INTRODUCTION

This study was designed to assess the nature of the hemodynamic response function in adults who do and do no not stutter during real-world, functional telephone conversations.

- **Question 1**: Do measures of fNIRS oxygenated and deoxygenated hemoglobin concentration values differ significantly for adults who stutter (AWS)and adults who do not stutter (AWNS) in five cortical regions during listening, fluent speech, and disfluent speech conditions?
- **Question 2**: Does the functional connectivity among the five regions of interest differ for AWS and AWNS during listening, fluent speech, and disfluent speech conditions?

METHODS

Participants

- Fourteen right-handed adults
  - 12 Males and 2 Females
  - Ages 21-60
- Two groups matched for sex and age
  - 7 adults with no stutter (AWNS)
  - 7 adults with stutter (AWS)
    - Self-disclosed history of chronic stuttering

	Frequency					
	Stutter-like		Non-stutter-like		Total	
Group	*M*	*SD*	*M*	*SD*	*M*	*SD*
AWNS	2.157	0.714	6.756*	2.144	8.913	2.659
AWS	13.088*	6.100	3.900	1.229	16.989*	6.628

Note. AWNS = Adults who do not stutter; AWS = Adults who stutter. * = significant Mann Whitney U group differences (see text for values).

Task

- Participants were imaged while they made phone calls to businesses
- Prompts for the phone calls were provided on a computer monitor

Conditions

- Disfluency segments
  - Three 20-second blocks containing no disfluencies were extracted from digital recordings
- Fluency segments
  - Three 20-second blocks containing disfluencies were extracted
- Listening segments
  - Three 20-second blocks where participants were listening to the speaker on the phone *prior* to speaking were extracted

Instrument

- fNIRS Hitachi ETG-4000
- 44 channels
- ROIs selected via Polhemus PATRIOT digitizer channel registration analyses

An fNIRS Investigation of Fluent and Stuttered Continuous Speech in Adults Who Stutter

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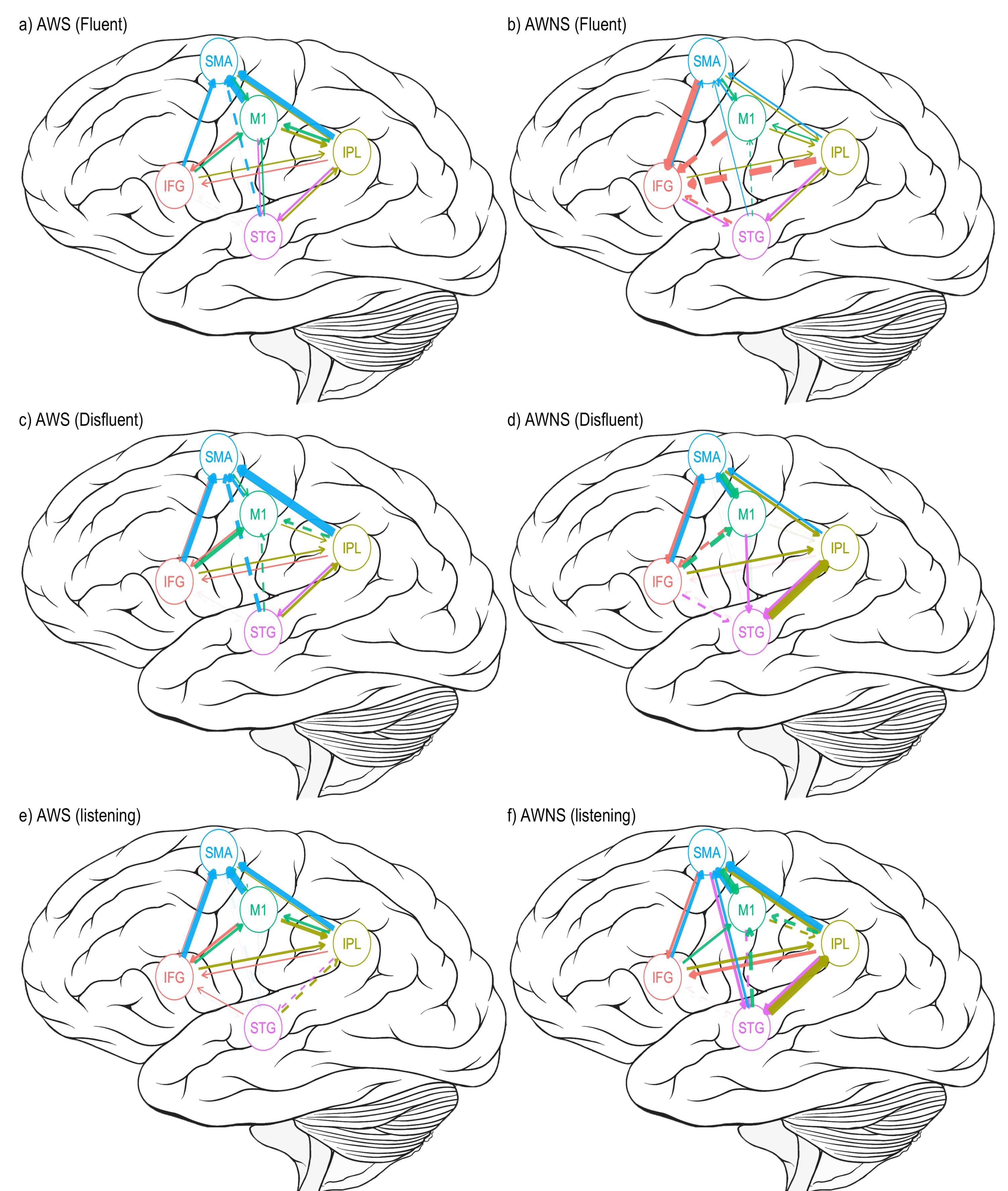
Connectivity Results



