Eye movement control in word recognition

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ICPEAL 17 – CLDC 9

10/19/2018, National Taiwan University

Outline

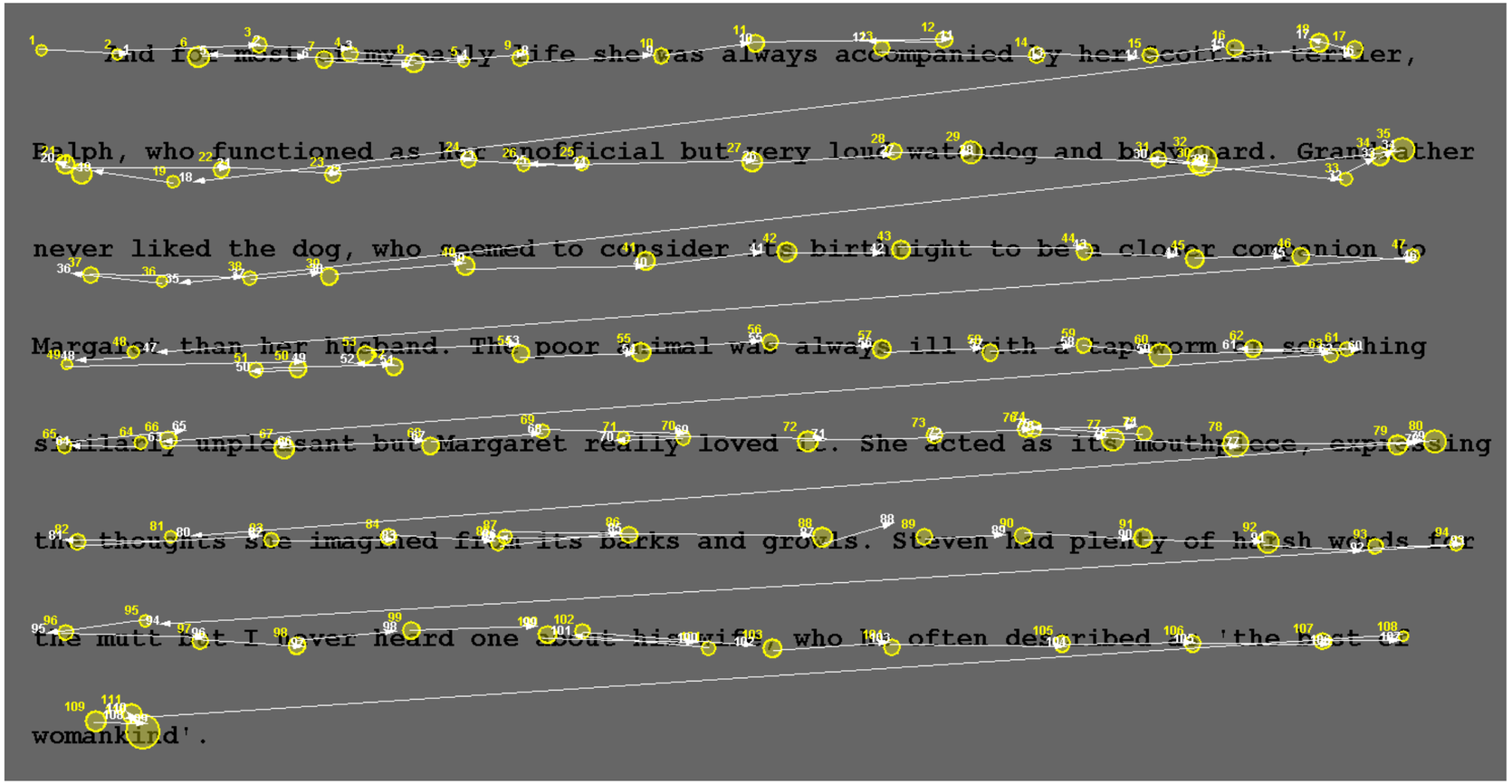
1. Lexical decision with eye-tracking
2. How many fixations are needed?
3. Are the eye movements informative?
4. What phenomena are particularly interesting at the first fixation?
5. What does LD with eye-tracking tell us about morphological processing?

