



# Auditory Processing Differences in Stuttering

Evidence from Load Theory of Attention

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This work was based on a pilot study conducted by  
C. J. E. Chua, J. Brinkert, N. Bashir, J. Fairnie and A. Remington.



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# Auditory Attention and Cognitive Load in Stuttering

- Auditory attention is critical for monitoring speech and processing complex acoustic environments (Daliri & Max, 2015; Phillips & Myers, 2024).
- Speech fluency may rely on automatic processing (Schneider & Shiffrin, 1977).
- People who stutter (PWS) experience difficulties when attentional demands increase (Bosshardt, 2006).
- Research in dual-task studies indicates that attention plays an important role in speech fluency (Arends et al., 1988; Bosshardt, 1999; Eichorn et al., 2019).

## Overload Theory

- Limited attentional resources become overloaded.
- Increased cognitive demand → increased disfluency.

## Regression Theory

- Diverting attention away from speech monitoring can promote more automatic speech.
- Reduced attention to speech → improved fluency.



# Load Theory, Auditory Attention and Listening Effort

- Load Theory proposes attentional resources are limited (Lavie, 1995).
- Low load:
  - spare capacity remains
  - distractors are processed
- High load:
  - capacity occupied
  - distractor processing reduced

## Why Relevant?

- PWS show auditory processing differences (Daliri & Max, 2015; Phillips & Myers, 2024).
- Increased cognitive load may increase listening effort and reduce processing efficiency.
- No study has examined Load Theory in PWS using non-speech auditory spatial listening tasks.



# Aim

To assess whether Load Theory of Attention applies to auditory processing and listening effort in PWS (Fairnie et al., 2016).

## Hypotheses

- **H1:** As load level increase, accuracy in the primary task should decrease for both groups, and PWS should be less accurate than controls.
- **H2:** Reaction times should increase with increasing load and PWS should exhibit slower responses.
- **H3:** Detection Sensitivity, (DS) in the secondary task should decrease as load level increases for both groups with lower DS in PWS compared to controls.



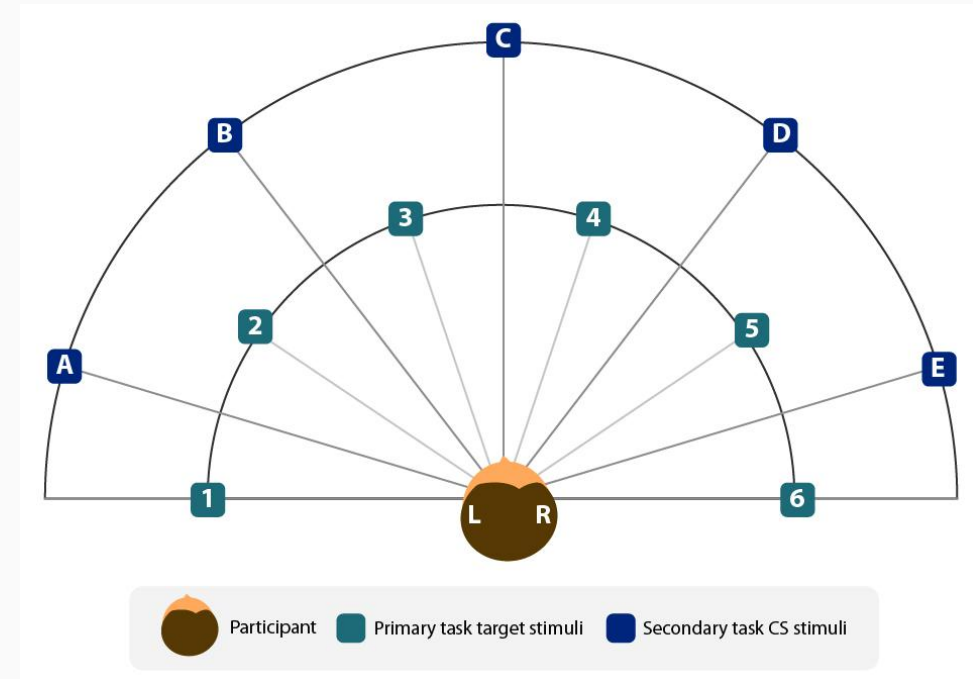
# Methods

## Participants

- 22 Controls
- 22 PWS

## Procedure

- **Primary task:** Identify target sounds (dog/lion sound).
- **Secondary Task:** Detect critical stimulus (CS; car sound).
- Load manipulation:
  - **Load 1:** Target only + CS.
  - **Load 6:** Target + CS + 5 distractor sounds.
  - Spatialised auditory stimuli simulated complex listening environments.



**Figure 1.** Spatial distribution of auditory stimuli (inner circle: targets/non-targets; outer circle: critical stimuli at -6 dB).



# Results

## Primary Task

- Accuracy: Significant group effect; significant load effect.
- RT: Significant load effect.

## Secondary Task

- DS: Significant group, load effect and Group x Load Interaction.
- People who stutter showed lower detection sensitivity than controls, particularly under high load.

