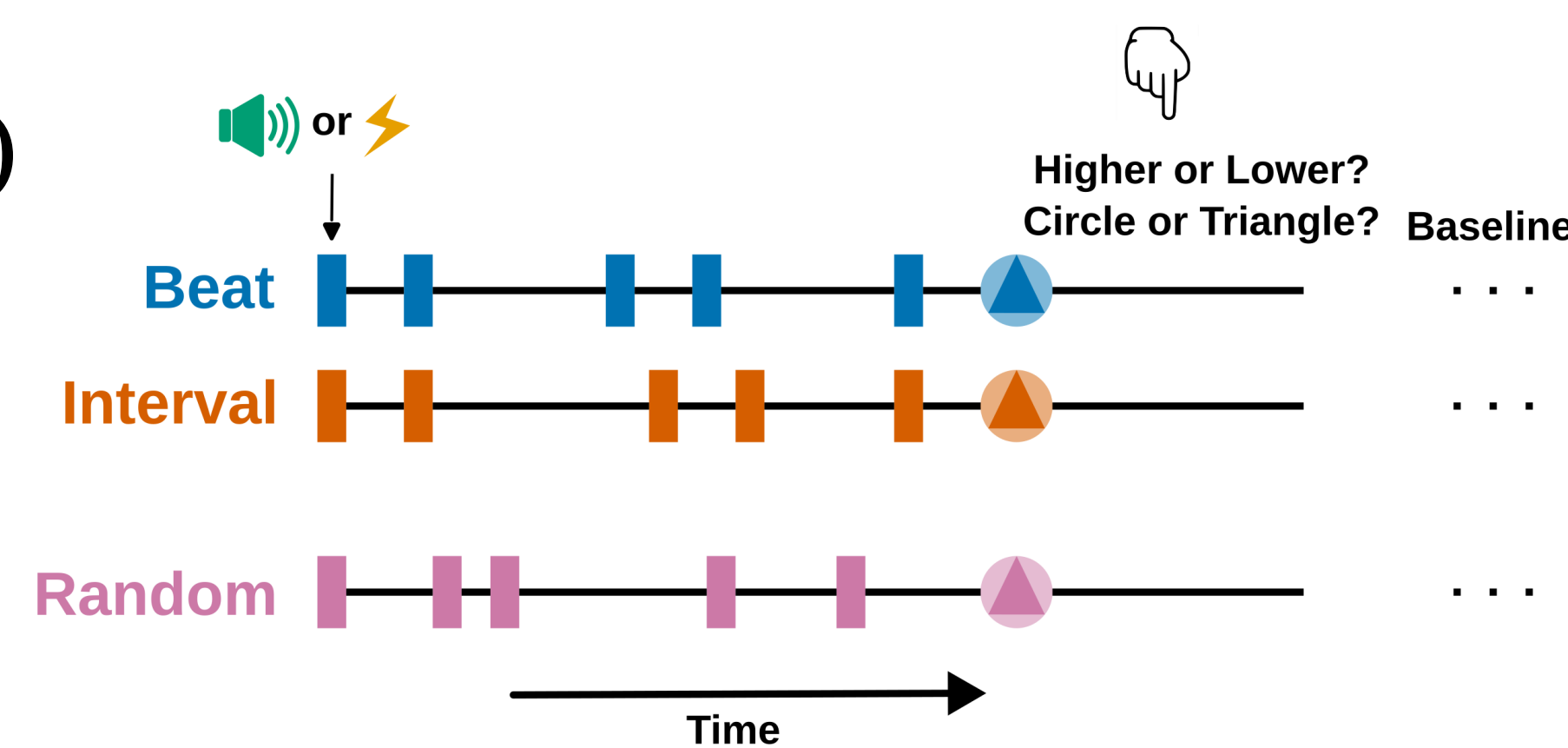
### Perception

×2: Audio and Visual



### Non-Temporal Feature Discrimination (NTFD)

×2: Audio and Visual



## References

- [1] Breska, A. & Ivry, R. B. (2018) Double dissociation of single-interval and rhythmic temporal prediction in cerebellar degeneration and Parkinson's disease, *Proc Natl Acad Sci U S A*. 115(48), 12283-12288. doi: [10.1073/pnas.1810596115](https://doi.org/10.1073/pnas.1810596115)
- [2] Teki, S. et al. (2012) A unified model of time perception accounts for duration-based and beat-based timing mechanisms. *Front Integr Neurosci*. 5-90. doi: [10.3389/fnint.2011.00090](https://doi.org/10.3389/fnint.2011.00090)
- [3] Teki, S. et al. (2011) Distinct Neural Substrates of Duration-Based and Beat-Based Auditory Timing. *J Neurosci*. 31(10):3805-12. doi: [10.1523/JNEUROSCI.5561-10.2011](https://doi.org/10.1523/JNEUROSCI.5561-10.2011).

