Time-Course of Grammatical Processing in Students with Deafness

(Gómez-Merino, N., Fajardo, I., Ferrer, A., & Arfé, B.)

LECTURA
Estructura de Recerca Interdisciplinar

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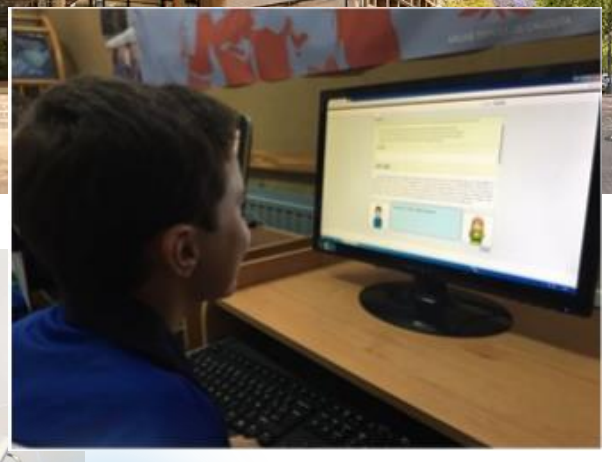

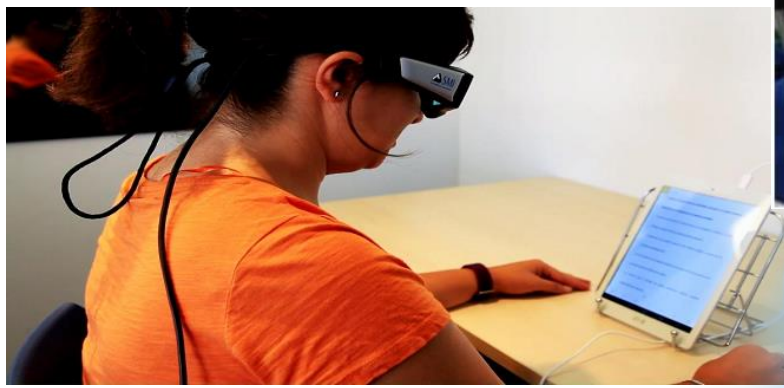

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Overview

Theoretical Framework

Objetive

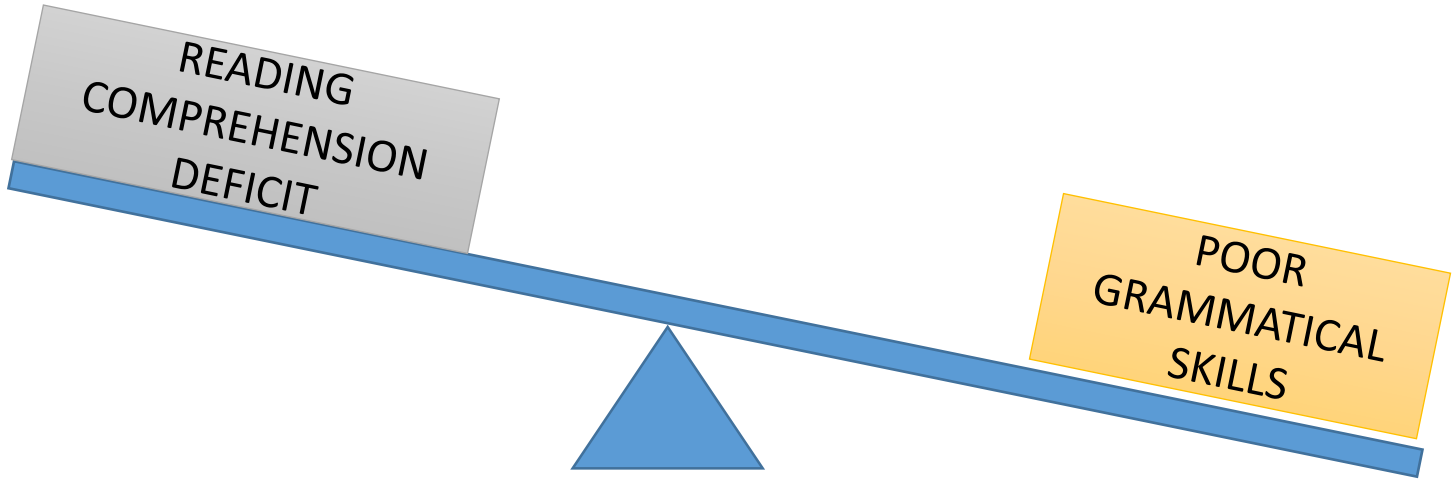
Methodoloy

Results

Conclusions

Theoretical Framework.