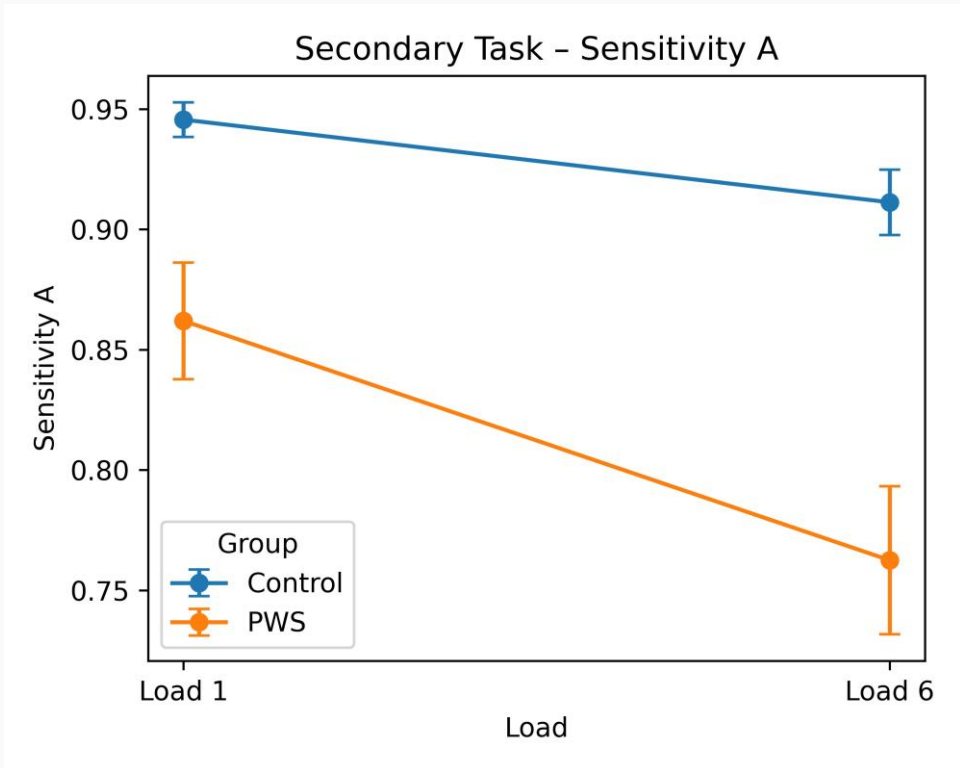


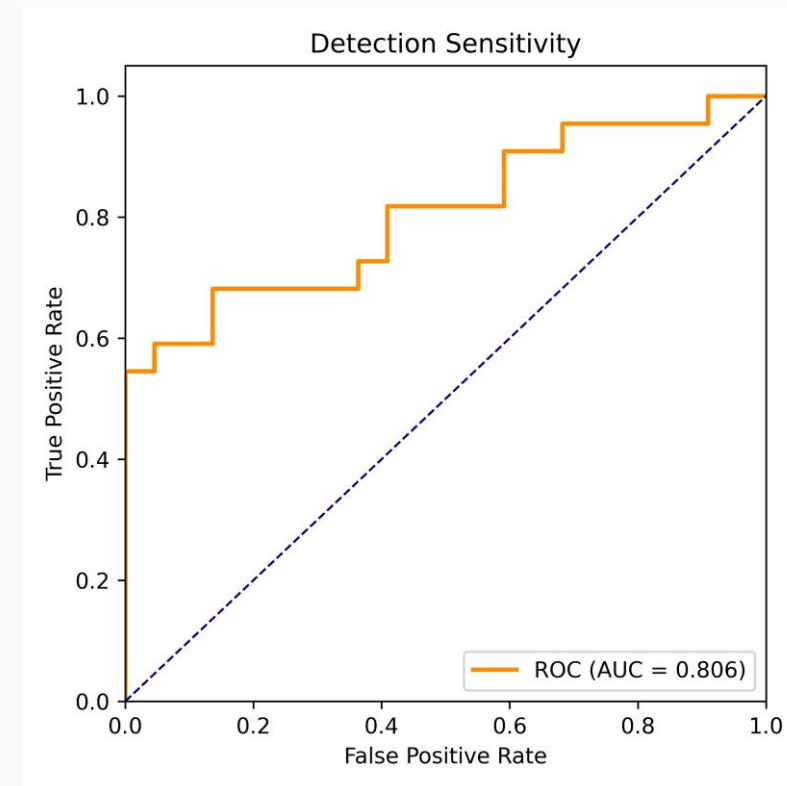
Figure 2. DS in the secondary task for each load level.



# Results

## Detection Sensitivity as a Potential Behavioural Marker

- AUC = 0.806
- Classification accuracy = 77%
- Reduced detection sensitivity was associated with PWS membership.
- DS under high load was the strongest discriminator.
- Detection sensitivity may represent a behavioural marker of auditory attentional efficiency.



**Figure 3.** ROC curve for DS predicting group membership (Controls and PWS).



# Discussion and Conclusions

## Load Theory applies in auditory processing for PWS

- Higher load:
  - ↓ Accuracy
  - ↑ RT
  - ↓ Detection Sensitivity
- Supports attentional overload account of stuttering.

## Implications

- Reduced detection sensitivity suggests increased listening effort under high auditory load.
- Auditory attentional limitations may contribute to difficulties processing complex acoustic environments.
- Detection sensitivity may provide a useful behavioural measure of auditory cognitive efficiency.



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