1

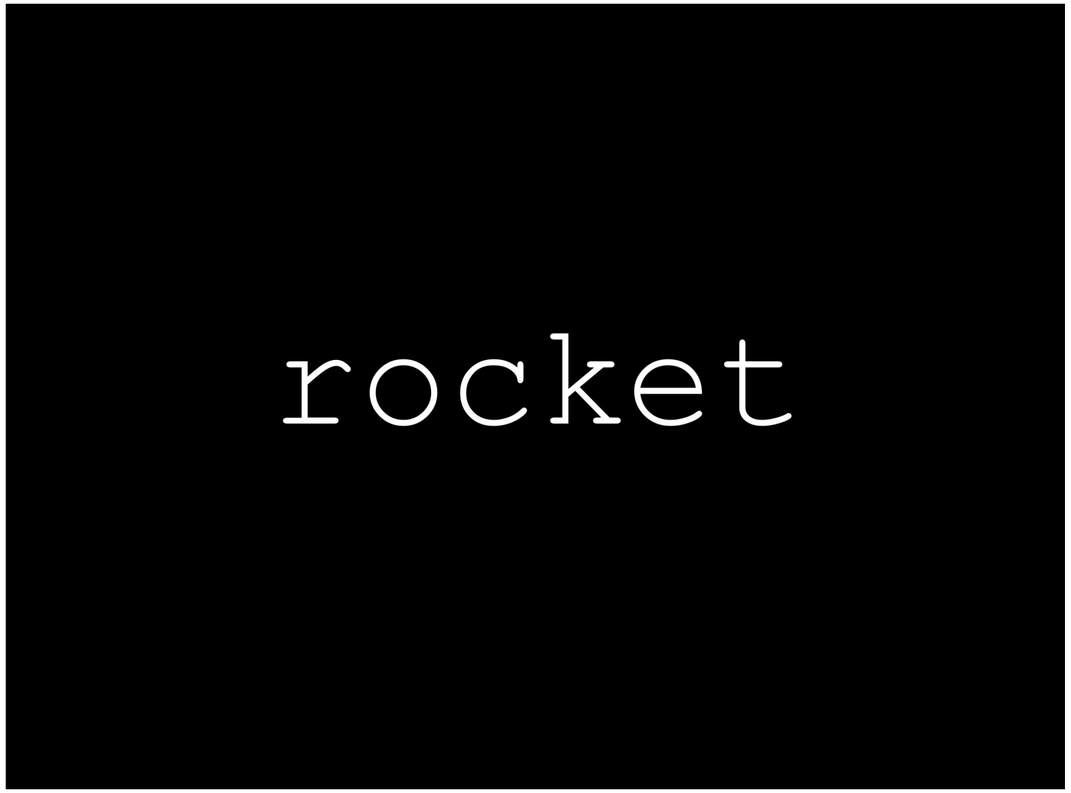
Lexical decision with eye-tracking

There are eye movements in reading

- There are eye movements in reading (Rayner, 1998).



Word recognition



Lexical decision

556 ms

rocket

Lexical decision

556 ms

rocket

Lexical decision with eye-tracking

Lexical decision with eye-tracking

Miwa, Libben, Dijkstra, & Baayen (2014)

Participants: Japanese readers

Item: Japanese two-kanji compounds (large font)

Japanese two-kanji compounds (small font)

Miwa, Libben, & Ikemoto (2017)

Participants: Japanese readers

Item: Japanese three-kanji compounds

Taylor, Miwa, & Mukai (in prep.)

Participants: Japanese-English bilinguals

Item: Japanese katakana words

English monomorphemic words

Miwa, Dijkstra, Bolger, & Baayen (2014)

Participants: English monolinguals

Japanese-English bilinguals

Item: English simple words

Miwa & Dijkstra (2017)

Participants: Japanese readers

Item: Japanese compounds (vertical alignment)

Miwa, Borgwaldt, Dijkstra, & Baayen (in prep.)

Participants: German-English bilinguals

Item: English compounds

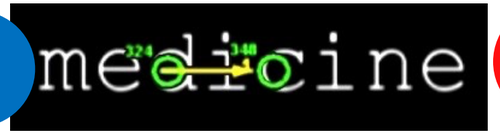
Lexical decision with eye-tracking

Miwa, Libben, Dijkstra, & Baayen (2014)

L1 

L1 

Miwa, Dijkstra, Bolger, & Baayen (2014)

L2 

L1 

Miwa, Libben, & Ikemoto (2017)

L1 

Miwa & Dijkstra (2017)

L1 

Taylor, Miwa, & Mukai (in prep.)

L2 

L1 

Miwa, Borgwaldt, Dijkstra, & Baayen (in prep.)