- Population with a severe to profound hearing loss have improved their linguistic performance due to advances on auditory technology and early cochlear implantation.
- However still differences arise between those people who receive a Cochlear Implant and people with normal hearing, e.g. as shown by longer latencies in the P300 in response to audio-tone frequencies (Ghiselli, Gheller,Trevisi, Rampazzo, Ermani & Martini, 2016)
- There are also improvements in Reading comprehension due to Cochlear Implants **BUT still significant variability.** (Mayer & Trezek, 2017)
- In need to explore in higher grades, where the gap between deaf and typical hearing (TH) students tends to increase (Arfé, Guiselli & Montino, 2016)



- Barajas , Gonzalez-Cuenca & Carrero, 2016
- Takahashi, Isaka, Yamamoto & Nakamura, 2017
- Worsfold, Mahon, Pimperton & Stevenson, 2018.

Theoretical Framework.

Grammatical markers are perceptually less salient

- Le Normand, 2004
- Boons et al., 2013
- Guo& Spencer, 2017

Poor Grammatical Skills and Reading Comprehension

Are they sensitive to grammatical cues?

OFF-LINE

- Key- Word Strategy (Domínguez, Carrillo, Pérez & 2014)

≠

- Gallego, Martín-Aragoneses, López-Higes & Pison (2016)

ON-LINE

- Breadmore, Krott and Olson, 2014
- Piñar, Carlson, Morford and Dussias, 2017
- Gómez-Merino, Fajardo & Ferrer, 2019 (in prep.)

Objetive

To have an insight into the reading behavior of orally educated deaf students by analyzing their eye-movements while taking part into a gramatical judgment task during sentence reading.

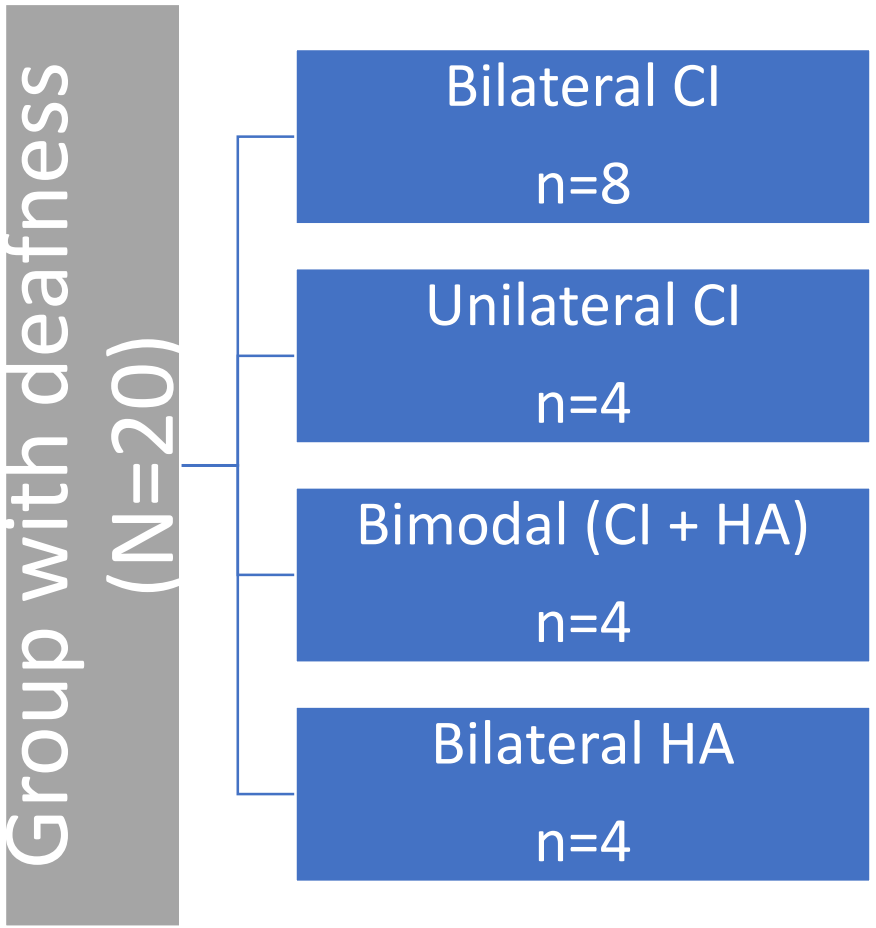
Participants

Students with deafness should:

- ✓ Be diagnosed with a Bilateral Prelingual severe to profound hearing loss (BIAP, 1997)
- ✓ Attend to a 4th to 10th grade.

They were excluded if:

- × Decoding skills were 2DT below the mean.
- × Additional difficulties which could interfere.
- × Not using spoken Spanish as a primmary communication mode.



Participants

Students from both groups were matched according to Non-Verbal IQ and Chronological age.

