

# Comparing the Lateralization of Prefrontal Cortex Activity of Speaking/Singing to Listening in Dynamic Adaptive Speech Reconstruction (DASR): A fNIRS Study

BOSTON UNIVERSITY

Sarayu Kalavapalli<sup>1,2</sup>, Tanisha Mehta<sup>2</sup>, Lauren Shi<sup>2</sup>, Maya Zeldich<sup>2</sup>, Samuel Yang<sup>2</sup>, Maddie Schutte<sup>2</sup>, Jonathan J. Wisco, PhD<sup>2</sup>  
Coppell High School 185 W Parkway Blvd, Coppell, TX 75019<sup>1</sup>, Department of Anatomy and Neurobiology, Boston University School of Medicine, Boston, MA, 02118<sup>2</sup>

## Introduction

- Melodic Intonation Therapy (MIT) **recruits the right homologue** of Broca's area through music and rhythm to assist with speech production
- **Dynamic Adaptive Speech Reconstruction (DASR)** builds upon MIT by adding increasingly challenging speech, melody, and rhythmic tasks.
- This study aims to determine the effect of DASR on **hemispheric lateralization of speech and song production and listening** in normal subjects before applying to subjects with global aphasia.

## Methods

- We used **Functional Near-Infrared Spectroscopy (fNIRS)** imaging throughout the DASR algorithm including listening periods.
- The fNIRS headband monitors **8 bilateral functional regions of the frontal lobe**; the ventrolateral, dorsolateral, orbitofrontal, and frontopolar prefrontal cortexes of the left and right hemispheres.
- Brain activity detected using **Blood Oxygen Level dependent (BOLD)** signals.
- We analyzed the **difference in oxygenated and deoxygenated blood flow** in each hemisphere of the listening and task periods of the DASR algorithm.
- 1) speak; 2) speak and tap; 3) sing; 4) sing and tap; 5) sing the augmented 4th; and 6) sing the augmented 4th and 7) tap the phrase "happy birthday to you."
- Mean difference in oxygenated and deoxygenated blood flow of the left and right hemispheres during listening and speaking periods of all seven tasks was compared using 14 **one-sample t-tests**.



Figure 2. DASR paradigm.

## Results

- We observed substantial differences in mean BOLD signals throughout all 7 tasks, though these results are not statistically significant.

