Preliminary Research into the Association Between Cognition and Hearing

David Welch
Ellen Giles
Renique Tenhagen
Brad Rose
Mariam Mousa
Cognitive Nourishment Theory

• Starvation
  – Social isolation
  – Environmental impoverishment

• Scarcity
  – Effort (Cognitive load)
We need to hear to nourish our minds, but listening hard absorbs our cognitive resources
Previous Research: IQ and normal hearing in childhood

Research questions

Can listening effort be assessed?

Does listening effort relate to measures of cognition and hearing?

Can we develop a quick assessment of hearing-related cognition?
Methods

• 25 Participants
• Normal-mild hearing loss
• Listening effort (dual task)
• Cognition (WAIS subtests)
• Hearing (PTA and CNC words)
• Questions (super-list of 117 questions from various sources)
Dual Task

Simultaneously presented:

• Listening Component
  – Present triplets of CNC words in noise
  – Measure proportion correct

• Working Memory Component
  – Present series of numbers on screen
  – Participant decides whether a presented number was in the series
  – Measure response time and proportion correct
Listening Component: Word-Triplets in Noise

![Graph showing the relationship between proportion correct in dual task and proportion correct in alone task. The points are scattered around the line of equality, indicating a weak positive correlation.](image)

$p=0.11$
Working-Memory Component: Response Time

p<0.01
Working-Memory Component: Accuracy

Proportion correct (dual task) vs. Proportion correct (alone)

p<0.01
Accuracy and Response Time

\[ r = -0.47 \]
\[ p = 0.02 \]
“Effort” combines changes in speed and accuracy

Larger score represents longer response time and lower accuracy in the dual task compared to alone.
No association between Effort and change in Listening Score

$r = -0.03$

$p = 0.90$
Interim summary

- Performance did not drop on the listening component.

- Speed and Accuracy decreased on the working-memory component.
  - Accuracy tended to decrease as time increased.

- Change in performance on the working-memory component (Effort) was not associated with change on the listening component.
  - But Listening Score hardly changed, so an association would be expected to be small anyway.
Cognitive Tests (from WAIS)

- Digit Span
- Matrix Reasoning
- Arithmetic
- Symbol Search
- Coding

- Attention (Brief test of attention)
Those who used more Listening Effort did **better** at mental arithmetic.
Questionnaire

• 117 questions taken from various sources

• Related to hearing, disability, listening, etc.

• 6-point rating scales

• Administered to the 25 participants
Questionnaire Reduction

• Questions preserved:
  – correlated with both hearing and cognitive measures (19 items)
  – correlated with ‘Effort’ (4 items)

• 23 item short questionnaire
  – Called the ‘Hearing and Cognition Questionnaire’ (HaCQ)
  – Reliable (Cronbach’s Alpha = 0.94)
  – Hearing and Processing subscales
  – Quick and easy
Research questions

• Developed techniques to measure ‘Effort’:
  – Dual task

• Odd associations between effort and cognition:
  – Intriguing
  – Need more people and with hearing loss

• Questionnaire looks useful
  – HaCQ
Future/Ongoing Research

- People with CIs
- Longitudinal studies of cognition
- Treatment effects
- Early intervention
Thanks

- Our participants
- Bay Audiology
- Mike Williams
Questions?