



# Using a Musical Beat to Influence Linguistic Statistical Learning

Aspen Leung & Dr. Laura Batterink  
Department of Psychology, Western University

## Background

- Music and language consists of events that unfold over time, made up of discrete units that follow certain rules
- This allows listeners to make predictions about the upcoming note or syllable
- **Statistical learning (SL)** involves the ability to pick up on statistical regularities in the environment around us
- SL is a process that is thought to be present in both the music and the language domain
- **Neural entrainment** is the synchronization of neural oscillations with an external stimulus, aligning neural excitability with stimulus events (Obleser & Kayser, 2019)
- Music has been used by Tal et al. (2019) as a stimulus for neural entrainment: despite not having acoustic signals at the beat frequency, entrainment still occurred at this frequency
- Structural similarities between music and language and presence of SL in both domains → music as an external stimulus for neural entrainment that might lead to differences in SL

## Research Aim

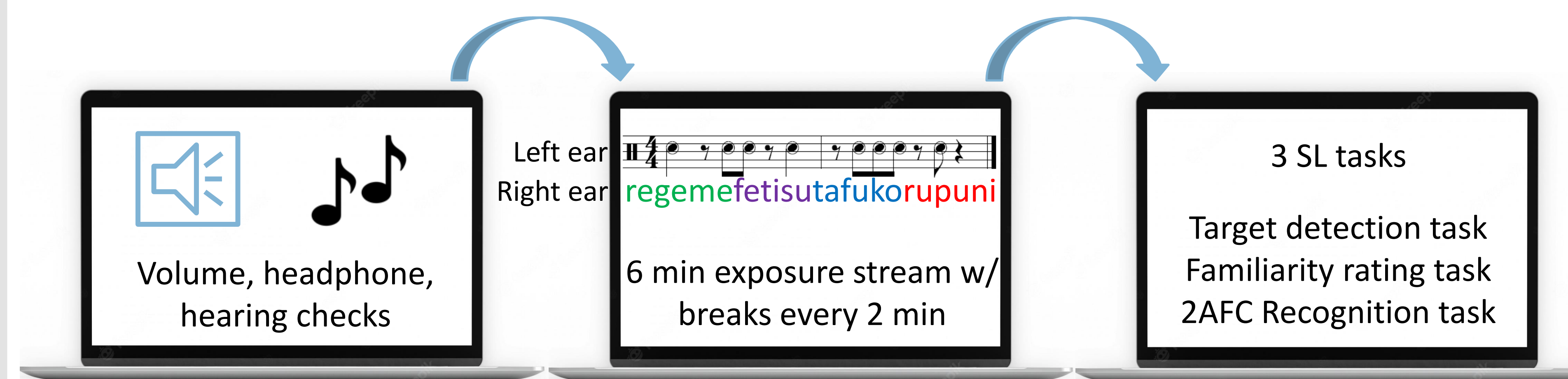
- Broad research question: does neural entrainment influence statistical learning?
- Pilot aim: verify behavioural results of using music as a stimulus for neural entrainment
- Future project direction: verify neural entrainment to music stimulus through EEG to confirm behavioural results from pilot

## Methods

- Exposure stream consists of a speech stream (Batterink & Paller, 2019) and a music stream (Tal et al., 2017)