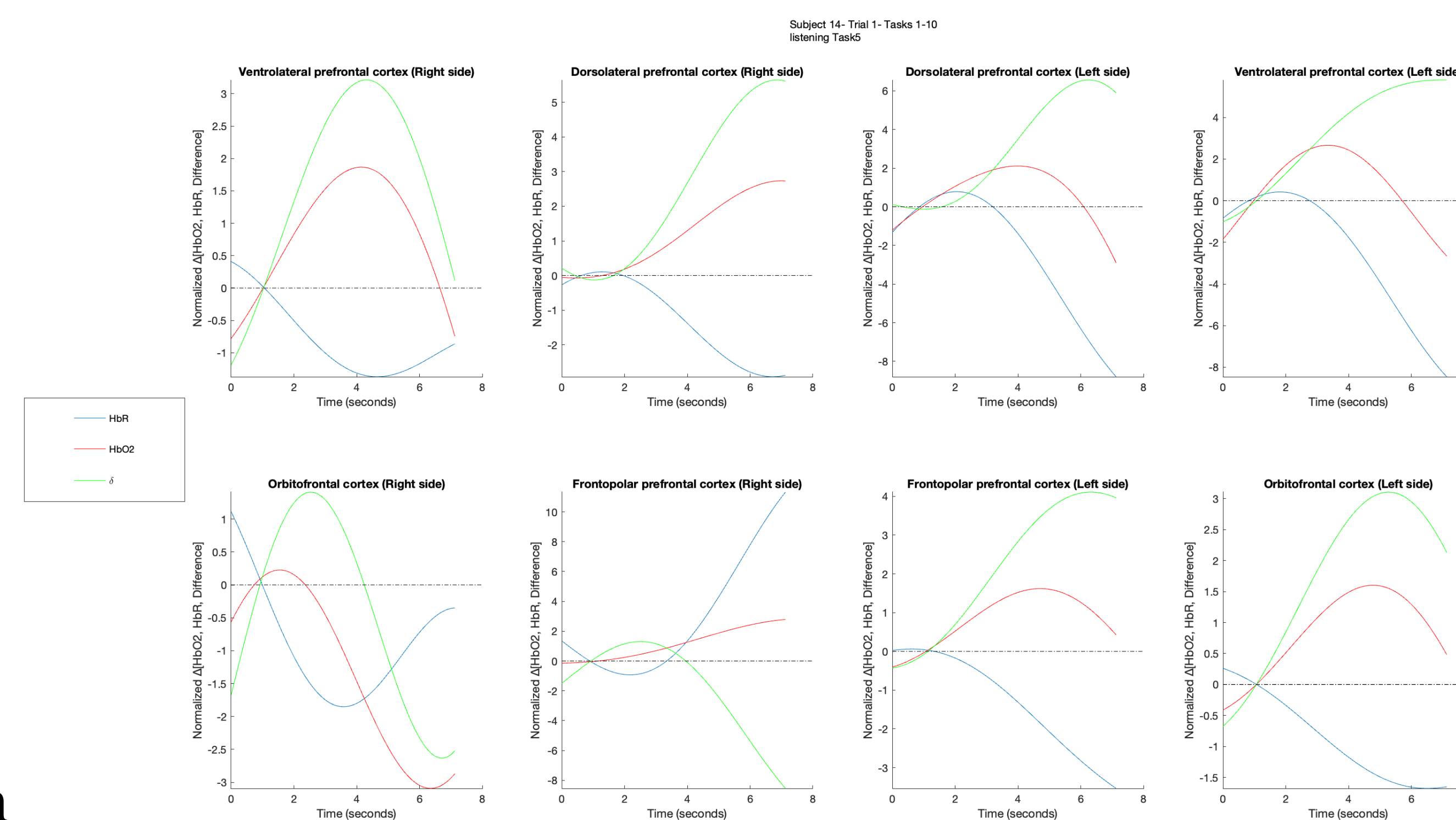


Figure 3. Analysis of Listening Task 5 of subject 14.

