Selecting laboratory test scenarios

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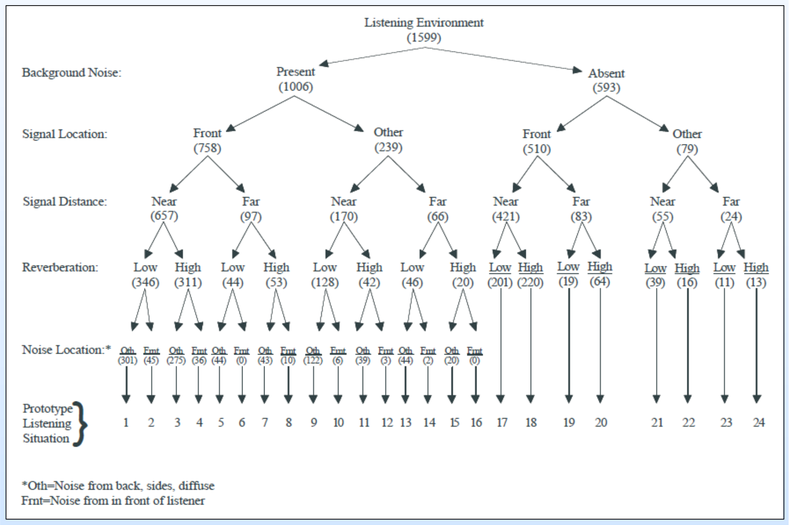
Introduction

When performing hearing-related laboratory tests, a selection of test scenarios is needed. Traditionally, various speech situations (in quiet or in noise) have been implemented, with varying degree of ecological validity. Some research groups have suggested a set of "prototype listening situations" that can be used for laboratory testing.

Walden and colleagues (1984, 1997) introduced the term "Prototype Listening Situations" (PLSs). Retrospective questionnaire of HA benefit, 128 participants.

PLS1: Listening to Speech in Quiet
PLS2: Listening to Speech with Reduced Cues
PLS3: Listening to Speech in Background Noise
PLS4: Listening to Environmental Sounds

Walden and colleagues (2004). Acoustics model (24 PLSs) qualified by reports of "active" listening situations using EMA, 17 participants.



Wu and colleagues (2012). Pen and paper EMA study (27 participants) reporting on activities and environments.

Table 2. Activity and Environment Categories Provided in the Journal

	Environment Category				
	Outdoors		Indoors		
Activity Category	A. Outdoor traffic *(Traffic)*, %	B. Outdoor other than traffic, %	C. Home, ≤10 people *(Home)*, %	D. Indoor other than home ≤10 people *(nonHome)*, %	E. Crowd of people, ≥11 people *(Crowd)*, %
1. Conversation: small group (≤3 people)	[1] 2.3	[2] 0.7	[3] 9.8	[4] 5.9	[5] 1.3
2. Conversation: large group (>4 people)	[6] 0.5	[7] 0.8	[8] 2.4	[9] 3.3	[10] 3.5
3. Conversation: phone	[11] 0.1	[12] 0.02	[13] 0.8	[14] 0.2	[15] 0
4. Speech listening: live	[16] 0.3	[17] 0.03	[18] 0.5	[19] 0.5	[20] 1.5
5. Speech listening: media	[21] 3.7	[22] 0.1	[23] 20.9	[24] 2.2	[25] 0.4
6. No or little conversation or speech-listening involved	[26] 3.6	[27] 2.5	[28] 24.0	[29] 6.3	[30] 2.0

Note: Terms in italics are the label of a given environment category. Numbers in square brackets represent the event numbering. Values following brackets represent the mean percentage of time of a given event, referenced to the time duration of all events, across all participants.

Wu and colleagues (2018). Smartphone-based EMA and audio recordings during many weeks, 20 participants. Only speech analyzed.