L2 

Lexical decision with eye-tracking

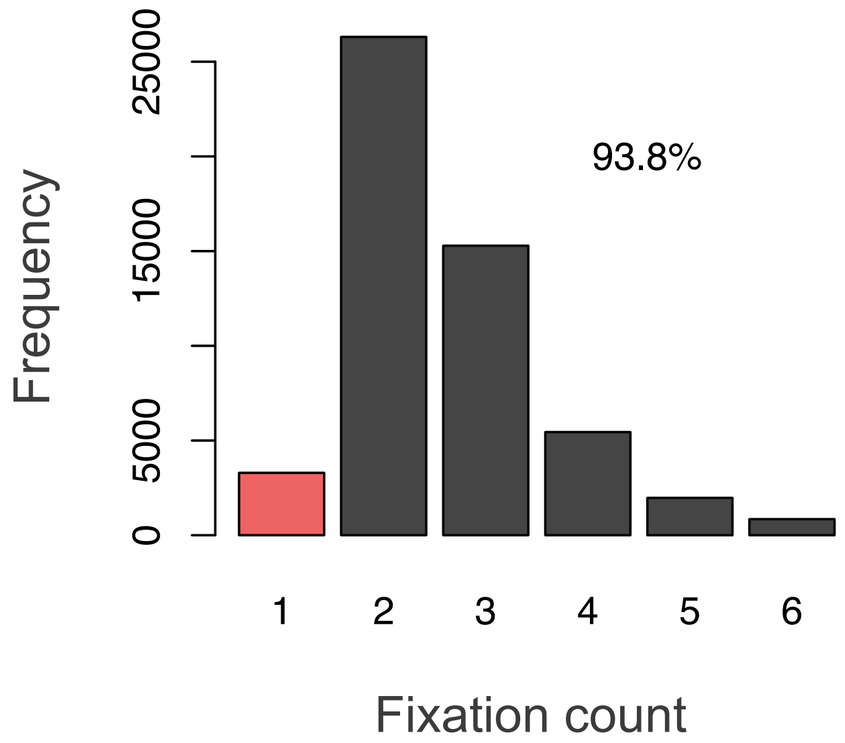
- I have conducted lexical decision experiments with **English** and **Japanese** words, testing both **native** and **non-native** speakers.
- So far, I have collected over 40,000 lexical decision responses and eye movements in those trials.
- I present what I learned about eye movement control in word recognition.

2

How many fixations are needed?

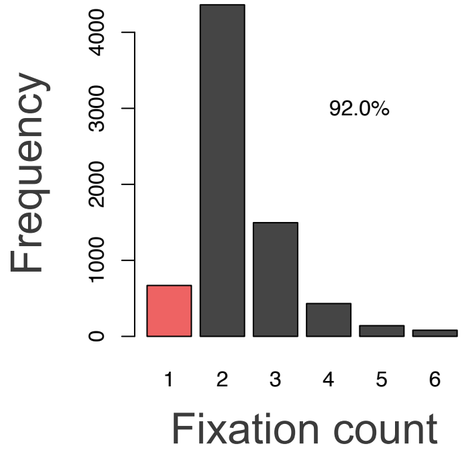
How many fixations are needed?

- Words are read with multiple fixations almost all the time.



How many fixations are needed?

L1



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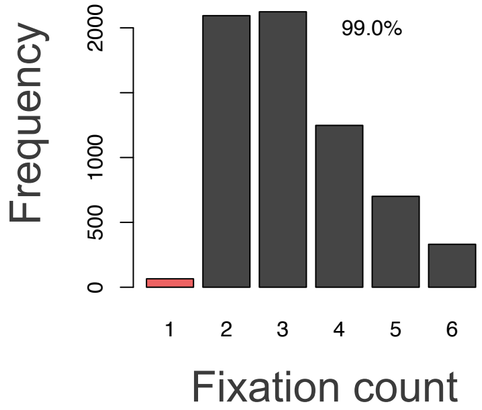

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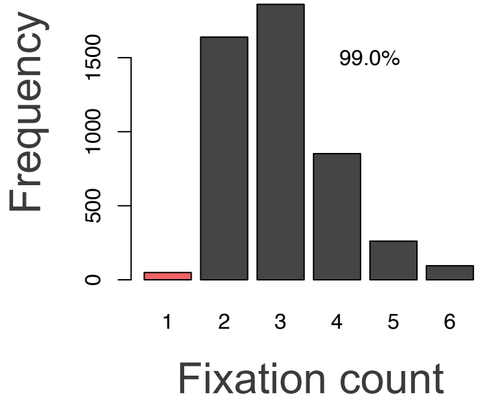
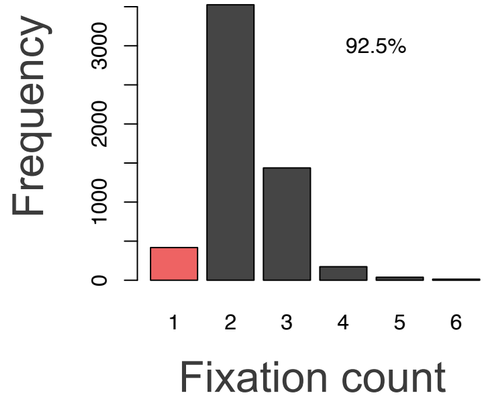


L1



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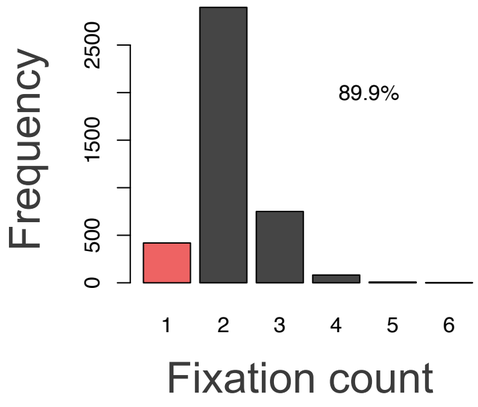