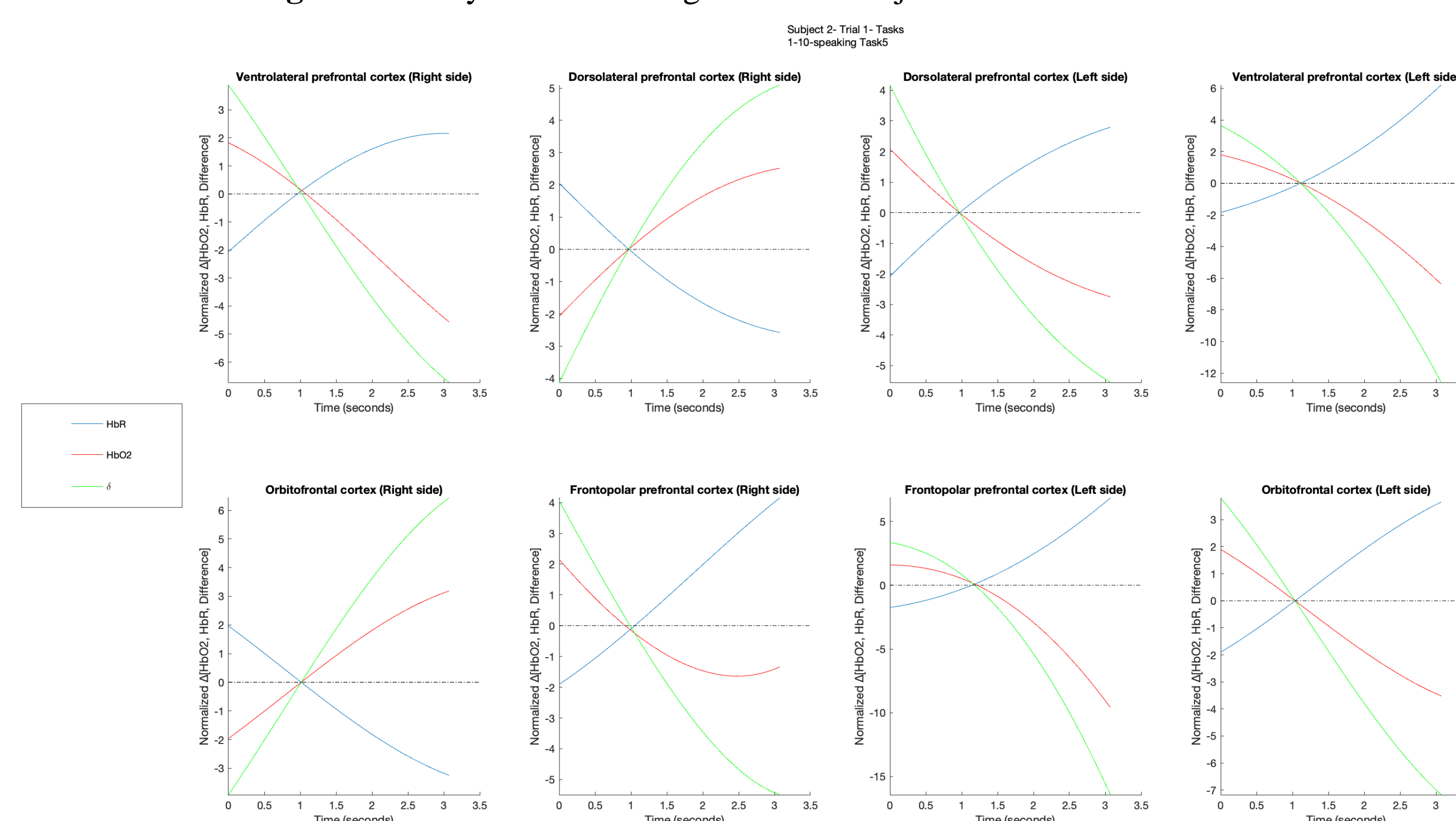


Figure 4. Analysis of Speaking Task 5 of subject 2.



Figure 1. fNIRS headband.

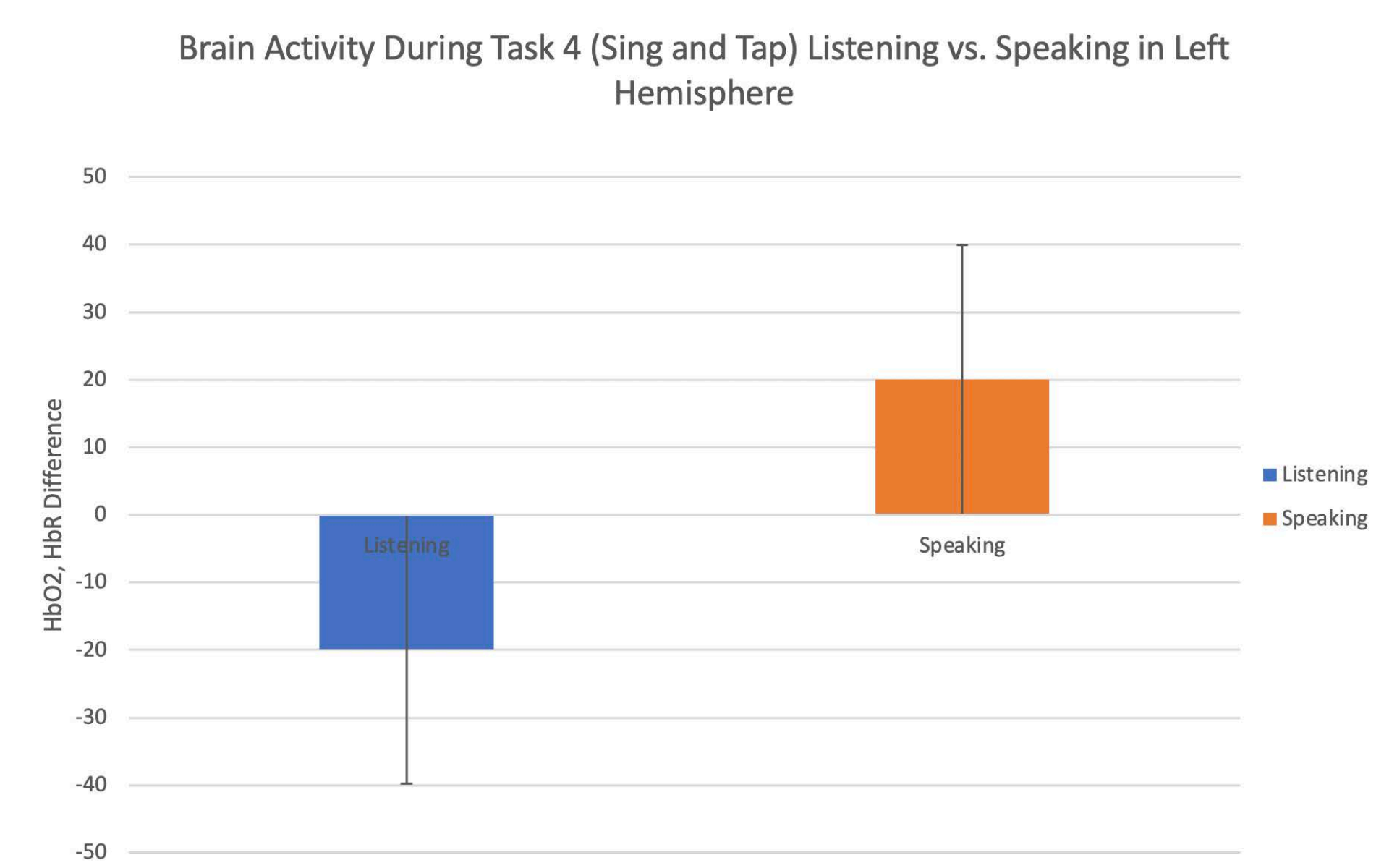


Figure 5. Mean difference in HbO2 and HbR in Task 4.

