Title: The Leftward Word Identification Span of Deaf Readers

Authors: Casey Stringer; Frances Cooley, PhD; Emily Saunders; Grace Sinclair; Karen Emmorey, PhD; & Elizabeth R. Schotter, PhD

Background

- Although some deaf individuals face obstacles when it comes to learning to read, those that become skilled readers are able to read more efficiently than reading-level matched hearing people[1,2,3,4]
- Skilled deaf readers extract information from a larger area to the right of fixation while reading [1,2] (i.e., they have a larger rightward *word identification span*[5])
- No research has independently examined the leftward span, which may be larger for deaf signers because of experience with ASL, a visual language in which one-handed signs are produced by the dominant (in most cases, right) hand and are therefore viewed in the left visual field
- Understanding the unique reading process of skilled deaf readers allows for more appropriate and helpful reading strategies to be taught to deaf individuals

Hypothesis

- Deaf readers will show a larger word identification span to the left of fixation than hearing readers matched on reading ability
  - If true, this would suggest skilled deaf readers make use of information that hearing readers largely ignore in order to read more efficiently

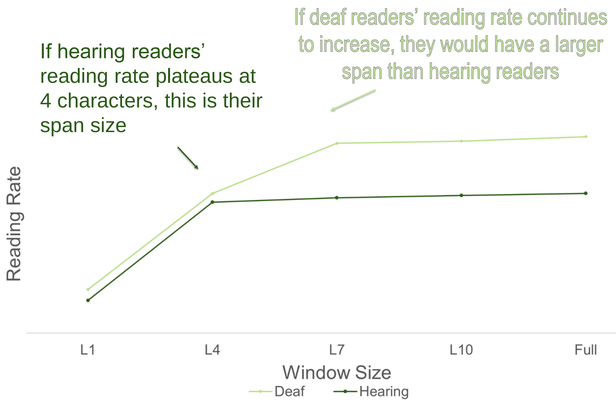

Figure 1. An example of the gaze-contingent moving widow paradigm. The * represents the part of the sentence at which the eye is currently looking, and the bottom line shows the full sentence.

```
xxxx used the mathemaxxxxx xxxxxx xx xxxxxxx xxx xxxxx xxxxx xx xxx xxxxx xxxx.
               *
xxxx xxxx xxx xxxxxxxxical device to mxxxxxx xxx xxxxx xxxxx xx xxx xxxxx xxxx.
                                  *
xxxx xxxx xxx xxxxxxxxxxxx xxxxxx xx xxxxxre the exact sloxx xx xxx xxxxx xxxx.
                                                 *
xxxx xxxx xxx xxxxxxxxxxxx xxxxxx xx xxxxxxx xxx xxxxx xxxxx xf the steel beam.
                                                                    *
They used the mathematical device to measure the exact slope of the steel beam.
```

Scan to see video example of gaze-contingent moving window

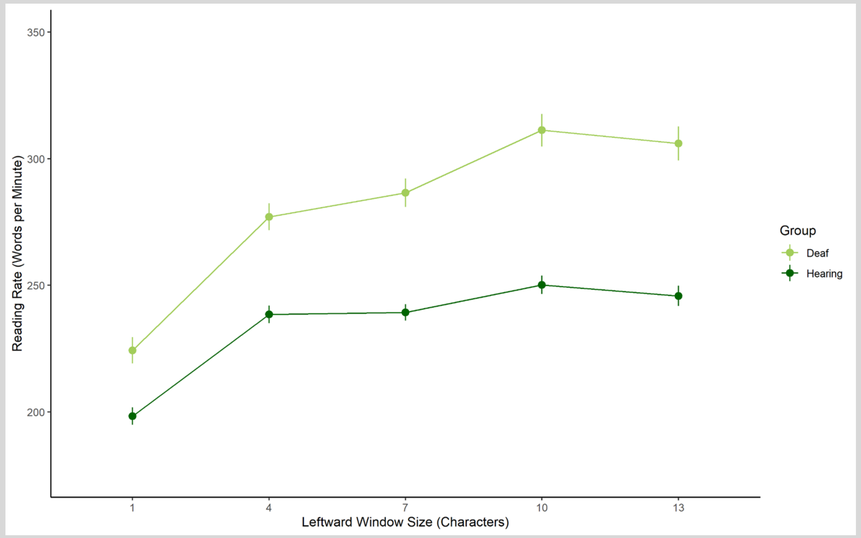

Figure 2. Plotted results of the reading rates (words per minute) of deaf and hearing groups at each window size