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RESULTS & ANALYSIS

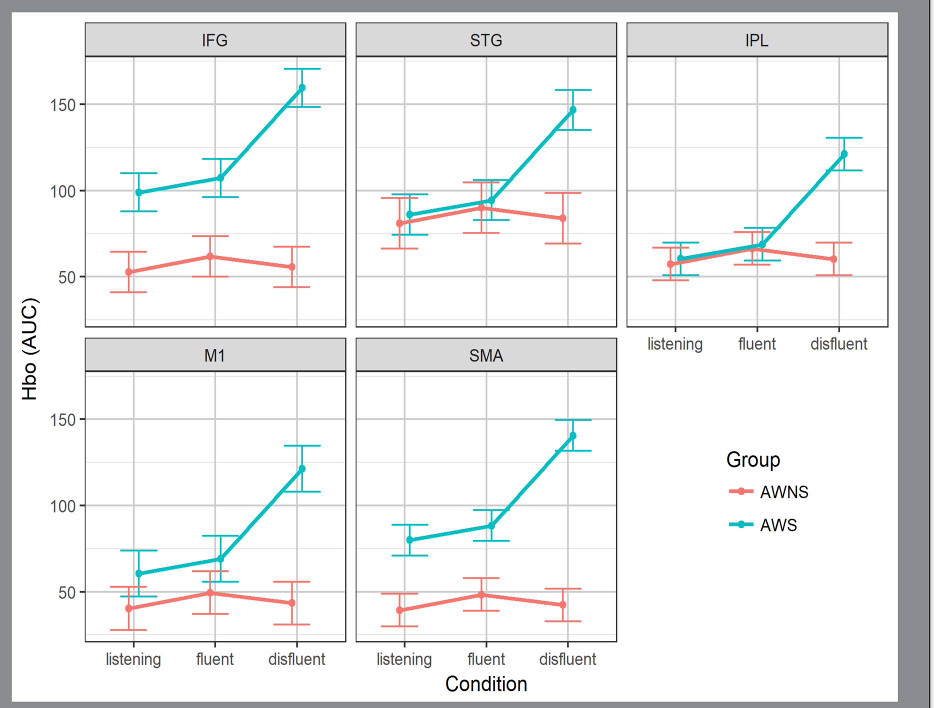
Analyses

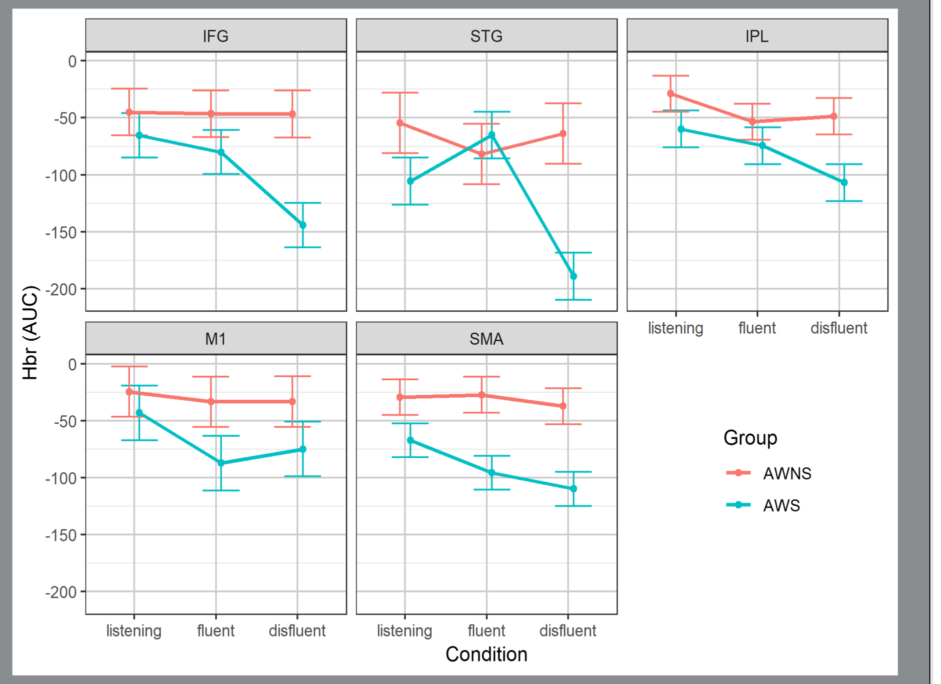
- Data filtered using NIRS-SPM
- Area under the curve (AUC):
  - Period of the waveform determined individually using Fourier series
- Linear mixed effects modeling for activation and functional connectivity (lag1) analyses

Results

- Hbo activation:
  - 2, two-way interactions (Group x Condition and Group x ROI)
- Hbr activation:
  - A three-way interaction (Group x Condition x ROI)
- AWS > AWNS: SMA for listening, fluent and disfluent
- AWS > AWNS: all ROIs when disfluent

- Connectivity:
  - AWNS had greater reciprocal connections to and from IPL-SMA and IFG-SMA in all conditions
  - AWNS had a more established STG-IPL connectome for disfluent and listening conditions





DISCUSSION

- fNIRS enables measurements of neural activation during real-world conversations.
- The phone calls made by AWS in this study emulate important variables known to increase stuttering in natural conversational contexts: telephone situation fears, talking to strangers, asking questions containing multi-syllabic words.