N= 40

	Deaf	TH
Gender	12 Girls ; 8 Boys	11 Girls; 9 Boys
Chronological Age	12:05	12:00

p= .503

Background Assesment

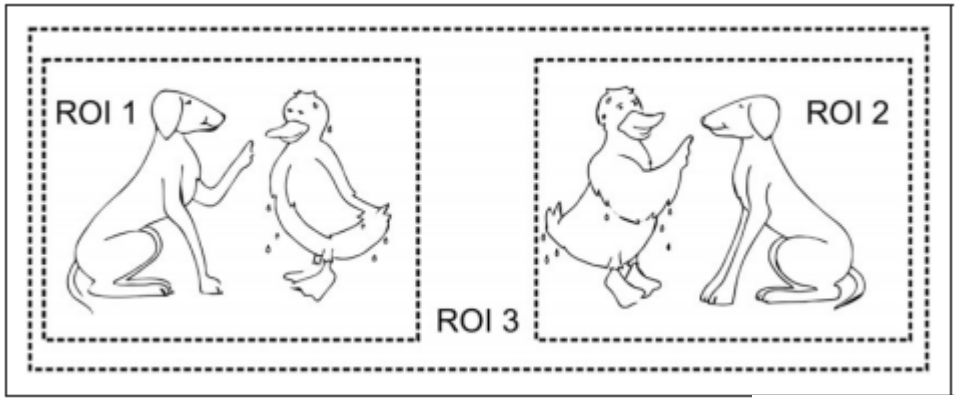
- Non- verbal IQ (Matrices Subtest, K-BIT)
- Reading Comprehension (EMLE –TALE 2000)
- Word and Non-Word Reading (PROLEC-Se / PROLEC-R)
- Receptive Vocabulary. (Peabody Picture Vocabulary Test- PPVT-III)
- Oral Syntactic Ability. (Formulated Sentences, CELF-IV)
- Written Syntactic Ability.

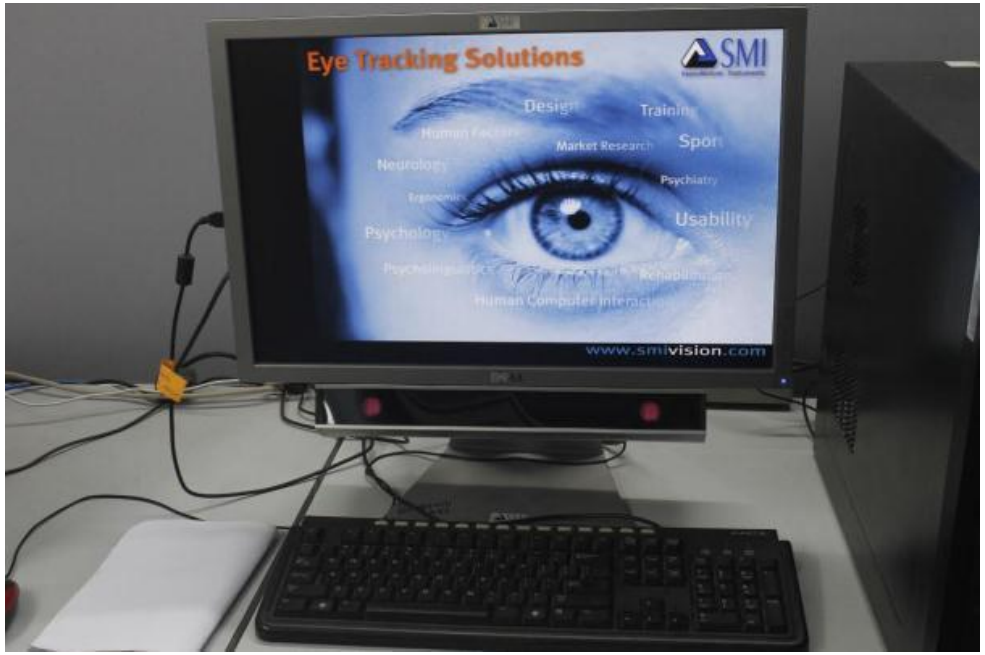
Hasta que

1. Mañana llega … Madrid			
☐ con	☐ para	☐ de	☐ entre
2. Trabajamos … lunes a viernes			
☐ con	☐ de	☐ entre	☐ en
3. Luís estaba … triste			
☐ muy	☐ mucho	☐ con	☐ nunca

Experimental Task: Apparatus

- Participants' eye movements during the task were tracked using an SMI eye tracker with a recording sampling rate of 60Hz





How Hearing Impairment Affects Sentence Comprehension: Using Eye Fixations to Investigate the Duration of Speech Processing

Dorothea Wendt[1,2], Birger Kollmeier[1,3], and Thomas Brand[1,3]

The Effect of Residual Acoustic Hearing and Adaptation to Uncertainty on Speech Perception in Cochlear Implant Users: Evidence from Eye-Tracking

Bob McMurray[1], Ashley Farris-Trimble[2], Michael Seedorff[3], and Hannah Rigler[4]

[1]Departments of Psychological and Brain Sciences, Communication Sciences and Disorders, and Linguistics, University of Iowa, Iowa City, Iowa, USA