	b	*SE*	*t*	*p*
Hearing group	**234.45**	**16.94**	**13.84**	**< 0.001**
Window L4 vs L1	**40.15**	**10.25**	**3.92**	**< 0.001**
Windows L7 vs L4	0.90	10.21	0.088	0.93
Windows L10 vs L7	10.82	9.21	1.18	0.24
Windows L13 vs L10	-4.30	8.81	-0.49	0.63
Deaf vs Hearing	46.81	24.40	1.92	0.06
Deaf vs Hearing (L4 vs L1)	13.42	10.02	1.34	0.19
Deaf vs Hearing (L7 vs L4)	6.98	9.93	0.70	0.49
Deaf vs Hearing (L10 vs L7)	14.32	7.56	1.89	0.06
Deaf vs Hearing (L13 vs L10)	-0.87	6.47	-0.14	0.89

Table 2. Results of linear mixed effects models for the hearing group and the interaction between the two groups. Significant effects are bolded.

	b	*SE*	*t*	*p*
Deaf group	**284.83**	**27.47**	**10.37**	**< 0.001**
Window L4 vs L1	**54.96**	**10.17**	**5.40**	**< 0.001**
Windows L7 vs L4	4.43	10.18	0.46	0.65
Windows L10 vs L7	**23.61**	**10.17**	**2.32**	**< 0.01**
Windows L13 vs L10	-5.30	10.17	-0.52	0.60

Table 3. Results of linear mixed effect model for deaf group only. Significant effects are bolded.

References

1. Bélanger, N. N., Slattery, T. J., Mayberry, R. I., & Rayner, K. (2012). Skilled deaf readers have an enhanced perceptual span in reading. *Psychological science*, 23(7), 816-823. https://doi.org/10.1177%2F0956797611435130
2. Bélanger, N. N., Lee, M., & Schotter, E. R. (2018). Young skilled deaf readers have an enhanced perceptual span in reading. *Quarterly Journal of Experimental Psychology*, 71(1), 291-301. https://doi.org/10.1080%2F17470218.2017.1324498
3. Bélanger, N. N., & Rayner, K. (2015). What eye movements reveal about deaf readers. Current directions in psychological science, 24(3), 220-226. https://doi.org/10.1177%2F0963721414567527
4. Traxler, M., Banh, T., Craft, M., Winsler, K., Brothers, T., Hoversten, L., Piñar P., & Corina, D. (2021). Word skipping in deaf and hearing bilinguals: Cognitive control over eye movements remains with increased perceptual span. *Applied Psycholinguistics*, 42(3), 601-630. https://doi.org/10.1017/S0142716420000740
5. Rayner, K. (1998). Eye movements in reading and information processing: 20 years of research. *Psychological Bulletin*, 124(3), 372–422. https://doi.org/10.1037/0033-2909.124.3.372

Methods

- 38 participants (20 hearing, 18 deaf), target is 24 of each group
  - Matched on years in college, age, and reading comprehension (Peabody Individual Achievement Test-Revised; PIAT-R), see Table 1
- 2 (hearing status) x 6 (window size) mixed factorial design
- Gaze contingent moving window paradigm (Fig. 1)
  - L1, L4, L7, L10, L13; always 8 characters to the right
  - Full condition (no window) to test normal reading rates

	Hearing	Deaf	Difference
Reading Rate	**247.7 (59.27)**	**347.9 (180.81)**	**>0.05**
PIAT	87.6 (7.25)	83.9 (11.18)	0.26
Years in College	4.0 (2.89)	5.8 (3.03)	0.09
Age	29.9 (11.19)	33.8 (9.04)	0.27
Regressions	11.4 (7.31)	8.5 (7.71)	0.26

Table 1. Demographic information for the deaf and hearing groups. Reading rate and percent regressions are based on the average reading rate of the groups in the "full" (no mask) condition. Values given are the mean with the standard deviation in parentheses for the two groups, and the p-value for the difference between the two. Significant differences are bolded.

Preliminary Results

- For hearing readers, the largest significant increase in reading rate between conditions was between the L1 and L4 conditions, suggesting they have a leftward span size of 4 characters (Fig. 2, Table 2)
- For deaf readers, the largest significant difference between conditions was between the L7 and L10 conditions, suggesting they have a leftward span size of 10 characters (Fig. 2, Table 3)
- Deaf readers read significantly faster than hearing readers in the full condition (Table 1)

Conclusions

- These findings suggest that deaf readers do have a larger leftward word identification span than hearing readers
- Skilled deaf readers make use of information that hearing readers largely ignore to read more efficiently