## Behavioral Study

### Aims

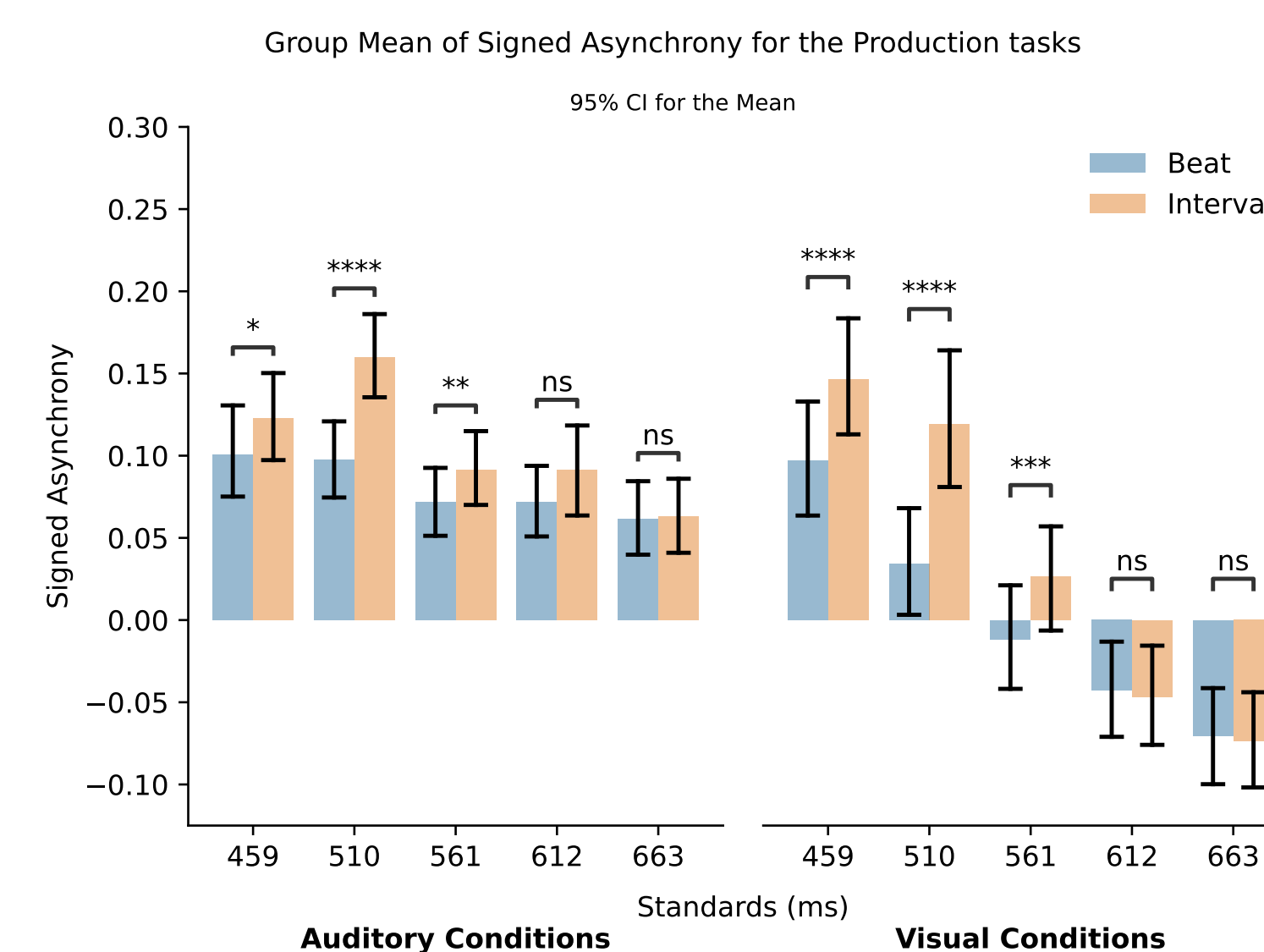
- Evaluate differences in performance between conditions:
  - expect **Beat** better than **Interval**.
- Evaluate differences in performance between modalities:
  - expect **Audio** better than **Visual**.