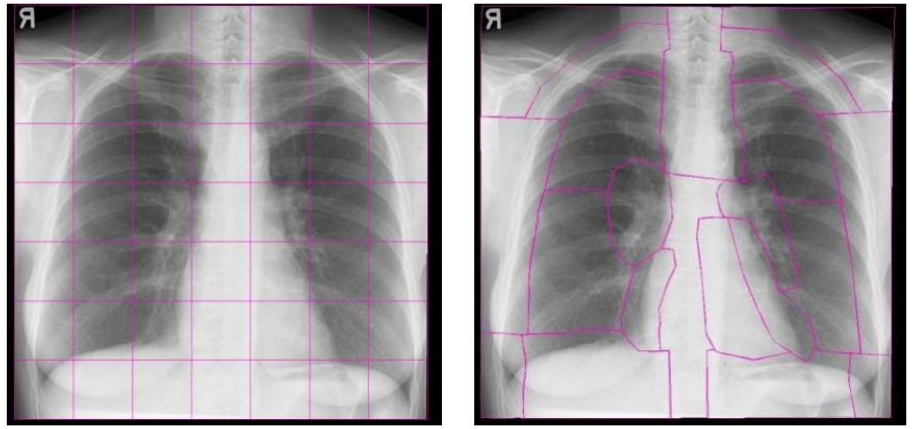
Experimental Task: Apparatus

1.For analyzing and designing the stimuli, it is divided into Areas Of Interes (AOIs)

2. A critical region should be identify (mainly where the manipulation occurs)

3. It’s also important to analyse spillover region (the text that follows the critical region)

4. Fixation durations index cognitive effort (longer fixation duration = more difficulty /more cognitive effort required)



La madre quiere a la	padre	mucho.

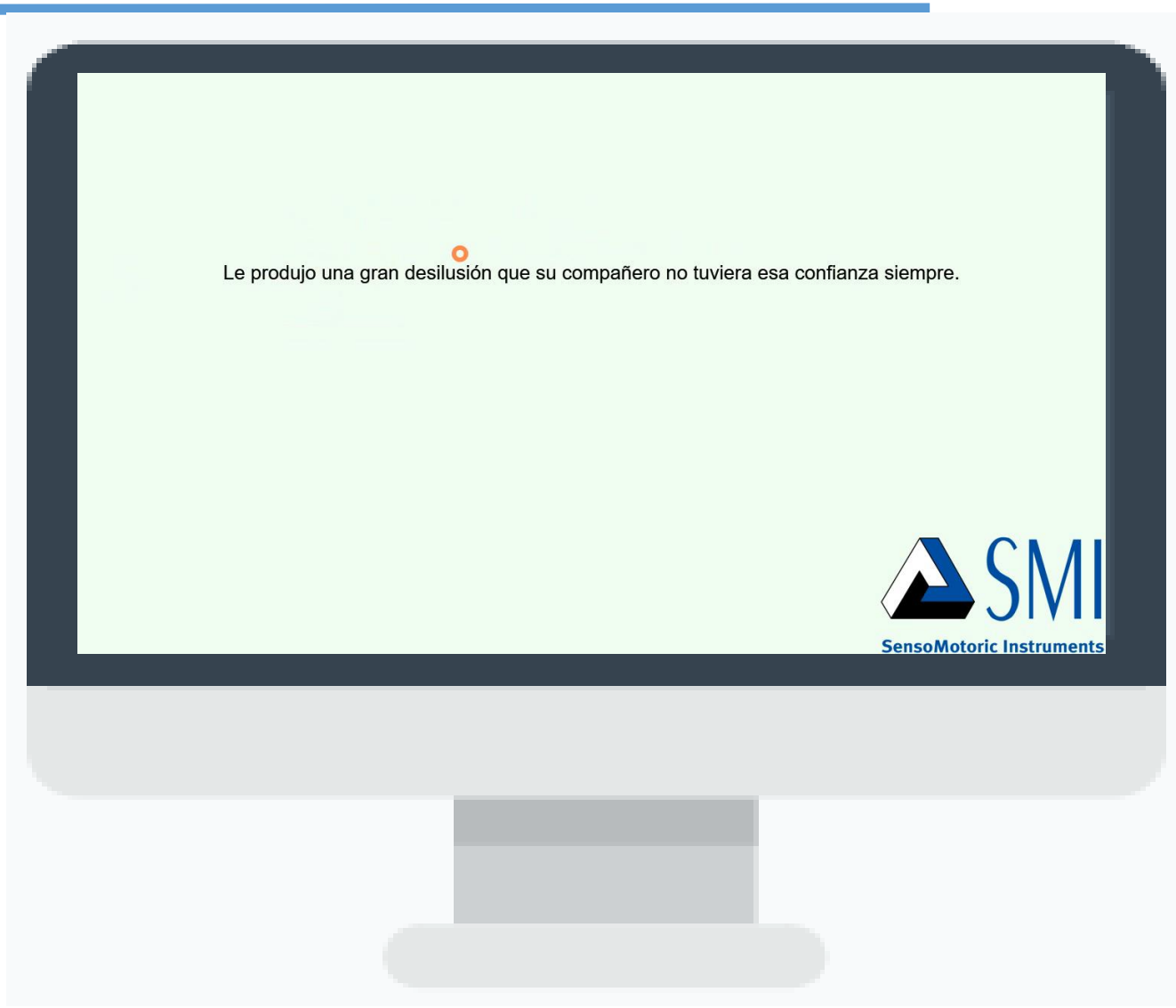
Experimental Task: Stimuli

- 24 sentences written in Spanish (12 congruent and 12 incongruent).
- A target word was manipulated in order to generate a grammatical incongruence in half of the trials .
- The incongruent word was semantically associated with the congruent one and matched on length and frequency.
- The congruency of the sentences was checked in a pilot study with n=88 Typical Hearing students.

