Awesome title

Best first author[1], *Honorable co-authors*[2]

[1]Dep-A
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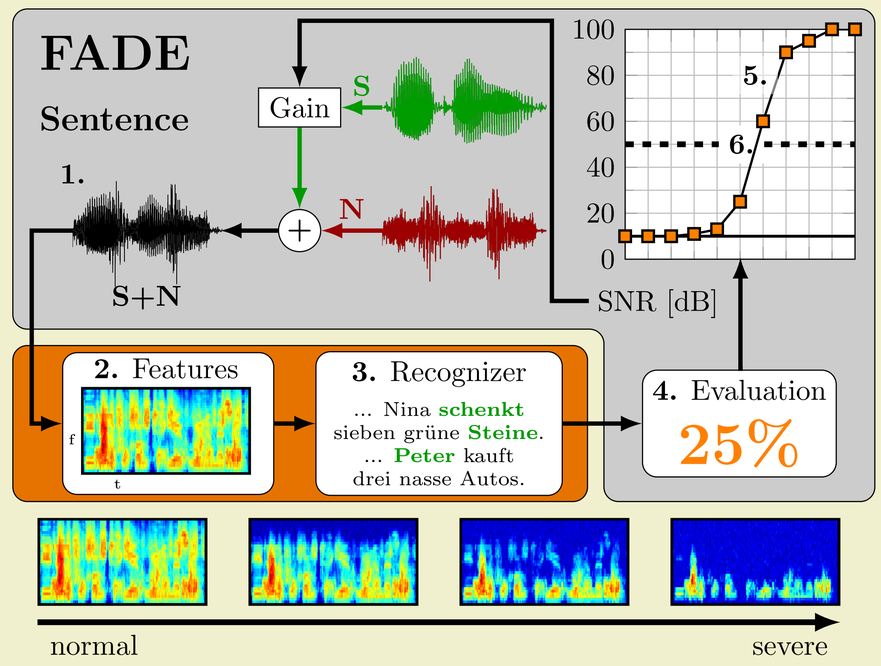
Summary

Listeners with impaired hearing show decreased speech recognition performance, and complain about communication problems in difficult acoustic environments. Recently, the effect of impaired hearing on speech reception thresholds (SRTs) was examined in [1]. Two domains of assumed linear relationship between SRTs and the pure-tone average (PTA) were identified; one for listening in noise and one for listening in *quiet*. Two models were used to predict the SRTs, i.e., the framework for auditory discrimination experiments [FADE, 2] and the speech intelligibility index [SII, 3]. Overall, FADE was found to be more accurate than the SII, especially for very steep hearing losses. In the listening-in-noise domain, the SRTs were underestimated by FADE and overestimated by the SII. This is because FADE here explicitly assumes no supra-threshold component of hearing loss, while the SII evidently does. These results suggest that a supra-threshold component of hearing loss should be considered separately from the hearing threshold even both are probably correlated. Further, the absolute hearing threshold could only partly explain the SRTs