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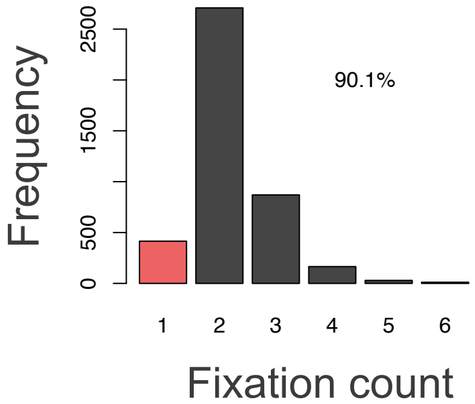
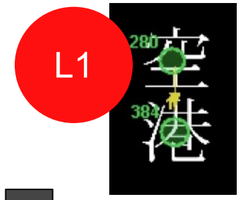
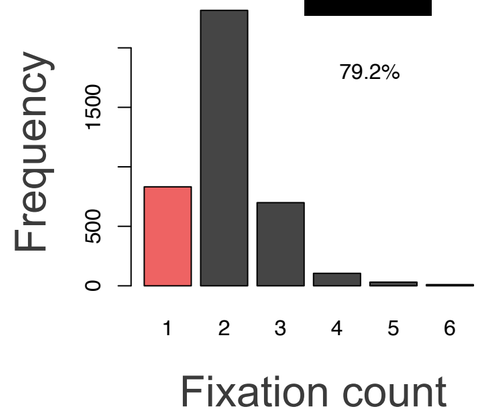
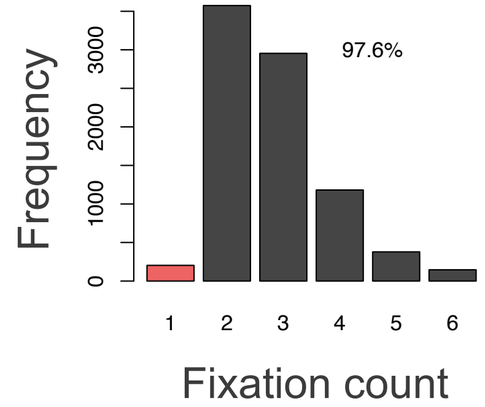


L1





L2

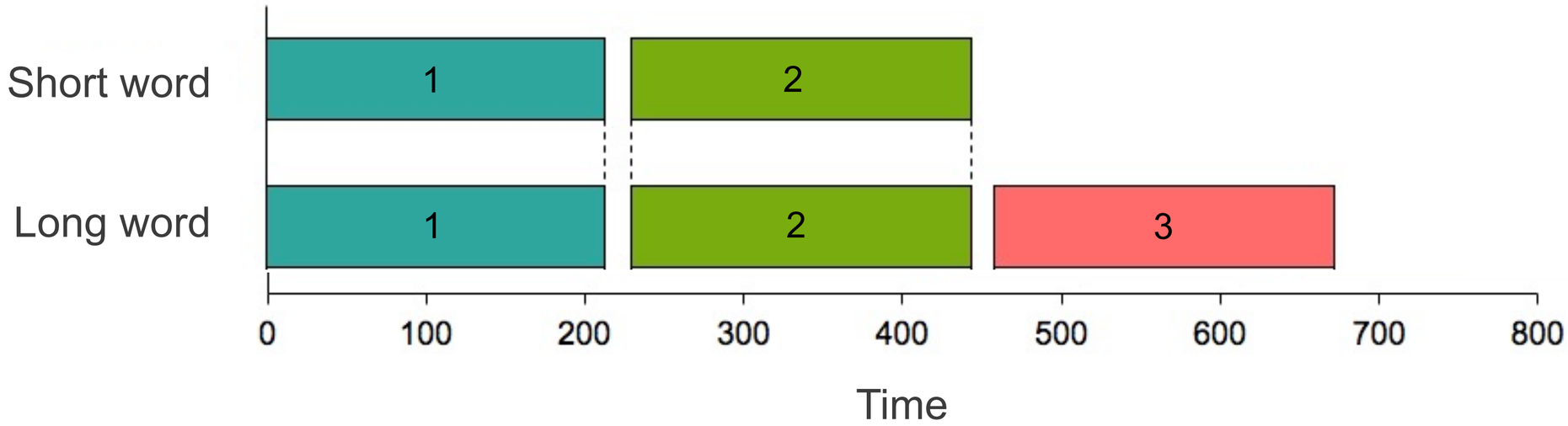


3

Are the eye movements informative?