PRE-TARGET	TARGET	POST-TARGET
La madre quiere a la *The mother loves the*	hija *daughter*	mucho. *a lot.*
La madre quiere a la *The mother loves the*	padre *father*	mucho. *a lot.*

Experimental Task

Students read in silent and judged the correctness of the sentences by clicking on YES or NO, after the Reading of each sentence.



Results: Background assesment.

	Deaf (N=20)		TH (N=20)		Comparisons between groups		
	Mean	*SD*	*Mean*	*SD*	*F*	*U*	*p*
Non Verbal IQ (RS)	33.85	7.63	34.35	4.72		159.5	.271
Non Verbal IQ (SS)	103.2	9.12	109.25	10.85	.158		.064
Text Reading Comprehension (SS)	87.5	19.18	103.9	6.65		80	.001
Word Reading Accuracy (RS)	39.4	.88	39.7	.47		191	.762
Word Reading Accuracy (SS)	106.85	8.23	107.07	8.07		198.5	.967
Non Word Reading Accuracy (RS)	38.65	1.56	38.55	1.6		192.5	.833
Non Word Reading Accuracy (SS)	109.51	9.41	108.75	7.24		172.5	.456
Word Reading Speed (Sec)	33.65	7.59	28.9	5.8		127	.048
Word Reading Speed (SS)	107.51	10.86	115.99	7.36		105	.010
Non Word Reading Speed (Sec)	47.45	8.46	49.15	9.73	.565		.559
Non Word Reading Speed (SS)	111.78	10.18	113..46	7.69		172.5	.456
Receptive Vocabulary (RS)	110.95	24.45	139.25	14.49		69.5	<.001
Oral Syntactic Ability (RS)	35.9	8.06	43.45	5.9		87	.002
Written Syntactic Ability	43.65	13.55	52	11.09		125	.042

RS= Raw Scores
SS= Standard Scores
Sec= Seconds

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Hyphotesis

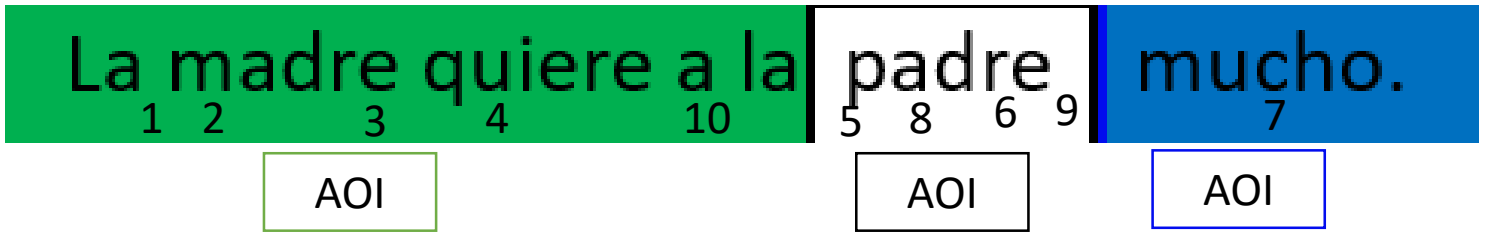
1) Deaf readers would be less able than TH readers to detect the grammatical incongruence of the sentences read.

2) No significant effects of grammatical violations on the target area for the deaf readers, but delayed effects in terms of number and duration of visits and regressions to pre- and post-target areas (Breadmore et al., 2014).

La madre quiere a la | padre | mucho.

Results: Experimental Task

Eye-Movement Measure	
First Fixation Duration:	The Duration of the First Fixation in an AOI. (i.e = t.5)
First Pass Gaze Duration:	Sum of fixations durations from the first entry into an AOI until the eyes leaves it in any direction. (i.e= t.5 + t.6)
Second Pass Gaze Duration:	Sum of fixation durations from the second entry to the AOI until the eye leaves it in any direction. (i.e= t.8+ t.9)
Regressions into AOI:	Number of revisits to the AOI from the right. (i.e= 8 + 9= 2n)
Fixation Time:	Sum of all fixations durations within the area of interest. (i.e= t.5+t.6+t.8+ t.9)
Fixation Count:	Total number of fixations within the area of interest. (i.e= 5+6+8+9=4)