regemefetisutafukorupunitafukoregemefetisurupunifetisutafuko

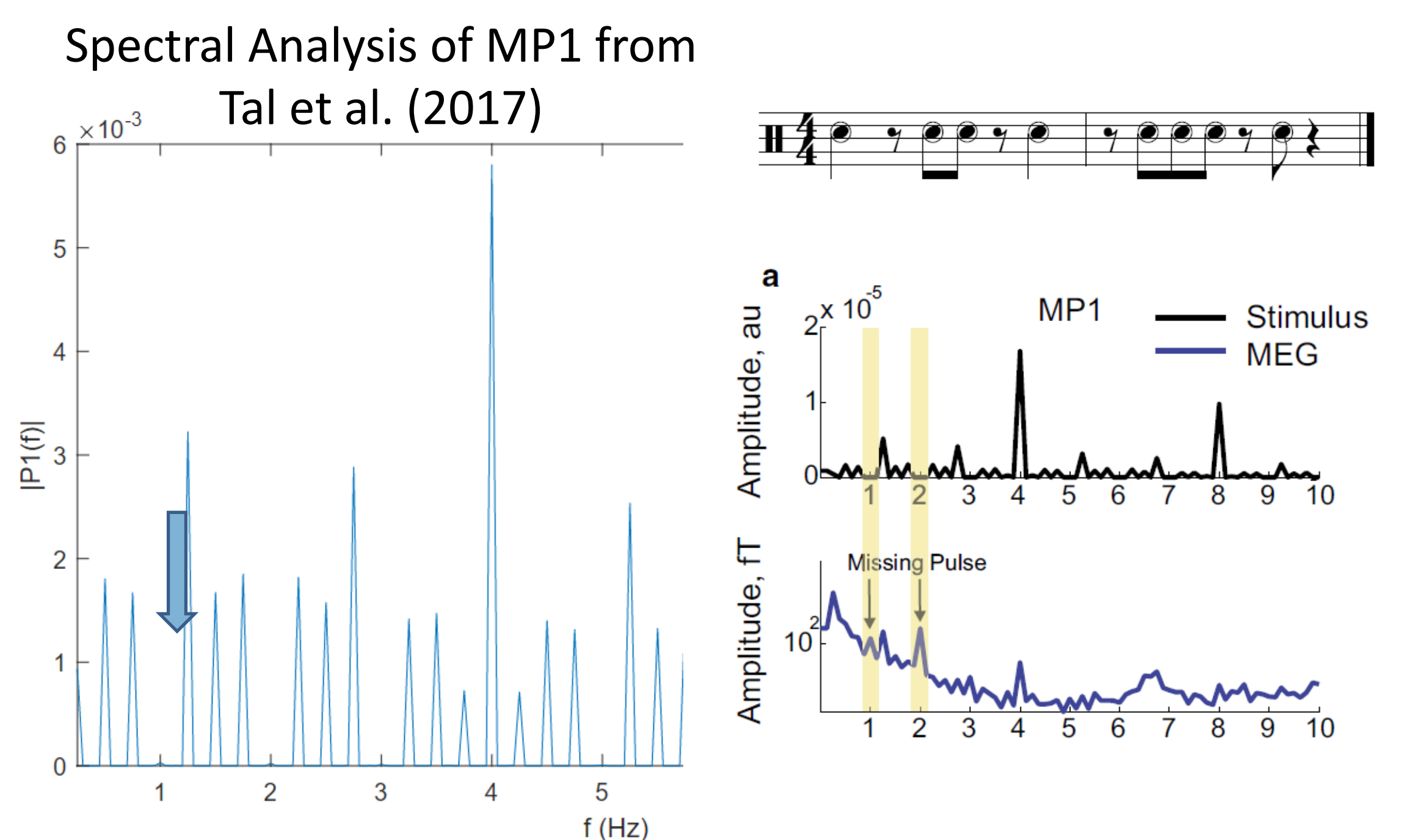
Speech stream frequency adjusted to match the expected beat frequency of music stream (1.0 Hz)



## Finalized Music Stimuli

### Drum rhythms from Tal et al. (2017)

- Syncopated drum rhythm MP1 and the random drum rhythm used for experimental and control conditions respectively
- Both contain no pulse energy at the expected beat frequency of 1 Hz but still lead to a perceived beat at 1 Hz



