

Cognitive and auditory factors underlying the ability to understand speech in noise: Clinical implications for diagnosis and rehabilitation

Ingrid Yeend^{1,2,3,#}, Elizabeth Beach^{1,3}, Mridula Sharma^{2,3} and Harvey Dillon^{1,2,3}

¹ National Acoustic Laboratories, ² Macquarie University, ³ The HEARING CRC

ingrid.yeend@nal.gov.au

MOTIVATION

A proportion of listeners report problems understanding speech in background noise yet their audiogram is clinically normal. A growing body of research in the cognitive hearing science field suggests that both hearing and cognition are important for understanding speech in challenging listening situations.

Study objectives

- 1) to determine **which factors predict the ability to understand speech in noise;**
- 2) to work towards a new diagnostic tool to identify which normal-hearing adults are likely to experience difficulty understanding speech in noise.

METHODS

Using data from a larger study (n = 122) investigating 'hidden hearing loss', we calculated a **composite speech-in-noise score (CSS)**, based on a self-report measure (SSQ12 speech) and two speech-in-noise (LiSN-S and NAL-DCT) scores¹. We identified **low-** and **high-performing subgroups** (n = 30 in each) using the CSS, then compared the two groups on 17 variables, e.g., hearing thresholds, temporal perception, noise exposure, attention and working memory. There were significant differences on 10 variables (see table below). We then fit a regression model using these predictor factors to determine their relative effect on the CSS.

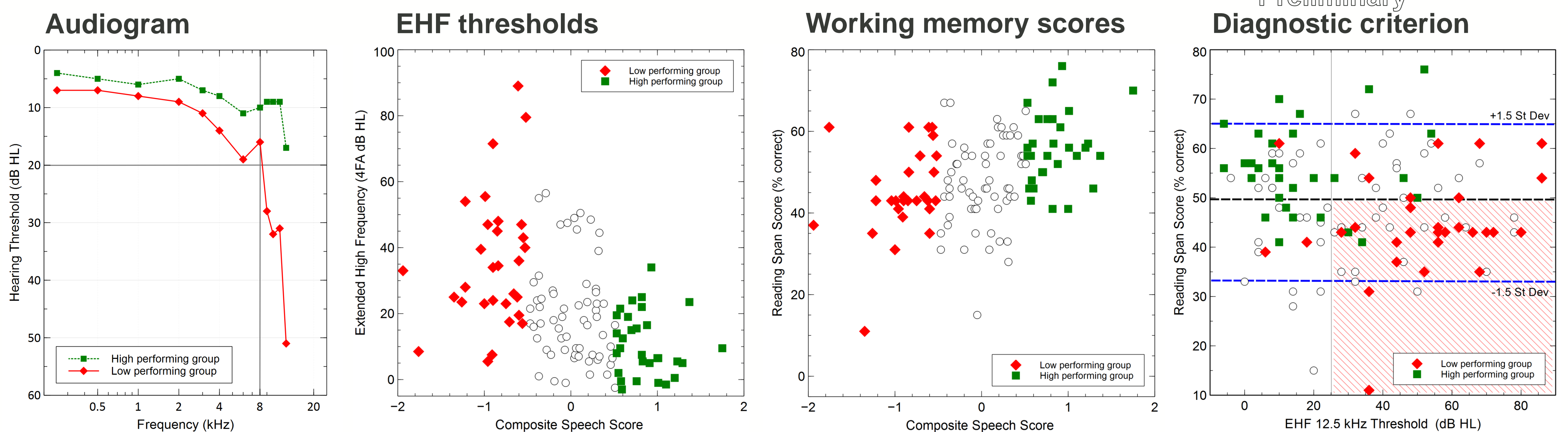
RESULTS

Main finding: poorer extended high frequency (EHF) hearing thresholds and working memory scores were highly significant predictors of the ability to understand speech in noise.

Multiple regression weights

Variable	Low-Performing		High-Performing		Composite Speech Score	
	Mean	SD	Mean	SD	b	p value
Age	48.47	6.65	42.33	4.79	-0.02	0.05
Gender (%)	♀: 37	-	♀: 63	-	-0.21	0.05
LF hearing	7.67	4.29	5.10	3.84	-0.01	0.47
HF hearing	14.53	8.35	8.58	6.14	-0.01	0.54
EHF hearing	36.96	19.96	11.06	9.57	-0.01	0.0062
TFS	66.65	44.04	36.46	25.36	-0.0023	0.08
AM90	-22.93	4.31	-25.11	3.91	-0.01	0.53
TRT	61.00	2.70	58.59	3.21	0.0004	0.06
Attention (TEA)	7.13	2.05	8.35	2.03	-0.01	0.70
Working memory (RST)	44.82	10.47	55.68	8.98	0.02	0.0006

Model Strength ($r^2 = .46$, $p < .001$)



CLINICAL IMPLICATIONS

Preliminary diagnostic criteria: these results suggest that extended high frequencies, a possible early warning sign of auditory impairment, and working memory evaluation could be included in diagnostic assessments for normal hearers experiencing speech-in-noise difficulties e.g., restaurants, workplaces, open plan offices.

Rehabilitation: online working memory training and/or extended bandwidth hearing devices may be beneficial for people presenting with problems understanding speech in noise.