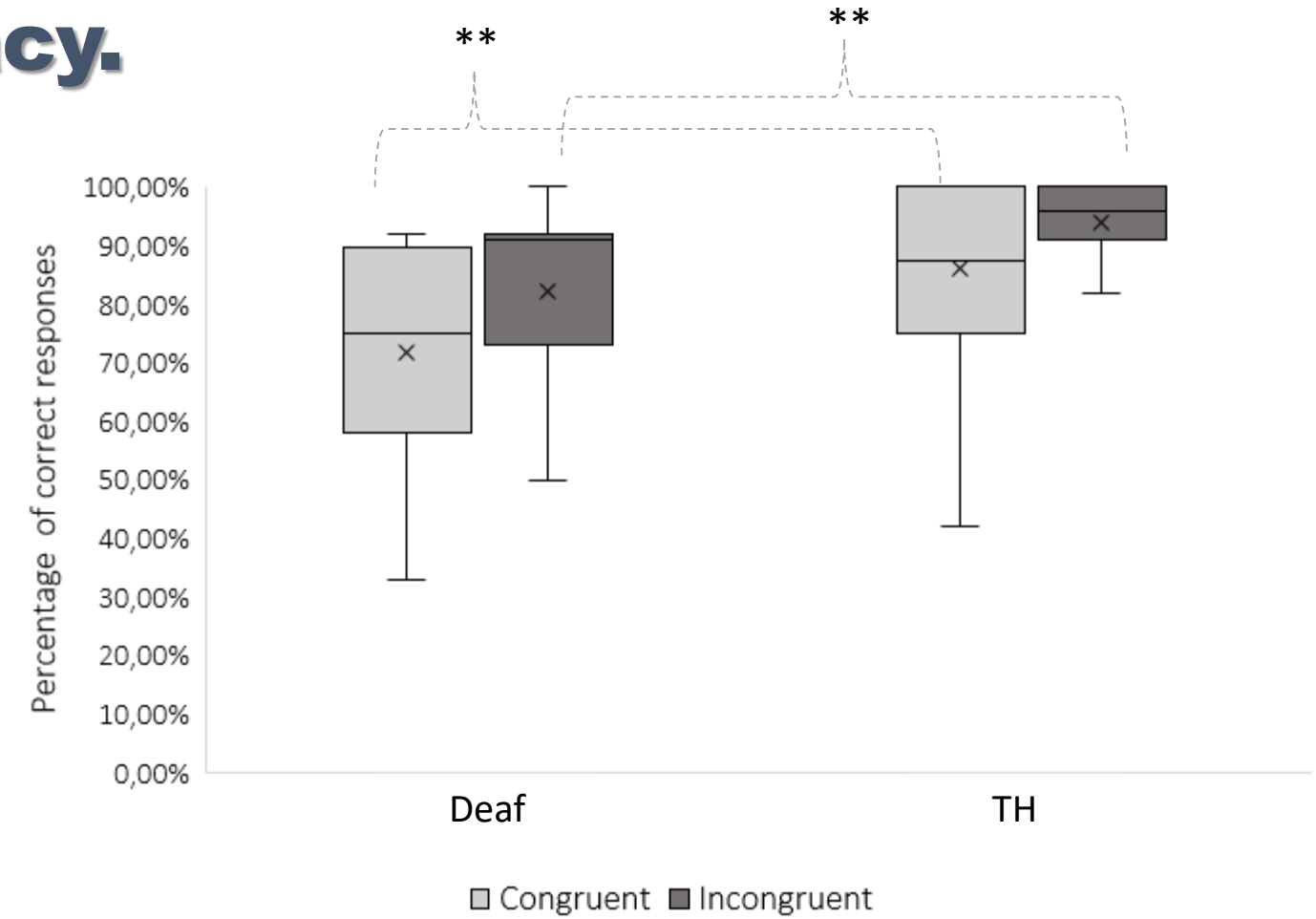


Experimental Task: Apparatus

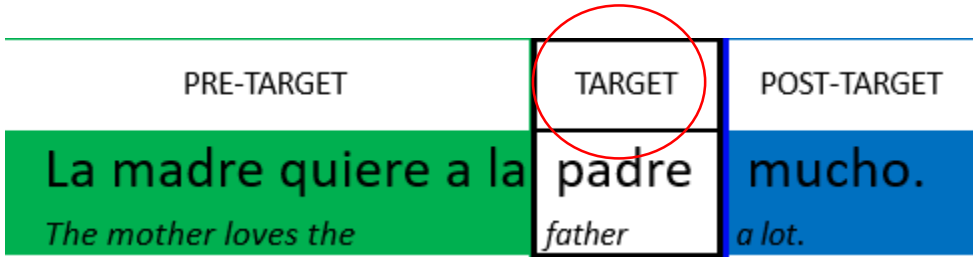
- Fixations shorter than 80 ms were excluded from the data set.
- For each eye-movement time measure, the cells >2.5 SDs above or below each participant mean for each condition were excluded from the analyses (following Micai et al., 2017)