TABLE 1. General prototype listening situations

Subgroup	Numbering	Cluster Size	Speech Level (dBA)	Noise Level (dBA)	Signal to Noise Ratio (dB)	Visual Cues	Talker Location	Noise Location
Quiet	1	115 (16%)	63.9	50.5	13.4	Always	Front	N/A (quiet)
	2	96 (13%)	61.5	50.6	10.9	Sometimes	Side	N/A (quiet)
	3	45 (6%)	60.4	50.4	10.0	Sometimes	Front	N/A (quiet)
	4	37 (5%)	65.4	51.0	14.4	Always	Side	N/A (quiet)
	5	20 (3%)	62.6	50.7	11.9	Sometimes	Back	N/A (quiet)
Diffuse noise	6	93 (13%)	68.5	59.9	8.6	Always	Front	All around
	7	87 (12%)	67.3	60.9	6.4	Sometimes	Side	All around
	8	74 (10%)	68.8	64.0	4.8	Sometimes	Front	All around
	9	53 (7%)	68.7	59.4	9.2	Always	Side	All around
	10	20 (3%)	67.4	60.6	6.7	Sometimes	Back	All around
Nondiffuse noise	11	42 (6%)	64.4	54.9	9.5	Always	Front	Front
	12	36 (5%)	69.5	61.9	7.6	Sometimes	Side	Side

TABLE 2. Noisy prototype listening situations

Numbering	Cluster Size	Speech Level (dBA)	Noise Level (dBA)	Signal to Noise Ratio (dB)	Visual Cues	Talker Location	Noise Location
1	153 (55%)	67.4	63.7	3.8	Always	Front	All around
2	127 (45%)	67.6	62.8	4.8	Sometimes	Side	All around

"The term prototype listening situations… refers to a set of situations that can represent a large proportion of the everyday listening situations experienced by individuals." (Wu et al. 2018)

Wolters and colleagues (2016). Common Sound Scenarios (CoSS) framework. Literature study, 187 listening situations categorized using a context-based approach.

Intention	Speech communication						Focused listening				Non-specific			
Task	2 people		More than 2 people		Through device		Live sounds		Through media device		Monitoring surroundings		Passive listening	
	Two people having a conversation		Several people having a shared conversation		Two or more people having a shared conversation through a communication device		Focused listening to sound without being able to control the sound source		Focused listening to sound while being able to control the sound source		Conscious or unconscious screening of sound of relevance to current activity		Unconscious perception of environmental sounds, without relevance to current activity	
Scenario	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11	#12	#13	#14
Occurrence	■	■	■	■	■	■	■		■	■	■	■	■	■
Difficulty		■	■	■	■	■	■	■						
Importance	■	■	■	■	■	■	■	■	■	■		■		
Scenario	Conversation at home	Conversation on metro	Meeting in an office	Car ride with family	Phone call at home	Mobile call in the street	Lecture	At a concert	Watching TV	Listening to car radio	Vacuum cleaning	City walk	Relaxing with a book	Relaxing on train

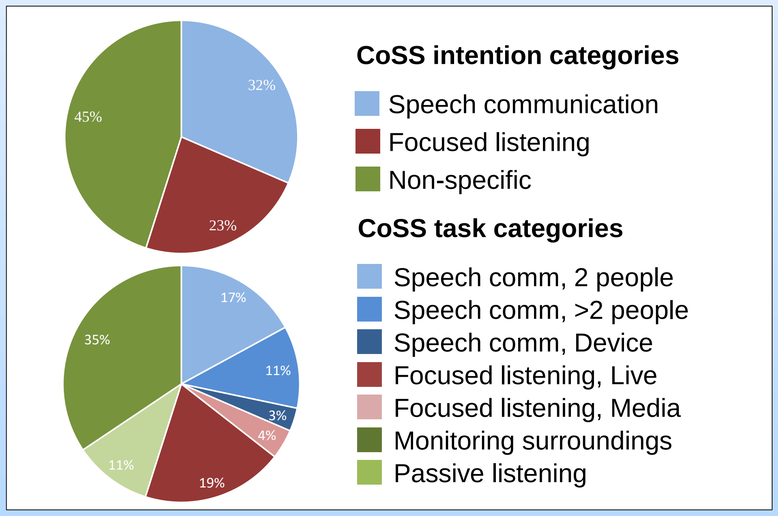
Current study

Method

- 19 elderly participants with hearing impairment
- Prompted EMA responses every 2 h (and self-initiated)
- 1-week field-trial period