### Data

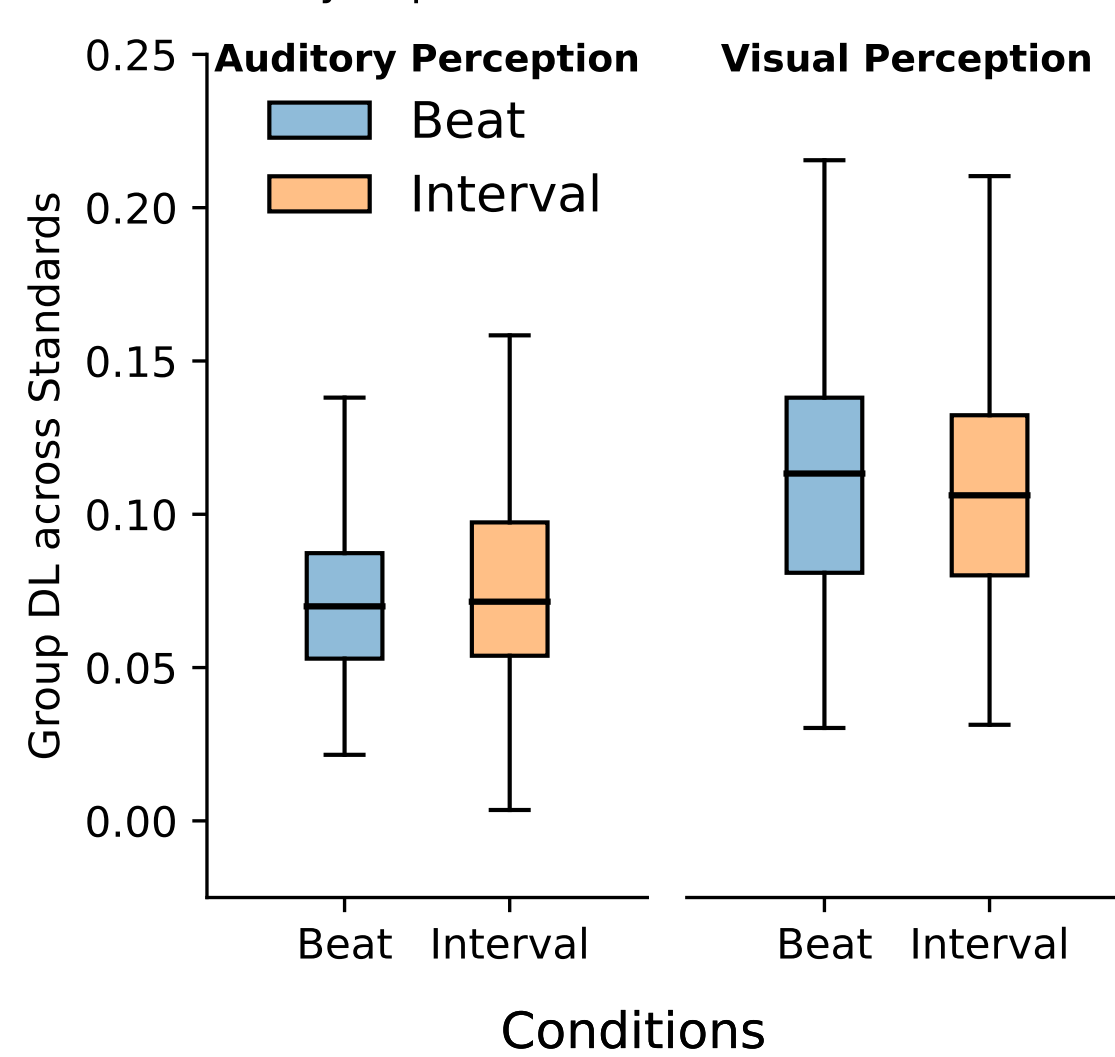
- **39** healthy adults, **195** sessions (5 sessions/participant)

### Results

- Lower Asynchrony for Beat than Interval across Standards.



