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# LOUDNESS BALANCING BETWEEN AUDIQUEEN'S DIFFERENT SPEECH NOISES

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## Introduction

The [A&E Azimuth localization test](#) presents sound from [SoundC](#) speakers. The default stimulus is a broadband speech-shaped noise (Wouters et al., 1994).

We've created more stimuli, namely

- A 3 kHz high-pass filtered (HPF) noise,
- A 400 Hz low-pass filtered (LPF) noise.

The main goal of this study was to balance the subjective loudness perception between the three stimuli.

## Materials and Methods

### Subjects entry criteria

The subjective loudness balancing was performed on five normal-hearing people aged 18 years or older.

### Test procedure

The standard speech noise from Wouters et al. (1994) was used as the reference stimulus. For the comparisons, amplified and attenuated versions of the HPF and LPF noises were created within 2 dB steps ranging from -12 dB to + 14 dB.

The filtered noises were the alternated with the reference noise, whereby the presentation level of the filtered noise was modified in an adaptive algorithm to match the loudness of the stimulus.

All repeated tests were performed in soundproof rooms and the same condition, either with headphones or in free field condition by means of AudiQueen psychoacoustic test suite (Otoconsult NV, Antwerp, Belgium).

Descriptive statistics were used for the analysis of data.

## Results

The results of the adaptive algorithms for the HPF and LPF noises are shown in Table 1 and Table 2, respectively.

The cells highlighted in red in the tables show the levels at which the reference and the tested stimuli were perceived as equally loud for each participant for more than 50% of the time.

**Table 1. Adaptive algorithm results for the HPF noise**

HPF (dB)	S1	S2	S3	S4	S5
14					
12			L		
10					L
8	L	L		LLL	
6				OOOLOO	O
4	LL	LL	LL	OLOOOSO	LLL
2	LLLL	OOLOO	LL	OOOSSS	OOLL
0	OLLLLO	SSSOO	OLOLLL	SS	OOOO
-2	OLOSSO	SS	OOLOOL	S	SSS
-4	SSSS	S	SOOSOS	S	
-6			SSS		S
-8			S		
-10	S	S			
-12					

*L= louder, S= softer, O= equal*

**Table 2. Adaptive algorithm results for the LPF noise**

LPF (dB)	#1	#2	#3	#4	#5
14					
12					
10					
8		L			
6		OOOLL	L	L	L
4	LL	OOOLO	L	LLL	LLL
2	OOLLLO	SOSSOO	LLL	OSOSO	OLOO
0	OOSOLO	SSSO	OSOOOO	SSS	OSSS
-2	SSSSS	S	OSSSOS	SSS	OSSS
-4	S		SSS		S
-6				S	S
-8		S			
-10					
-12			S		

*L= louder, S= softer, O= equal*

The equivalent loudness levels are presented in Table 3.

**Table 3. Individual and group results**

	HPF	LPF
S1	-2 dB	0 dB
S2	2 dB	4 dB
S3	-2 dB	0 dB
S4	4 dB	2 dB
S5	0 dB	2 dB
P25	-2 dB	0 dB
P50 (median)	<b>0 dB</b>	<b>2 dB</b>
P75	3 dB	3 dB

*re: reference stimulus*

## Discussion & Conclusions

There is no need for attenuation or amplification at the 3 kHz HPF version of the speech noise from Wouters et al. (1994). Both the HPF noise and the standard wide-band noise are perceived as equally loud. The 400 Hz LPF version, however, needed an amplification of 2 dB SPL to be perceived equally loud as the original wide-band speech noise (Wouters et al., 1994).

These corrections have been applied to the original sounds and they are now available in Audiqueen.

## References

Wouters, J., Damman, W., & Bosman, A. J. (1994). Vlaamse opname van woordenlijsten voor spraakaudiometrie. *Logopedie: informatiemedium van de Vlaamse vereniging voor logopedisten*, 7(6), 28-34.