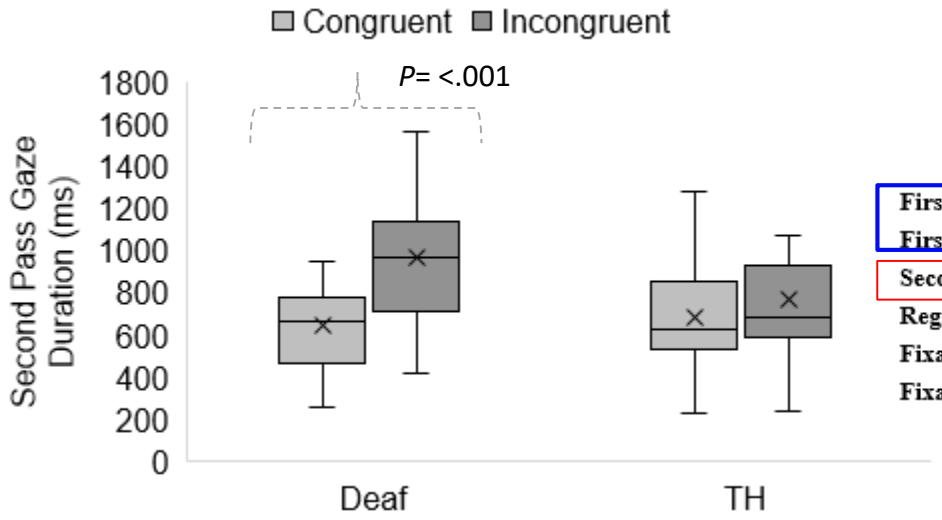
Results: Experimental Task

Accuracy.



Results: Experimental Task



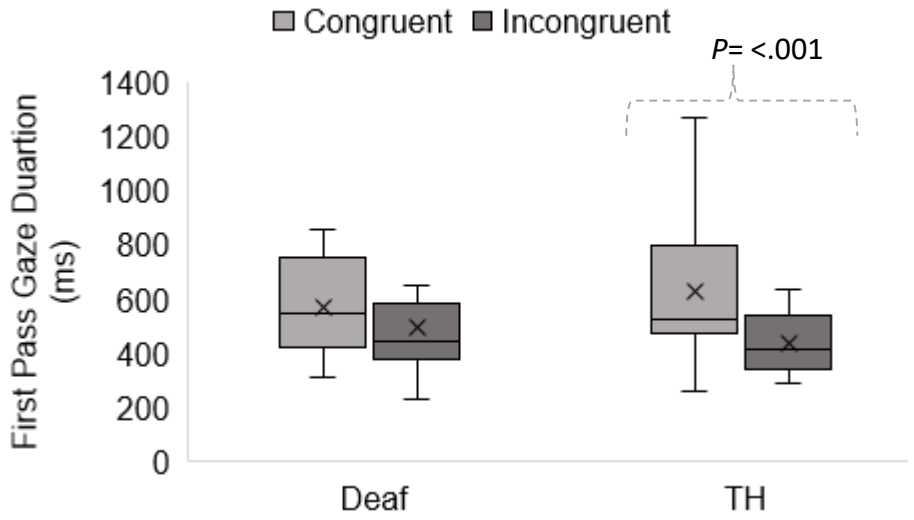


	Deaf			TH		
	Congruent Mean (SD)	Incongruent Mean (SD)	*p*	Congruent Mean (SD)	Incongruent Mean (SD)	*p*
First Fixation Duration (ms)	401 (117)	466 (177)	.006	414 (82)	462 (139)	.037
First Pass gaze duration (ms)	479 (171)	605 (240)	<.001	474 (87)	609 (174)	.001
Second pass gaze duration (ms)	651 (253)	968 (354)	<.001	682 (230)	775 (314)	-
Regressions into AOI	.53 (.29)	.59 (.3)	-	.49 (.3)	.63(.27)	-
Fixation Time(ms)	1130 (417)	1573 (495)	<.001	1157 (249)	1385 (377)	.017
Fixation Count	2.44 (0.72)	2.86 (.85)	.008	2.16 (.7)	2.4 (0.61)	-

- Early detection of the incongruence by both groups.
- However, deaf students needed to "Revise" as shown by their Second Pass Gaze Duration.