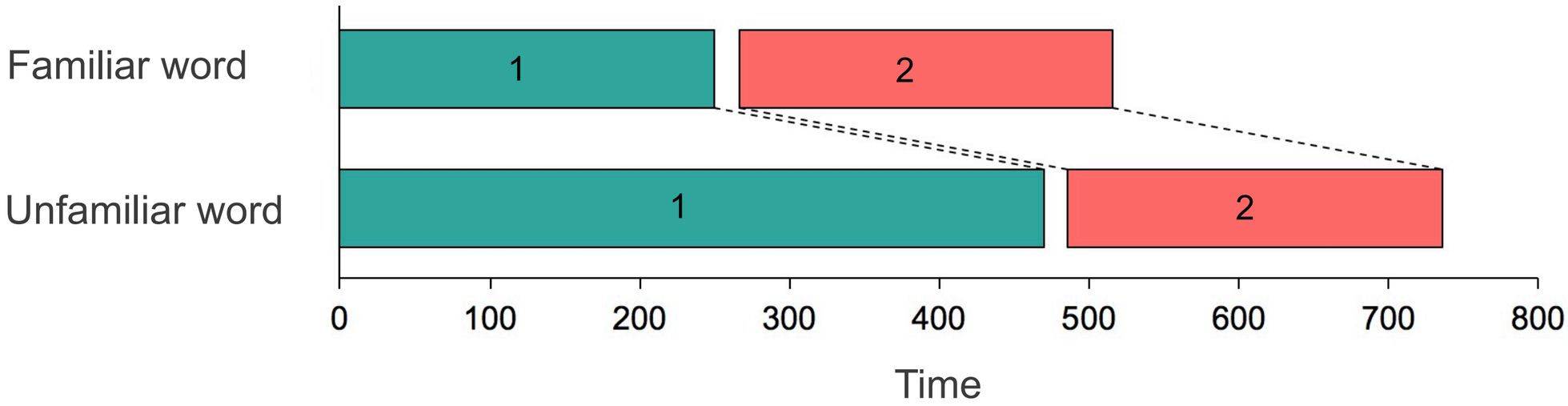
Are the eye movements informative?

- If the eye scans a word merely like a scanner, then the fixation durations are strictly co-determined by word length.
- In this case, eye movements are not informative for psycholinguistic research.



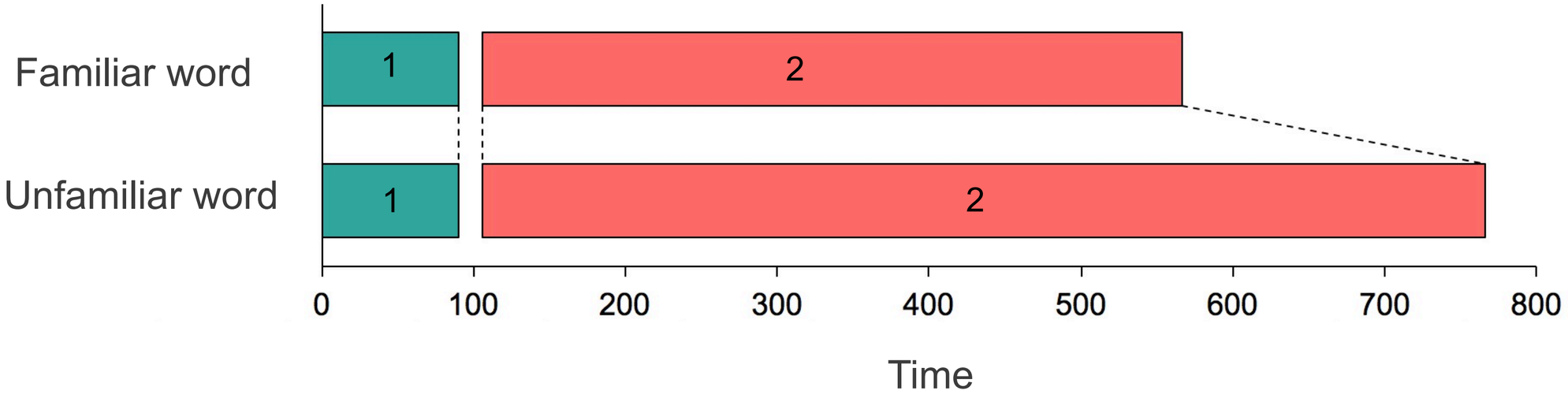
Are the eye movements informative?

- If all linguistic processes are done at the first fixation, late fixation durations reflect non-linguistic processes.
- In this case, eye movements are not informative for psycholinguistic research.



