

Return Sweeps during Chinese Multi-Line Reading: The Influence of Text Justification and Column Setting

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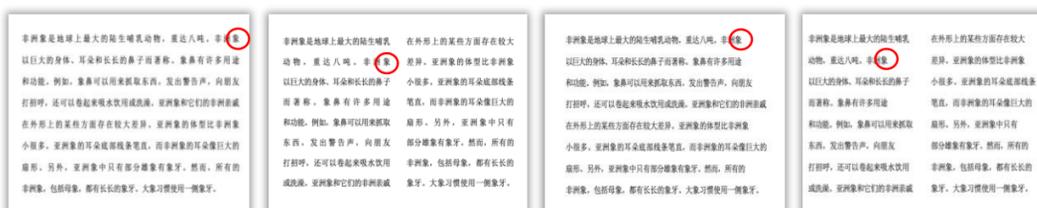


Introduction

- Current models of eye movements in reading are unable to simulate the reading of multi-line texts¹.
- Return sweeps are essential for reading multi-line texts and pose a cost to reading through saccadic targeting errors relative to the length of the preceding saccade², inflated line-initial fixation durations³ and lack of parafoveal preview⁴.
- Reading efficiency is also impacted by text justification due to disruption caused by “rivers of white space”⁵.
- Chinese, is a character-based language and little is known about return sweeps in Chinese readers.
- We examined text alignment (left-aligned vs. fully justified) and column setting (one vs. two) upon eye movements during the reading of multi-line passages of Chinese text to explore parameters specific to the return sweep among Chinese readers.
- **Predictions**
- **1)** Text would be read more efficiently in one column than two due to decreased disruption from return sweeps.
- **2)** Text justification may reduce disruption relative to left justified text due to line length homogeneity, but any effects should be reduced relative to those for alphabetic languages like English due to the absence of spaces in Chinese text.

Method

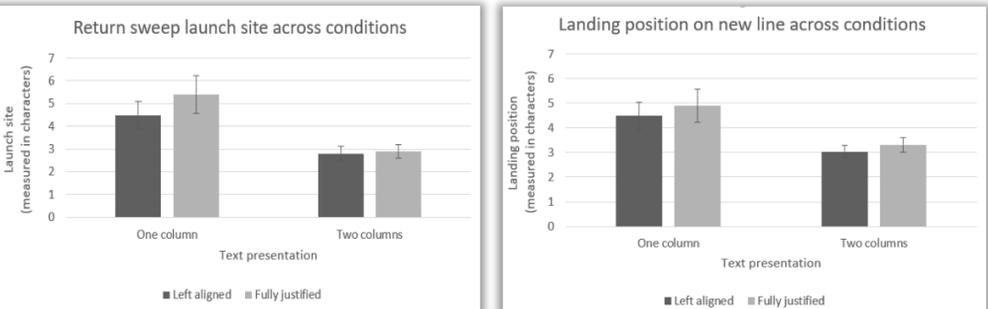
- Participants: 44 native Chinese speakers
- Stimuli: 20 passages of expository text
- Design: 2 (Alignment: Left vs. fully justified) x 2 (Column setting; one vs. two) within-participants design
- Procedure: Eye movements were recorded using an Eyelink 1000 Plus eye tracker



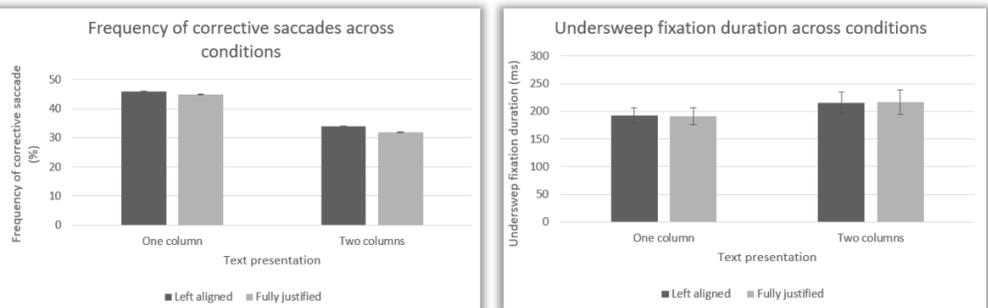
Example stimuli.

Note, as indicated on the images above, the line final words were controlled across conditions such that the line final word in one column corresponded to the final word on every second line in two columns.

Results



Note. Return sweep launch site is measured in characters from the end of the line-final word. Landing positions are measured in characters from the left margin of the new line.



Note. Error bars represent standard errors of the mean.

LMMs revealed:

- **Significant main effects** of text alignment and column setting on *launch site* and *landing positions*: readers launched their return sweeps from a point closer to the end of the line-final word and landed closer to the beginning of the new line in left aligned compared with fully justified text and in two columns than one column.
- **Significant main effect** of column setting on the *frequency of corrective saccades*: readers were more likely to undershoot the target in one column than two columns, necessitating a corrective leftward saccade.
- **Significant main effect** of column setting upon *undersweep fixation duration (UFD)*: UFDs were longer in two columns than a single column.
- Importantly, fixations outside of return sweep events were unaffected by text presentation with no differences between conditions for FFD, GD, page reading time or mean fixation count.

Discussion and Conclusion

- Our analyses demonstrate that text layout has a clear effect upon reading processes, however, these effects are **confined to the return sweep**.
- **Launch and landing positions:**
 - **Alignment:** Text in the fully justified condition was more horizontally distributed, resulting in reduced lateral masking relative to left aligned text. Increased lateral masking in the left aligned text meant that readers were less able to utilise parafoveal information and so they needed to fixate the line-final word.
 - **Column setting:** There are two possible explanations;
 - 1) The launch site distance from the line end is proportionate to the length of the upcoming saccade, however, further analysis did not support this.
 - 2) Alternatively, with a longer line, readers may strategically launch their return sweeps from a point further from the line-end in order to minimise the amplitude of the upcoming saccade.
- In line with previous research¹, readers are more likely to undershoot the target following a long than a short saccade. Furthermore, it seems likely that the inflated undersweep fixation durations result from the increased disruption to reading caused by more return sweeps in the two column compared with one column condition.
- Importantly, the launch site results indicate that readers do not always fixate line-final words, even though attention is presumably allocated to the left preceding the return sweep. This raises the question as to whether readers are able to lexically identify the line-final word parafoveally.

References

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