

Sound Categorization and Identification in Prelingually Deaf Children with Cochlear Implants

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Background

- Children with cochlear implants (CIs) may have difficulty with auditory categorization as the device cannot reliably transform certain acoustic features (ie., pitch and range of frequencies) [1]
- Although speech perception remains the principal focus of rehabilitation following cochlear implantation, understanding how children with CIs process everyday sounds should not be ignored
- Much of what we know about auditory categorization in CI users is from studies on post-lingually deafened adults [2, 3]
- Rehabilitation and performance on auditory categorization tasks after years of hearing experience will differ greatly from prelingually-deaf children who do not have the same experience, and therefore may be utilizing different underlying mechanisms to categorize and identify environmental sounds [4]

Participants

- Thirty-nine 3- to 6-year-old children assigned to cochlear implant group (n=10; M_{Age}=5y4m13d; SD=1y2m21d), or to the normal hearing group (n=29; M_{Age}=4y8m26d; SD=0y9m27d)

Eligibility Requirements:

- To be eligible for the normal hearing (NH) group, a child must be between 3 to 6 years of age
- To be eligible for the CI group, a child must:
 - Have a severe to profound hearing loss identified prior to 1 year of age
 - Be implanted at or before 36 months of age

Subject No.	Gender	Age at Test	Age CI Implantation	Configuration	Right Ear Device	Left Ear Device
1	F	4; 0, 16	13 months	Unilateral	CI	HA
2	F	3; 11, 15	12 months	Unilateral	HA	CI
3	M	5; 6, 0	12 months	Bilateral	CI	CI
4	F	4; 11, 24	24 months	Unilateral	CI	HA
5	M	4; 8, 9	13 months	Bilateral	CI	CI
6	M	5; 0, 5	13 months	Bilateral	CI	CI
7	M	5; 1, 3	11 months	Bilateral	CI	CI
8	F	5; 3, 12	11 months	Bilateral	CI	CI
9	F	5; 5, 29	12 months	Bilateral	CI	CI
10	F	5; 2, 12	11 months	Bilateral	CI	CI