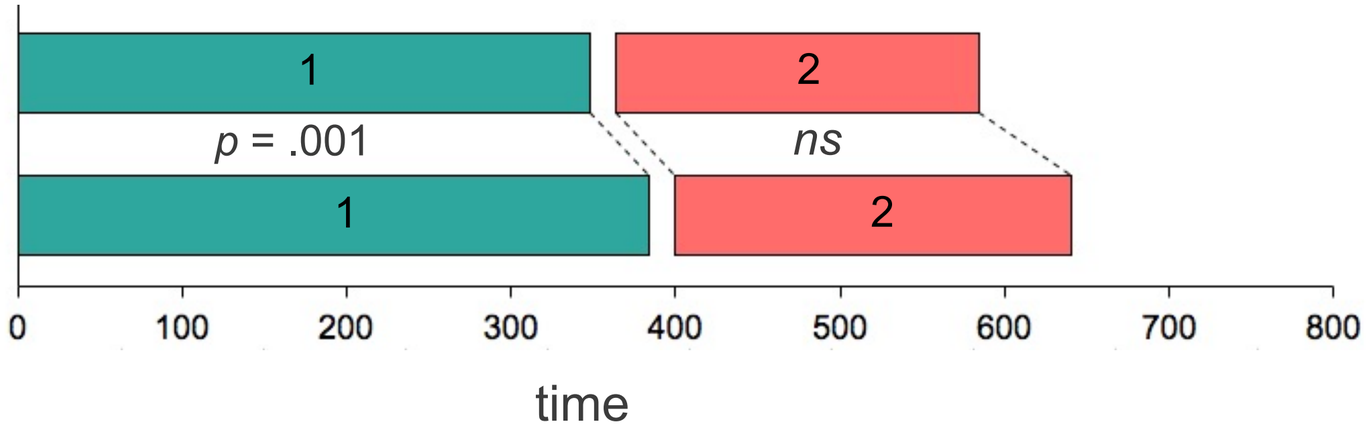
Are the eye movements informative?

- If the first fixation is merely a corrective fixation, only the late fixation durations reflect linguistic processes.
- In this case, eye movements are not informative for psycholinguistic research.

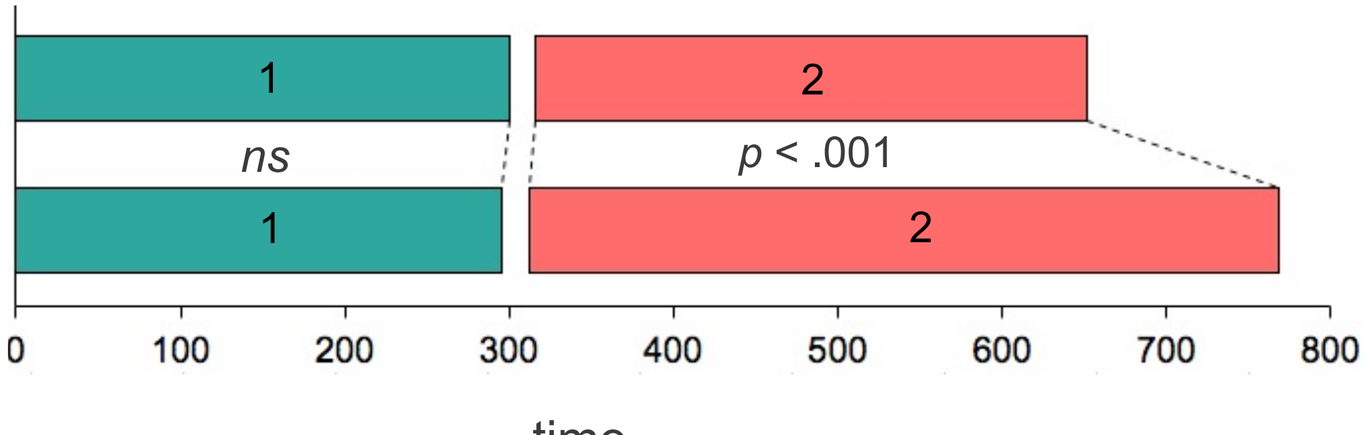


The eye movements are informative.

Miwa & Dijkstra (2017)