Model



Methods

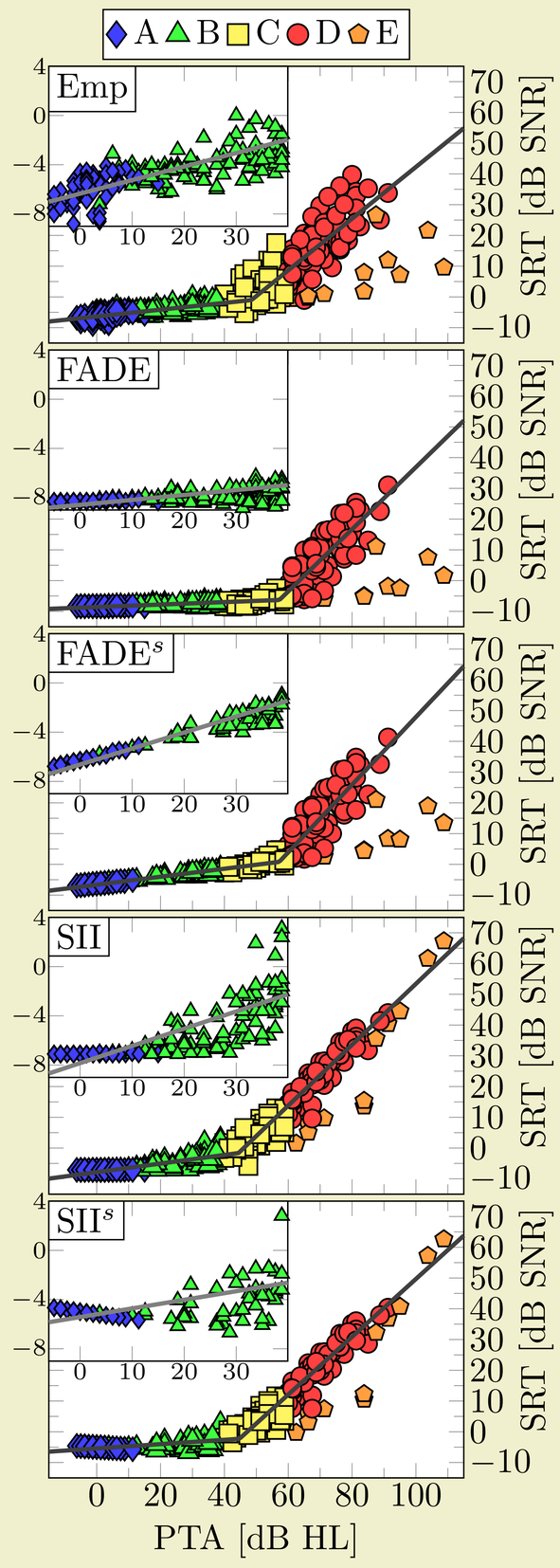
- Empirical SRTs of 315 subjects acquired with the German matrix test [4].
- Four listener groups from normal (A) to severe hearing impaired (D), and one group with special cases (E).
- Stationary noise masker at 65 dB SPL.
- Two domains: Listening in noise (ABC_1) and *effectively* listening in quiet (C_2D)
- Models: FADE and the SII.
- Only absolute hearing thresholds used for modeling
- Half of group ABC_1 used for fitting *typical* correction of SRTs (for FADE^s, and SII^s):