Methods

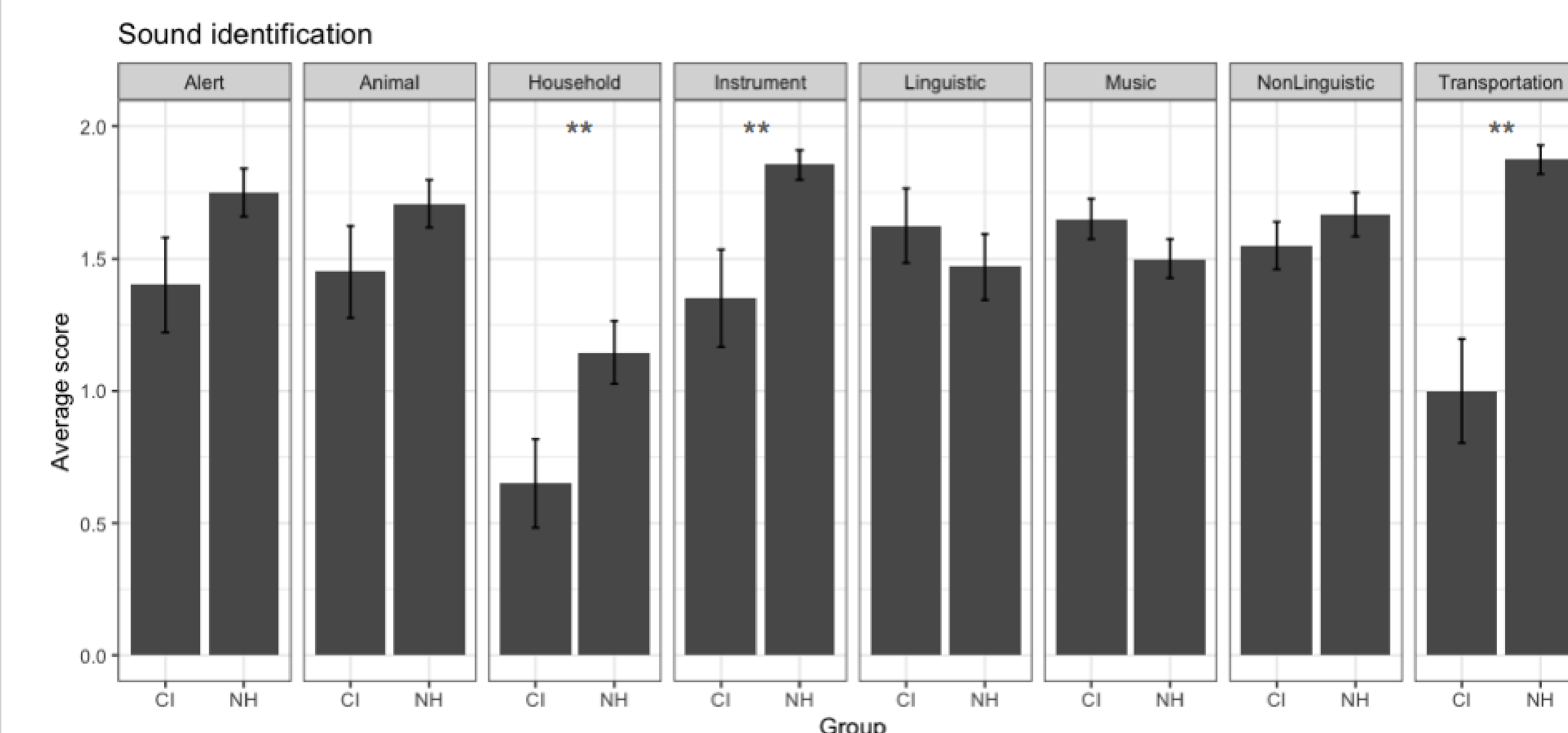
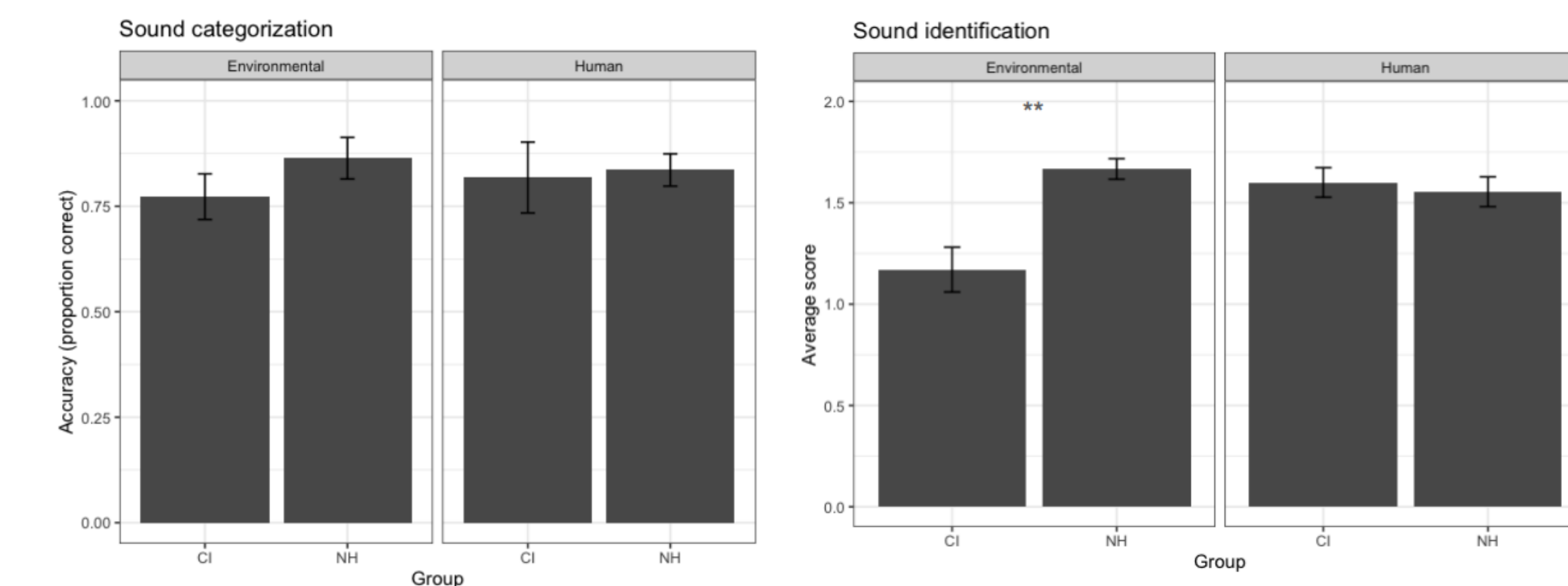
Auditory Categorization & Sound Identification Tasks

- Training Phase consisted of 4 trials with immediate feedback
- Test Phase consisted of 10 trials x 2 sets = 20 sounds overall (10 human, 10 environmental) with no feedback
- Child would be asked to:
 - Categorize the sound by verbal response or point
 - Identify and label the sound

Category	Subcategory	Description	
Human	Linguistic	Man CVC word	
		Woman CVC word	
		Baby CV	
		Woman sentence	
	Non-linguistic	Crying	
		Laughing	
		Coughing	
		Yawning	
		Whistling	
	Music	Singing	
		Animals	Dog
			Sheep
Non-Human Environmental Sounds	Household	Door close	
		Vacuum	
	Instruments	Piano	
		Drum	
	Alert	Telephone	
		Door bell	
	Transportation	Car	
Airplane			

Score	Index	Description
2	A	Correct and stable identification
	B	Fair, stable identification
	C	Fair, but not stable identification
1	D	Identification with a sound close to the proposed sound
	E	Identification by the superordinate category
0	F	Imitation of sound only
	G	Confused
	H	Not identified

Results



Discussion

- Results suggest:**
 - Children with typical hearing and children with CIs perform similarly when categorizing human-generated sounds
 - Children with CIs have more difficulty categorizing certain environmental sounds, particularly household items, instruments, and transportation sounds
 - Taken together, these findings suggest that processing environmental sounds can be challenging for children with CIs
- Ongoing Analysis**
 - Further acoustic analysis and investigating correlations with acoustic features of the sound stimuli will confirm differences in identifying speech and linguistic sounds from general non-linguistic human sounds
 - Confirm if children with CIs adopt a different strategy based on a musical listening mode [4]

REFERENCES

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 [4] Berland, A., Collett, E., Gaillard, P., Guidetti, M., Strelnikov, K., Cochard, N., Barone, P., & Deguine, O. (2019). Categorization of everyday sounds by cochlear implanted children. *Scientific Reports, 9*(1), 3532-3532.

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