## Creating the Music Stimuli

### Music stimuli criteria:

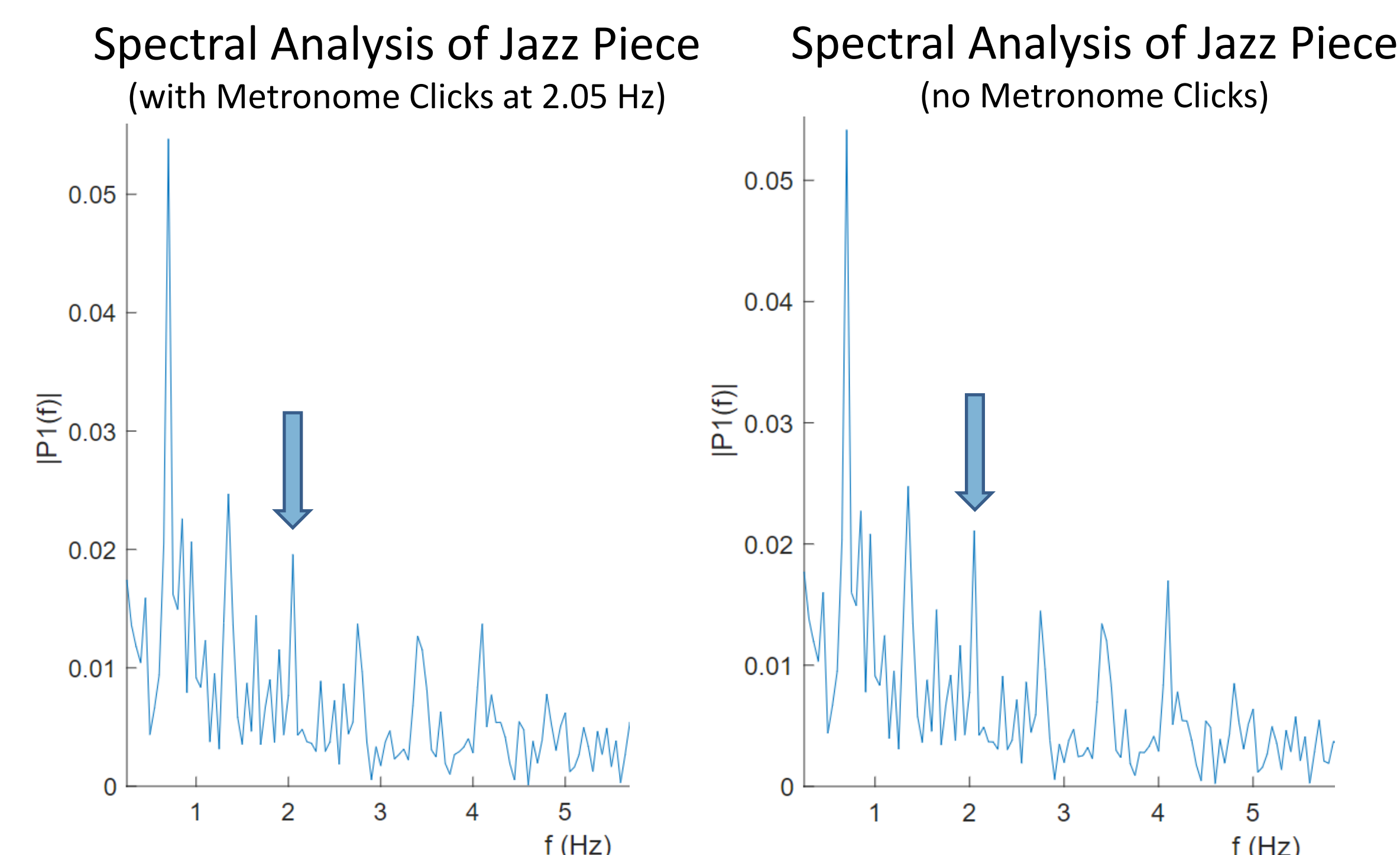
- Low excitability
- Consistent, predictable beat

### Lo-fi Piece

- Met criteria
- Percussion made beat too explicit to use
- Could not erase percussion sound completely

### Jazz Pieces

- Higher in excitability
- Less explicit beat because of syncopation
- Completed spectral analysis from Tal et al. (2017) on selected pieces
- Pieces were either too complex or had peaks at expected beat frequency



## Future Directions & Implications

Future directions for this project include collecting the behavioural data and eventually using EEG to verify neural entrainment to the musical stimulus and behavioural results.

Implications of the final project (with EEG and behavioural data) include using music as an intervention tool in educational settings for those who have difficulties with language learning.

## References

1. Batterink, L. J., & Paller, K. A. (2019). Statistical learning of speech regularities can occur outside the focus of attention. *Cortex*, 115, 56-71. <https://doi.org/10.1016/j.cortex.2019.01.013>
2. Mulgrew, J. "The Role of Neural Entrainment in Statistical Learning" (2020). Electronic Thesis and Dissertation Repository. 7158. <https://ir.lib.uwo.ca/etd/7158>
3. Obleser, J., & Kayser, C. (2019). Neural entrainment and attentional selection in the listening brain. *Trends in Cognitive Sciences*, 23(11), 913-926. <https://doi.org/10.1016/j.tics.2019.08.004>
4. Tal, I., Large, E. W., Rabinovitch, E., Wei, Y., Schroeder, C. E., Poeppel, D., & Golumbic, E. Z. (2017). Neural entrainment to the beat: The "missing-pulse" phenomenon. *The Journal of Neuroscience* 37(26), 6331-6341. <https://doi.org/10.1523/JNEUROSCI.2500-16.2017>