$$C_{SRT}(PTA) = \alpha + \beta \cdot PTA$$

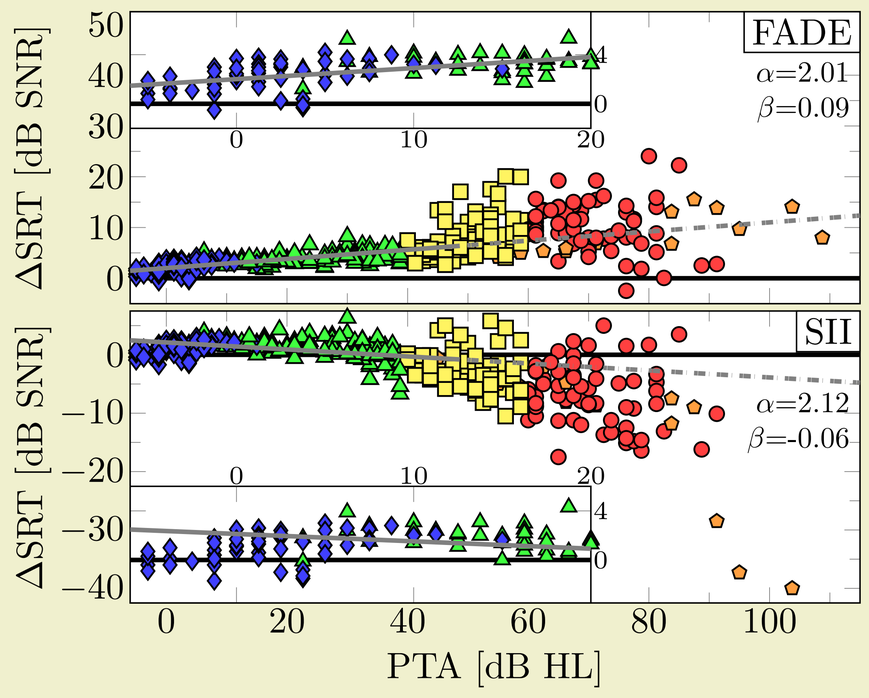
Discussion

- Models can hear noise with FADE being more sensitive than the SII.
- FADE predicted the SRTs of all groups contrary to the SII which failed when predicting SRTs of hearing-impaired listeners with intense drops in threshold at high frequencies (group E)
- Best subjects are as good as FADE: Room for improvement
- Subjects generally better than the SII: Over the top
- FADE^s: FADE misses crucial supra-threshold factors of hearing-impairment
- SII^s: The SII evidently incorporates supra-threshold factors, as a typical correction did not lead to better predictions

Results



Group	Data	R^2		RMSE [dB]	
All	FADE	0.84	[0.81 0.87]	7.57	[7.06 8.07]
	FADE^s	0.88	[0.86 0.91]	3.81	[3.34 4.27]
	SII	0.82	[0.75 0.89]	6.77	[5.19 8.34]
	SII^s	0.79	[0.70 0.88]	6.82	[5.00 8.61]
ABC_1	FADE	0.34	[0.25 0.45]	4.30	[3.98 4.63]
	FADE^s	0.65	[0.58 0.76]	1.38	[1.06 1.74]
	SII	0.57	[0.50 0.65]	2.12	[1.93 2.31]
	SII^s	0.41	[0.30 0.52]	1.95	[1.68 2.21]
C_2D	FADE	0.81	[0.76 0.85]	10.63	[9.93 11.33]
	FADE^s	0.81	[0.76 0.86]	5.02	[4.39 5.61]
	SII	0.81	[0.77 0.85]	6.94	[6.28 7.60]
	SII^s	0.81	[0.76 0.85]	5.75	[5.16 6.33]
E	FADE	0.92	[0.72 0.99]	9.04	[7.11 10.72]
	FADE^s	0.93	[0.78 0.99]	2.97	[2.44 3.51]
	SII	0.59	[0.40 0.92]	22.59	[12.34 30.54]
	SII^s	0.56	[0.36 0.92]	20.85	[10.83 28.60]



Conclusion

- Speech recognition of many hearing-impaired listeners is not only affected by increased hearing thresholds but also by supra-threshold components.
- FADE (in contrast to the SII) allows to disentangle the contribution of increased hearing thresholds from the supra-threshold component which was found to be partially correlated with the increased hearing thresholds even for mild hearing losses.
- For *special* audiograms, the predictions with FADE are far superior to those with the SII, probably because the assumption of static weights for independent frequency bands is not correct.

[1] Nina Wardenga, Cornelia Batsoulis, Kirsten C Wagener, Thomas Brand, Thomas Lenarz, and Hannes Maier. Do you hear the noise? The German matrix sentence test with a fixed noise level in subjects with normal hearing and hearing impairment. *International journal of audiology*, 54(sup2): 71–79, 2015.

[2] Marc René Schädler, Anna Warzybok, Stephan D Ewert, and Birger Kollmeier. A simulation framework for auditory discrimination experiments: Revealing the importance of across-frequency processing in speech perception. *The Journal of the Acoustical Society of America*, 139(5):2708–2722, may 2016.

[3] ANSI. S3. 5-1997, methods for the calculation of the speech intelligibility index. *New York: American National Standards Institute*, 19:90–119, 1997.

[4] Birger Kollmeier, Anna Warzybok, Sabine Hochmuth, Melanie A Zokoll, Verena Uslar, Thomas Brand, and Kirsten C Wagener. The multilingual matrix test: Principles, applications, and comparison across languages: A review. *International Journal of Audiology*, 54(sup2):3–16, 2015.

Fade4all:

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