P019

COGNITION

Auditory Cognitive Determinants of Speech-in-Noise Perception

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Background

- People exhibit a wide range of listening ability in the real world, influenced by several factors across the population.
- Clinical observations often reveal that individuals with similar hearing thresholds can have vastly different real-world listening experiences.
- It has been estimated that 12-42% of people struggle to understand speech in noisy environments despite having normal hearing [1, 2], highlighting the influence of multiple factors on real-world speech listening abilities.
- Auditory cognitive differences within the population can be helpful in better understanding the origins of this variation and its relevance to real-world listening, and to what extent.

Objective

- We aimed to identify the auditory cognitive mechanisms that predict speech-in-noise perception.
- We used a large sample that allowed structural equation modelling to explore different latent variables determined by 10 indicator variables including measures of auditory grouping and general cognitive factors. Age and pure tone audiogram (PTA) were also added to the model as external predictors of speech-in-noise listening.

Methods and Materials

- This study included a sample of 186 participants aged 18-75 years (mean 49.13 years), who reported no complaints of hearing disorders.
- We performed structural equation modelling in RStudio using the lavaan package.
- The ten of indicator variables are described below:

Word-in-Noise Test (B-ITCP) [3]
CVC word sets (e.g., 'ball-fall-shawl-wall').
8-talker babble noise.

Sentence-in-Noise Test
English Oldenburg Sentences (structure: <Name> <Verb> <Number> <Adjective> <Noun>).
16-talker babble noise.

Auditory Figure Ground Detection [4]
Assesses the ability to perceive temporally coherent auditory objects against a random background, with both made of pure-tone sound elements.

Auditory Figure Discrimination [4]
Assesses gap detection ability in the figure sound, which imitates natural speech. Mainly used to force figure tracking as the gap was too long to imitate natural speech pause

Gap Detection
A test for temporal processing ability.
Across-channel gap detection.

Auditory Working Memory [5]
Includes two domains: frequency and amplitude modulation.
The task requires participants to remember and match previously heard sounds after a specific time interval.

Digit Span
The backward component is a measure of phonological working memory.

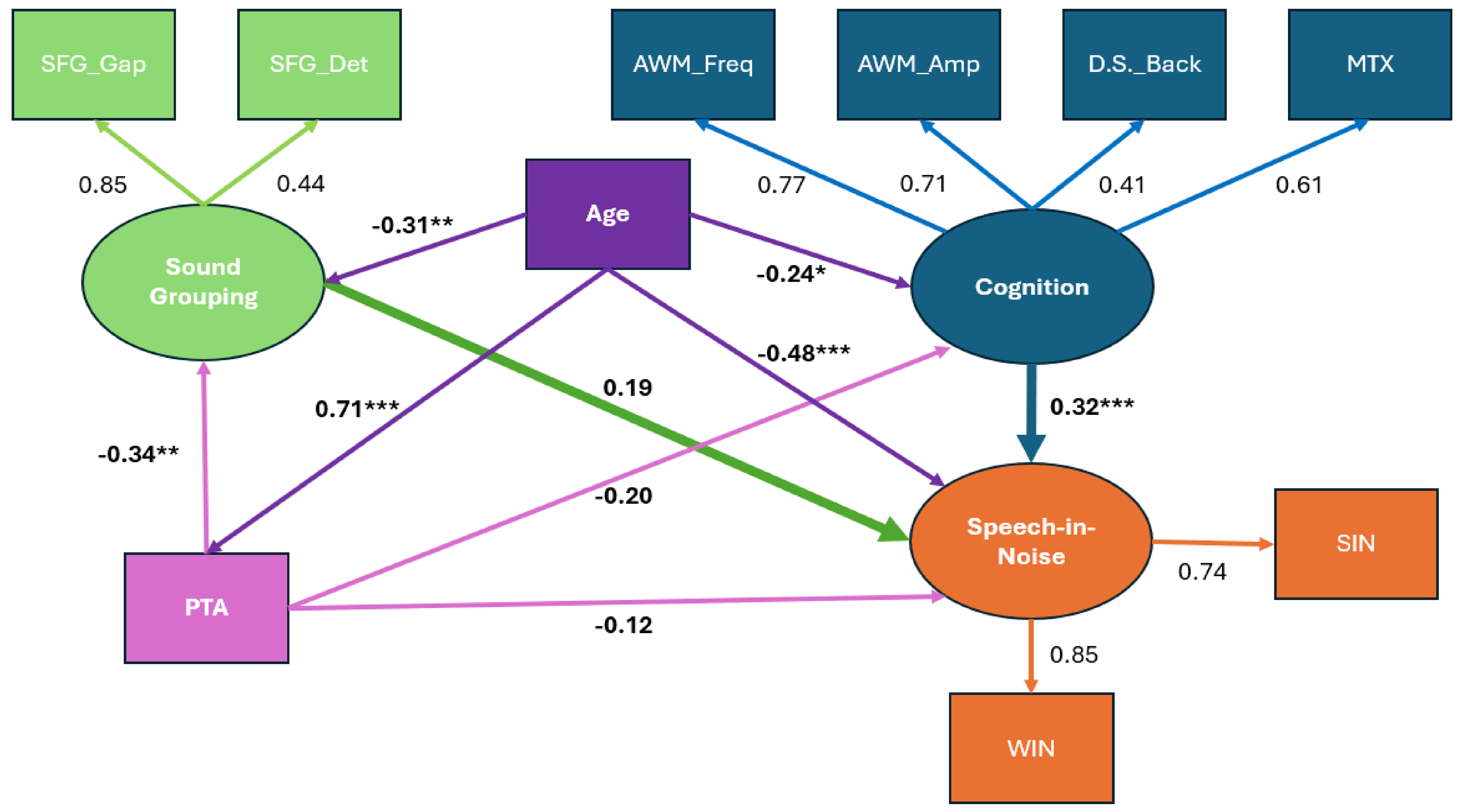
Nonverbal Reasoning
Measures fluid intelligence and novel problem-solving skills.

Goldsmith Musical Sophistication Index
A questionnaire that measures musical experience and perception.

WTAR Reading
Indicator of premorbid verbal intelligence and reading ability in adults.

- We carried out a preliminary analysis of this incomplete data set: we will carry out further analysis when we have 200 subjects.
- We explored a range of models to explain a speech-in-noise latent variable based on single-word- and sentence-in-noise indicators.
- The winning model based on fit indices is described below:

Results



* <0.05
** <0.01
***<0.001

P-value (Chi-square)
0.004
Comparative Fit Index (CFI)
0.963
Tucker-Lewis Index (TLI)
0.941
RMSEA
0.068
Adjusted R-squared for Speech-in-Noise
72.9%

- The structural equation model showed acceptable to excellent fit indices.

Conclusion

- The proposed model explained 72.9% of the variance in speech-in-noise listening.
- Age and cognitive factors (working memory and abstract reasoning) emerged as strong predictors of speech-in-noise performance.
- Sound grouping showed a weak effect that was outside significance (p = 0.067) in this preliminary analysis of an incomplete data set.
- General cognitive factors and aging are emphasised in a body of work on speech in noise listening.
- The role of sound grouping requires further evaluation.

References

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