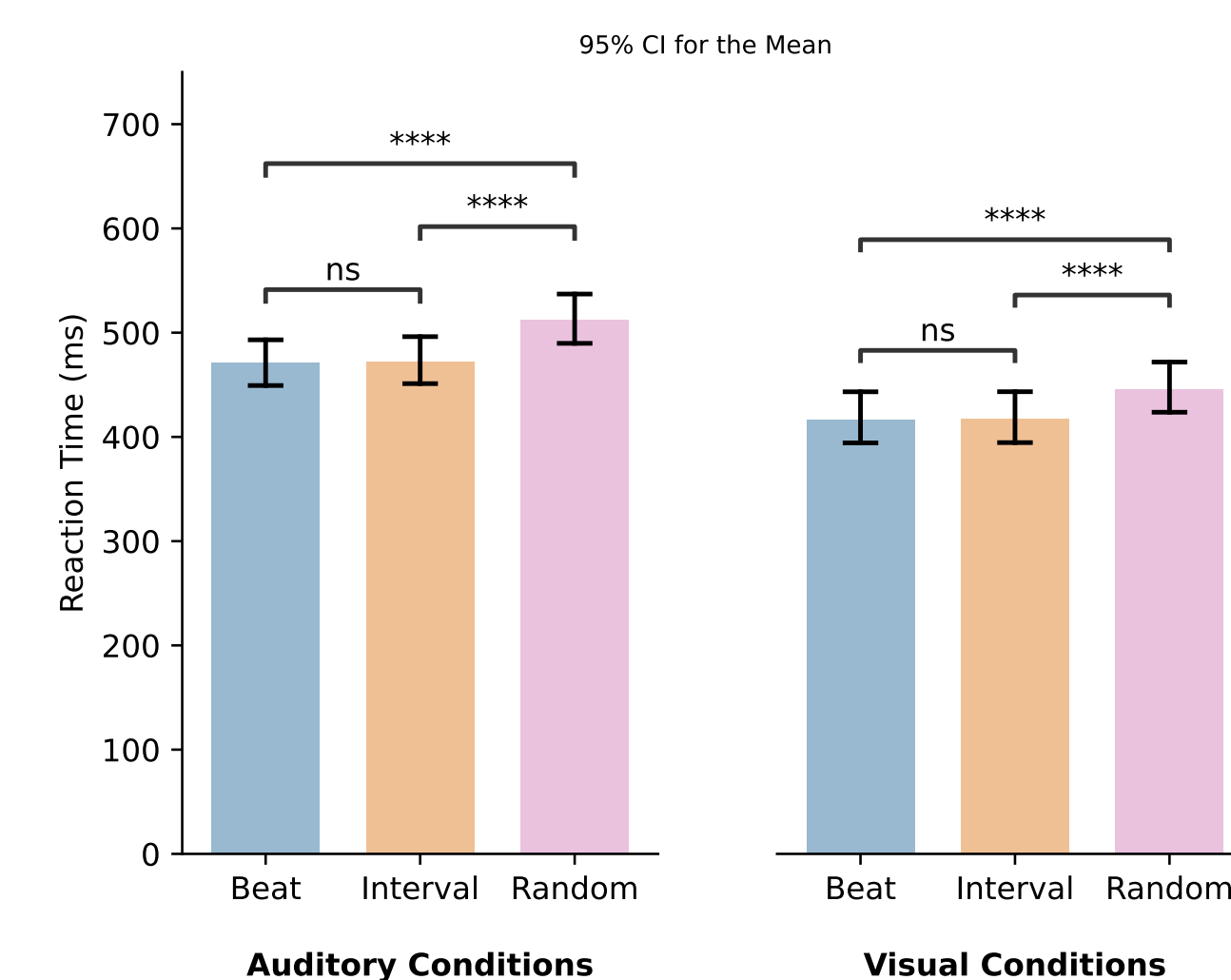
Descriptive Stats of Group DL across Standards for 3-way Repeated Measures ANOVA



Lower DL ≡ Better Performance

- Significant effect of DL for Modality:  $DL_{Visual} > DL_{Audio}$
- Better performance for Audio than Visual conditions.
- Significant interaction between Modality and Standard.

Group Mean of Reaction Time for the NTFD tasks



- Benefit of discrimination during Beat/Interval conditions over Random condition.
- No effect between Beat and Interval conditions across Standards and modalities.