Results: Experimental Task

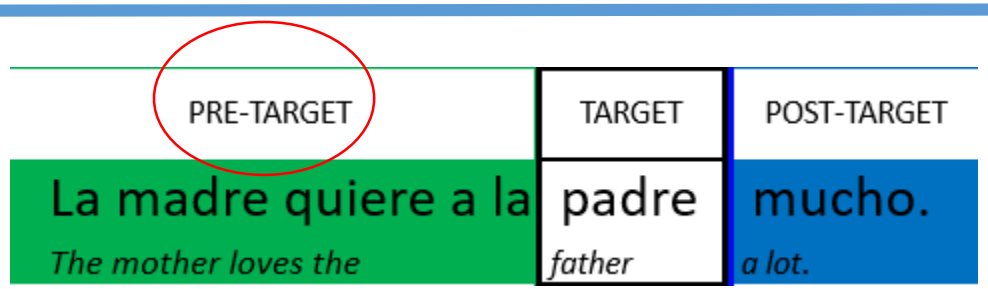
PRE-TARGET	TARGET	POST-TARGET
La madre quiere a la	padre	mucho.
The mother loves the	*father*	*a lot.*

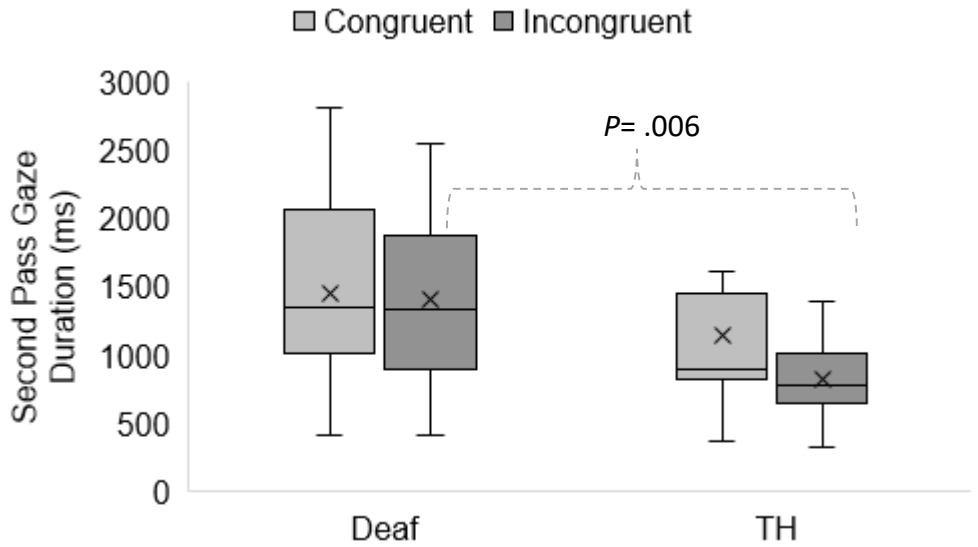


	Deaf			TH		
	Congruent Mean (SD)	Incongruent Mean (SD)	*p*	Congruent Mean (SD)	Incongruent Mean (SD)	*p*
First Fixation Duration (ms)	444 (124)	393 (143)	-	475 (120)	375 (99)	.001
First Pass Gaze Duration (ms)	573 (171)	495 (215)	-	628 (243)	437 (107)	<.001
Second pass gaze duration (ms)	688 (249)	708 (308)	-	607 (225)	539 (194)	-
Regressions into AOI	.016 (0.04)	.026 (.04)	-	.02 (.04)	.004 (.01)	-
Fixation Time (ms)	1210 (407)	1144 (449)	-	1205 (275)	1017 (331)	.023
Fixation Count	2.02 (0.6)	1.9 (.61)	-	2.03 (.52)	1.65 (.48)	.006

- Inverted data: They spent more on congruent sentences.
  - TH follow a different type of correctness once the ungrammaticality has been discarded.

Results: Experimental Task





	Deaf		TH	
	Congruent Mean (SD)	Incongruent Mean (SD)	Congruent Mean (SD)	Incongruent Mean (SD)
Regressions into AOI	1.32 (0,38)	1.26 (.47)	1.08 (.44)	.91 (.3)
Second Pass Gaze Duration (ms)	1447 (672)	1406 (585)	1151 (551)	826 (282)
Fixation Time (ms)	3134(1197)	3126 (982)	2829 (638)	2669 (561)

- Group effects: Late stage processing measures (Second Pass and Regressions into AOI) showed that **deaf students spent longer time and regressed more to the PRE than TH students**.

Conclusions

1) Deaf readers would be less able than TH readers to detect the grammatical incongruence of the sentences read.

2) No significant effects of grammatical violations on the target area for the deaf readers, but delayed effects in terms of number and duration of visits and regressions to pre- and post-target areas (Breadmore et al., 2014).

La madre quiere a la	padre	mucho.

Conclusions

- In our study the deaf group did not ignore morpho-syntactic cues as suggested by Dominguez and Alegría (2009). They actually used them very early as can be inferred from the grammaticality effects in the target region.

- Deaf readers re-read more and spend more time integrating the grammatical information delivered when judging for sentence correctness.

Need to focus not only in instructional intervention on deaf students' grammatical knowledge, but also on their explicit awareness and use of syntactic cues during reading.

Grazie mille per la tua attenzione

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The results presented are preliminary, final results have been published under the reference:

Gómez-Merino, N., Fajardo, I., Ferrer, A., & Arfé, B. (in press). Time-Course of Grammatical Processing in Deaf Readers: An Eye-Movement Study. *The Journal of Deaf Studies and Deaf Education*,enaa005, https://doi.org/10.1093/deafed/enaa005