Executive function in deaf native signing children

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INTRODUCTION

Deaf children experience difficulties in executive function (EF) (Figueras, Edwards, Langdon, 2008; Hintermair, 2013).

The auditory deprivation hypothesis: the lack of auditory input itself causes high-level cognitive skills deficits, inter alia EF problems (Conway, Pisoni, & Kronenberger, 2009).

The early language deprivation hypothesis: EF impairment in deaf children is connected with language delay and not with deafness *per se* (Hall, Eigsti, Bortfeld, & Lillo-Martin, 2017).

RESEARCH GOAL

We aimed to establish if deafness itself causes EF deficits, using experimental tasks to assess the EF level of deaf native signing children in comparison to hearing children.

PARTICIPANTS

	Deaf children Native signers DD	Hearing children HH
Number	N=20	N=20
L1	PJM (Polsih Sign Language)	Polish (spoken)
Cochlear implant	---	---
Parents	Deaf	Hearing
Age	M= 9;11 SD=2;00 min=6;1 max=12;11	M= 10,00 SD=1;11 min= 6;6 max=12;7
	Children mached on age	
Gender	4♂, 16♀	4♂, 16♀
	Children mached on gender	
Intelligence	No significant difference (Raven's progressive matrices) t(38)=-1,523, n.s.	

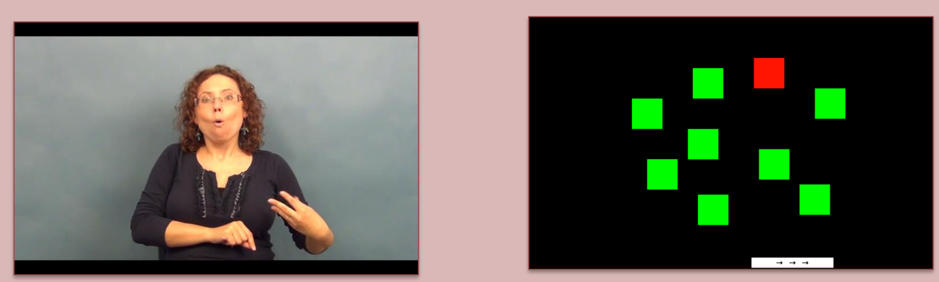
METHODS

NON-VERBAL EF ASSESSMENT TOOLS (COMPUTER VERSION):

1. Cognitive flexibility – Wisconsin Card Sorting Task

Task: Match the card from the top to one of four different cards on the bottom in accordance with a changing rule that should be discovered

2. Working memory (visual-spatial) – Corsi Block



Task: Repeat a sequence of lit up blocks in reverse order

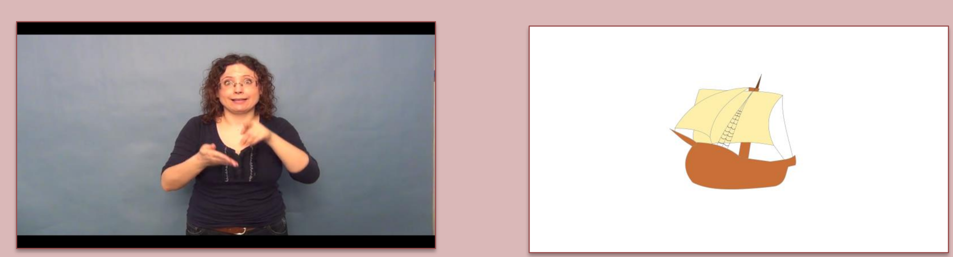
3. Planning - Tower of London

Task: Put the beads on the pegs on your board according to the model board on the top of the screen (with a limited number of movements and one bead at a time)

4. Inhibitory control – Simon task

Task: Tap the left SHIFT key when the blue butterfly is on the screen and tap the right SHIFT key when the red butterfly Appears

4. Inhibitory control – Go/no go task



Task: Tap the SPACE key when the boat appears on the screen and do not react when the fountain Appears

RESULTS

1. Cognitive flexibility – Wisconsin Card Sorting Task

The intergroup differences were not significant

($F(1,37) = .613$, $p = .439$, $\eta 2 = .016$)

2. Working memory (visual-spatial) – Corsi Block

The intergroup differences were not significant

($F(1,33) = 1.836$, $p = .185$, $\eta 2 = .053$).

3. Planning – Tower of London

The intergroup differences were not significant

($F(1,37) = 1.166$, $p = .287$, $\eta 2 = .031$).

4. Inhibitory control – Go/no go task

The intergroup differences were significant
($t(30) = 2.716$, $p = .011$, *Cohen's* $d = .182$)

The intergroup differences were not significant
between the hearing and deaf older groups (age ≥ 10;00)
($t(19)= -.424$, $p= .677$, *Cohen's* $d = 0.086$)

The intergroup differences were significant
between the two younger groups (age < 10;00)
($t(15)= -4.474$, $p = .000$, *Cohen's* $d = 1.847$)

5. Inhibitory control – Simon task

The intergroup differences were significant
($F(1,37) = 5.312$, $p = .027$, $\eta 2 = .126$)

The intergroup differences were not significant
between the hearing and deaf older groups (age ≥ 10;00)
($F(1,15) = 15.744$, $p = .001$, $\eta 2 = .512$)

The intergroup differences were significant
between the two younger groups (age < 10;00)
($F(1,19) = .561$, $p = .463$, $\eta 2 = .029$)

DISCUSSION

The findings presented here provide counter-evidence to the auditory deprivation hypothesis; deafness *per se* did not degrade EF skills in deaf children, who obtained similar scores to their hearing peers on a variety of performance-based EF tasks.

Deafness did not cause EF problems in the group of deaf children who did not have delays in language acquisition. Deaf native signing children with early exposure to sign language perform similarly to hearing peers on 3 performance based measures designed to assess high cognitive functioning: cognitive flexibility, planning and WM.
Inhibition skills (interference suppression and response inhibition) depended on child age: older deaf children scored similarly to hearing children. A different pattern was found in the younger deaf group: they had weaker inhibition and attention responses than hearing peers. Younger deaf children may still be learning how to deal with attention tasks and how to suppress responses. Similarly, Dye and Hauser (2014) found that younger deaf children show more problems with cognitive control in a continuous performance test.

References:1Conway, C. M., Pisoni, D. B., & Kronenberger, W. G. (2009). The importance of sound for cognitive sequencing abilities: The auditory scaffolding hypothesis. *Current Directions in Psychological Science*, *18*(5), 275–279. 2. Dye, M.W., & Hauser, P., (2014). Sustained attention, selective attention and cognitive control in deaf and hearing children. *Hearing research, 309*, 94-102. 3. Hall, M., Eigsti, I.-M., Bortfeld, H., & Lillo-Martin, D. (2017). Auditory Deprivation Does Not Impair Executive Function, But Language Deprivation Might: Evidence From a Parent-Report Measure in Deaf Native Signing Children. *Journal of Deaf Studies and Deaf Education*, 22(1), 1–13.