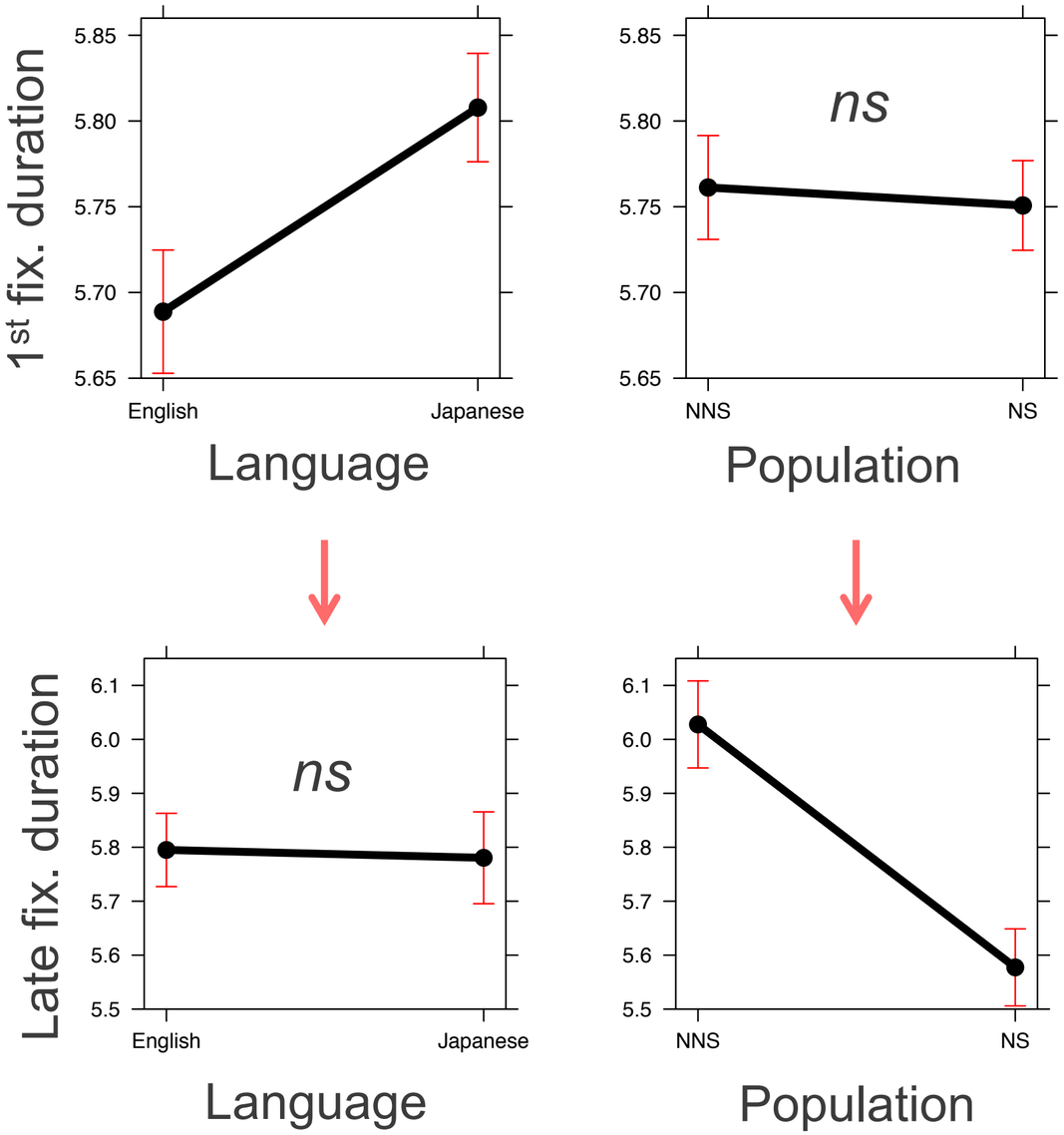


Taylor, Miwa, & Mukai (in preparation)