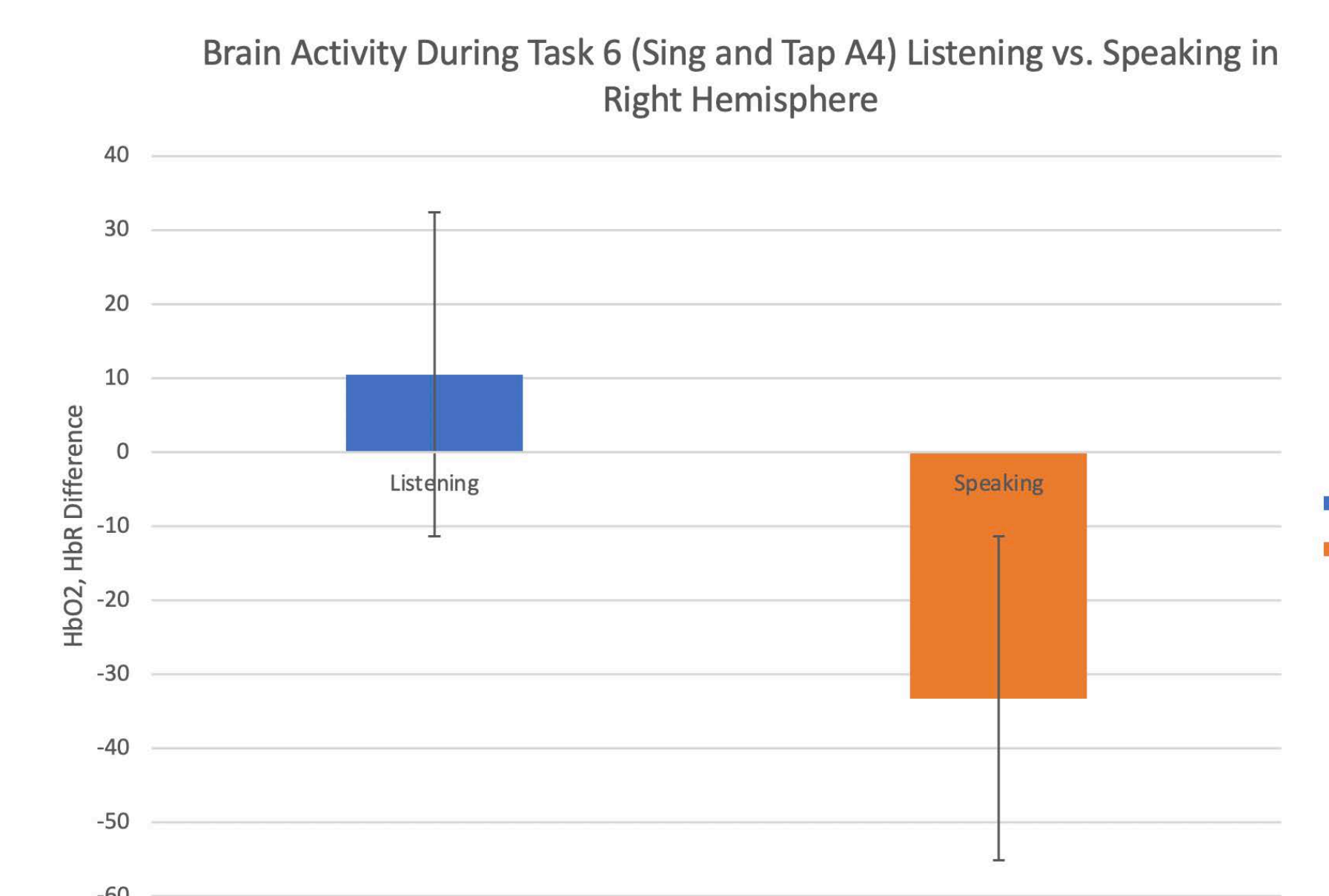


Figure 6. Mean difference in HbO2 and HbR in Task 6.

## References

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## Conclusions/Discussion

- Role of the DASR paradigm was further studied by analyzing the role of listening in recruiting the **right hemisphere**.
- Observes the inducement of neuroplasticity **in normal subjects**.
- Serves as a **model for comparison** as treatments for global aphasia are tested in aphasiac patients.

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