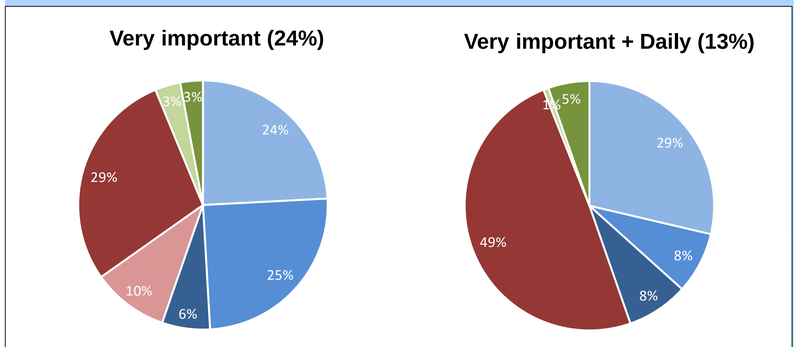
Location	Importance to hear well
Situation	Difficulty to hear
Noise presence and type	Occurrence

Results



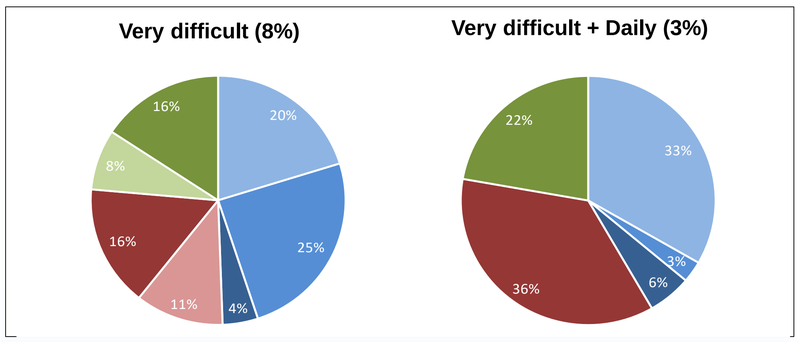
Focus on commonly occurring situations: speech communication focused listening to speech or other sounds, but also situations without focused listening.

Very important to hear well



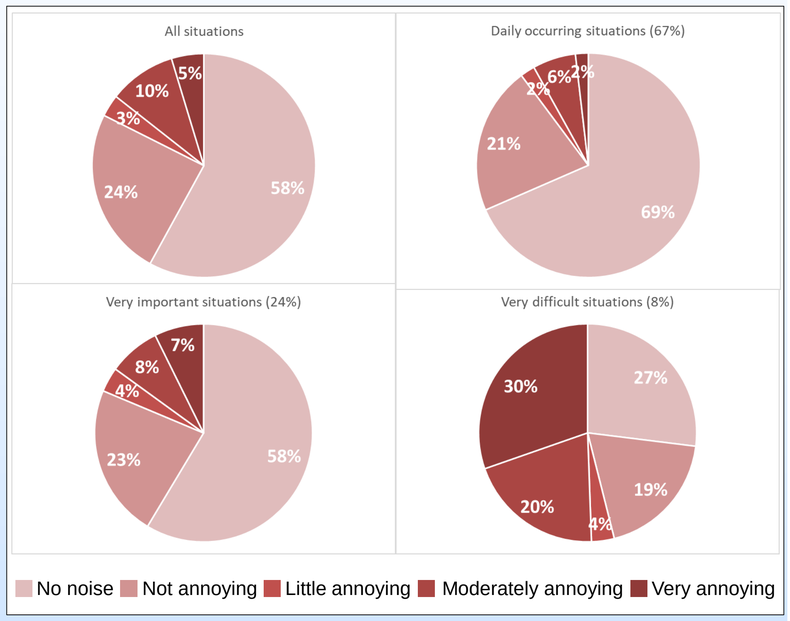
Focus on importance to hear well: speech communication should have priority, but when combined with occurrence, also TV/radio situations should be included.

Very difficult to hear



Focus on difficulty to hear: speech communication, but also noisy non-specific situations.

Noise distributions



Generally not noisy, except for situations judged to be difficult to hear in.

Conclusions

- Selection of a limited set of laboratory test scenarios could be important for research, development and clinical work
- Selection should prioritize ecological validity and include both active and passive listening
- Selection should be based on data collected in people's everyday life, using a multi-method approach
- Frequency of occurrence and rated difficulty may be suitable selection criteria
- Important data on speech situations by Wu et al. (2018)

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