## fMRI Study

### Aims

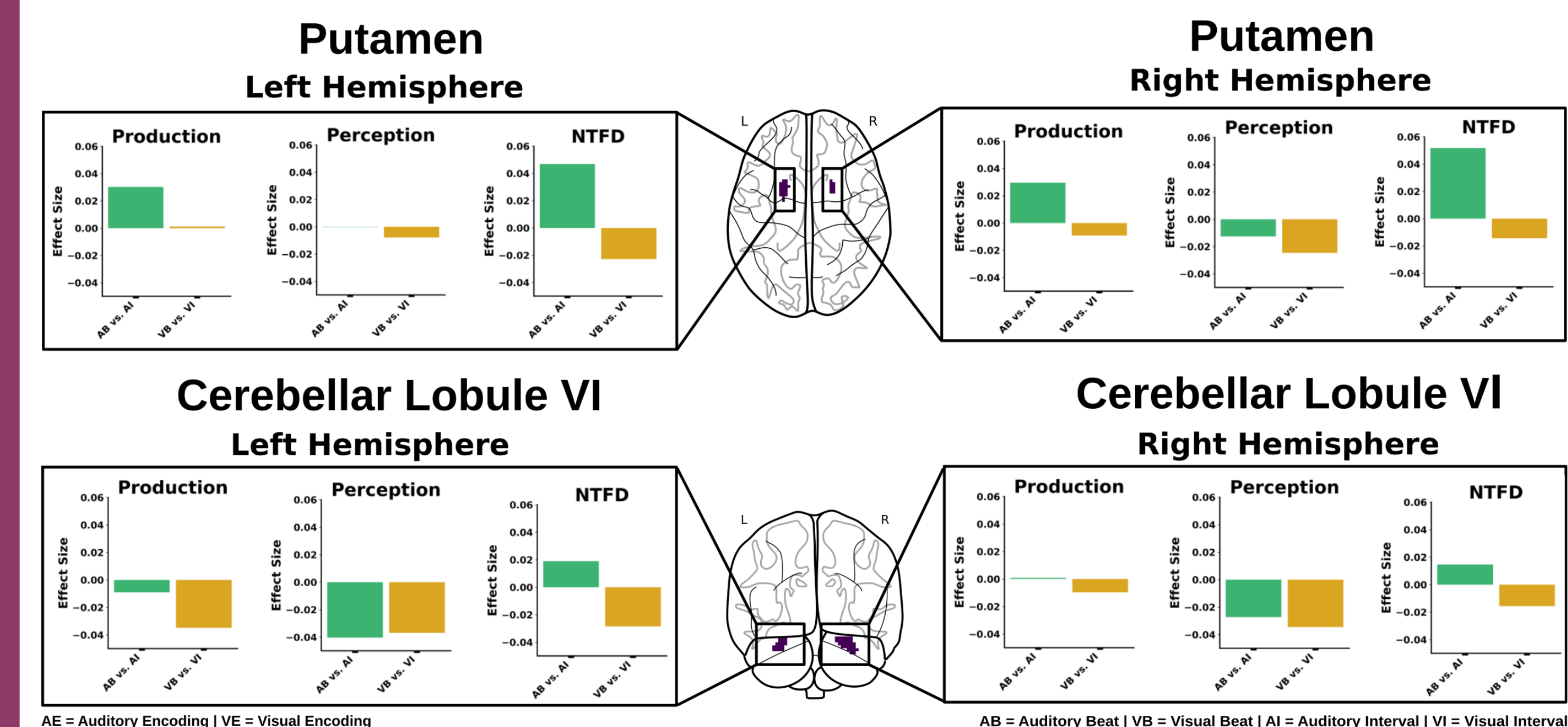
- Evaluate differences of neural correlates between conditions:
  - expect engagement of **Basal Ganglia** during **Beat**.
  - expect engagement of **Cerebellum** during **Interval**.
- Evaluate differences of neural correlates between modalities. (**Audio/Visual**) modulated by conditions.

### Data

- **31** healthy adults, **62** sessions (2 sessions/participant)

### Preliminary Results

- Imaging contrasts display cluster of activation in Putamen for Beat vs. Interval condition.
- Imaging contrasts display cluster of activation in Crus I and Cerebellar Lobule VI for Interval. vs. Beat condition.
- ROI analyses indicate benefit of Putamen during Beat vs. Interval condition and Cerebellum during Interval vs. Beat condition for Auditory tasks.



## Future Directions

- Behavioral Study: relation of different tasks and psychometric data (e.g. musical training and music sophistication).
- fMRI Study: individualize ROI's.
- fMRI Study: Functional connectivity analysis between Putamen/Cerebellum and the Cortex.