- Group differences in activation and connectivity in all three conditions are consistent with the hypothesis of intrinsic neurological differences between people who do and do not stutter.
- The lack of reciprocal connections between STG, IFG, IPL, SMA and M1 for AWS may be related to auditory feedback problems that interfere with fluency
- AWS lack critical connections between IFG, SMA, and MI during fluent and disfluent speech may underlie known problems with phonological coding, planning, and execution (Chang et al., 2011, 2018)

REFERENCES

1. Barrett, T.S. (2019). connectivity. URL: github.com/tysonstanley/connectivity. R package version 0.1.3
2. Bates, D., Mächler, M., Bolker, B., & Walker, S. (2015). Fitting linear mixed-effects models using lme4. Journal of Statistical Software, 67(1), 1–48. https://doi.org/10.18637/jss.v067.i01
3. Chang, S. E., Horwitz, B., Ostuni, J., Reynolds, R., & Ludlow, C. L. (2011). Evidence of left inferior frontal–premotor structural and functional connectivity deficits in adults who stutter. *Cerebral Cortex*, *21*(11), 2507–2518. https://doi.org/10.1093/cercor/bhr028
4. Chang, S., Garnett, E. O., Etchell, A., & Chow, H. M. (2018). Functional and Neuroanatomical Bases of Developmental Stuttering : Current Insights.