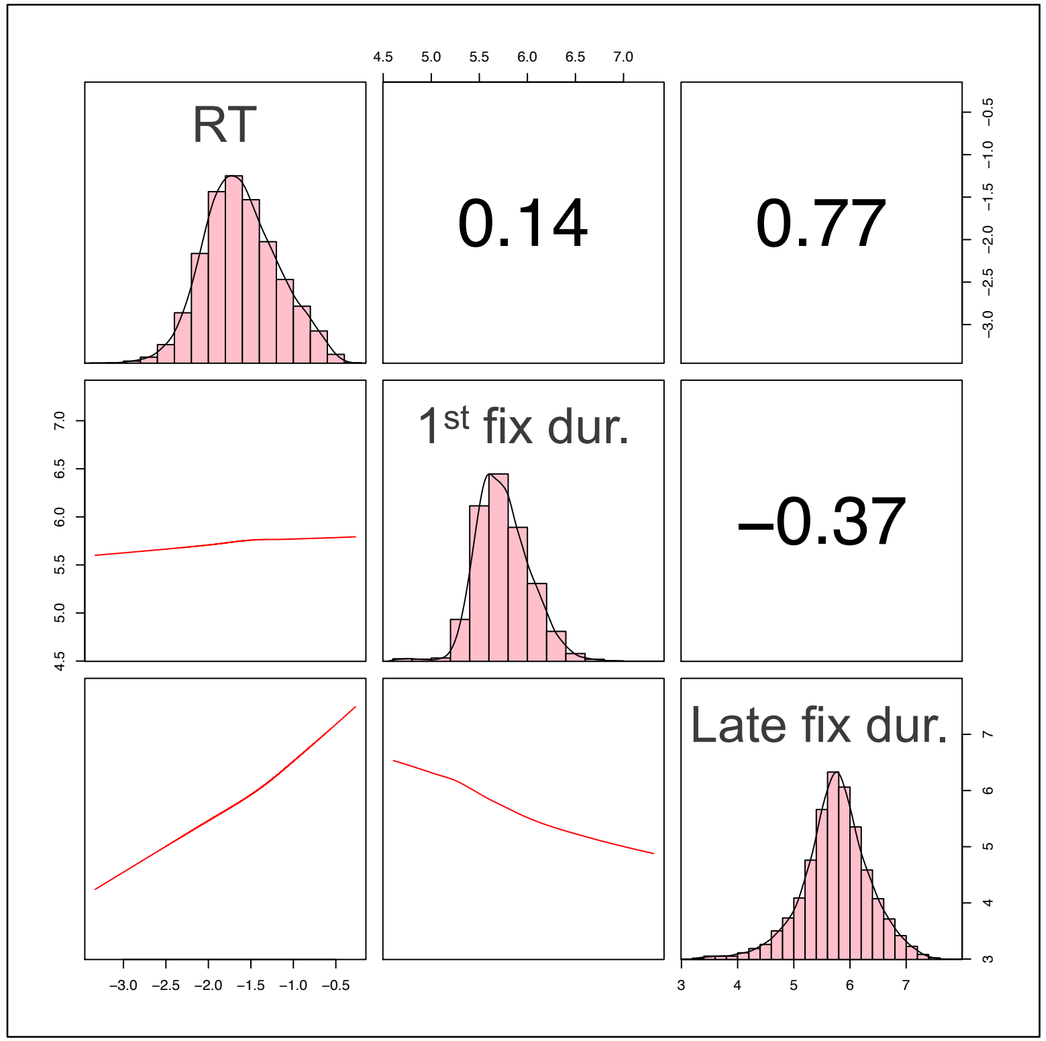
The eye movements are informative

- Native speaker advantage does not arise at the first fixation.
- There is no difference between Japanese and English at the late processing stage.



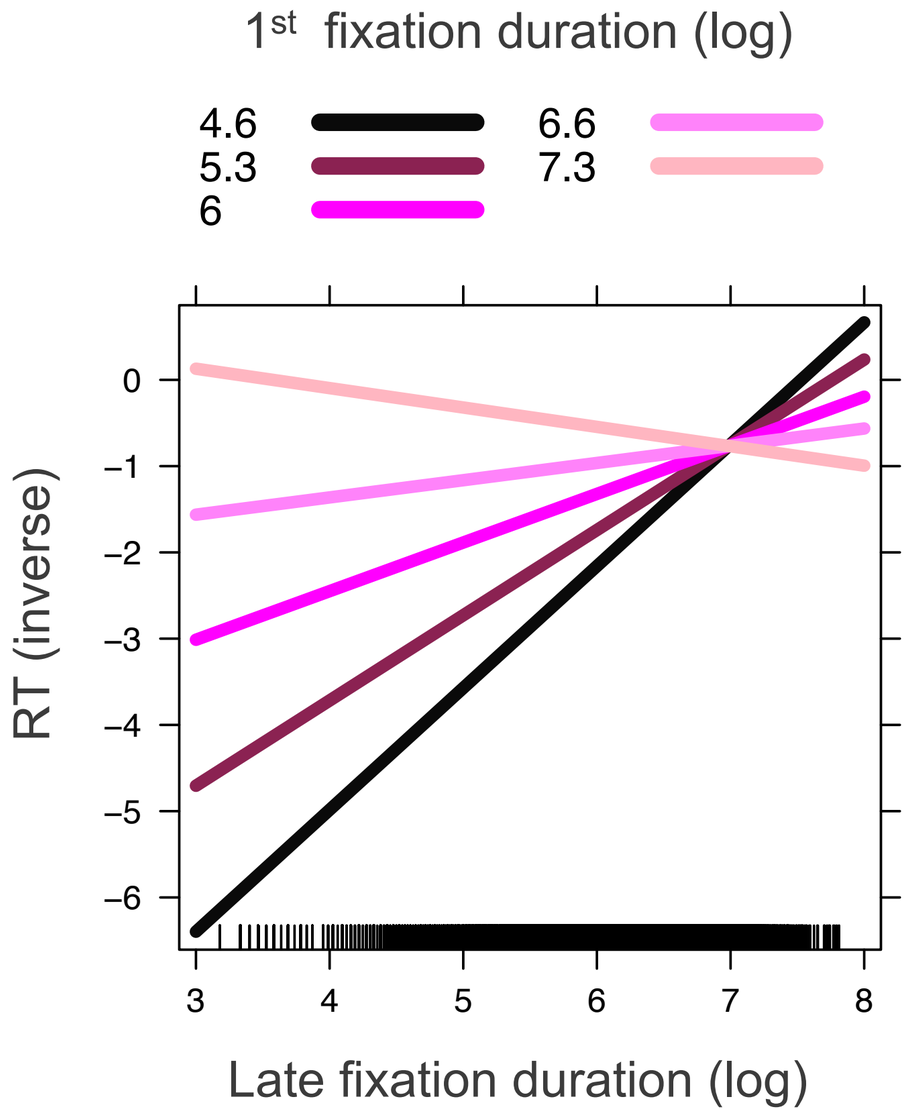
RTs and fixation durations

- RTs correlate with late fixation durations strongly.
- First fixation durations and late fixation durations correlate negatively.



RTs and fixation durations

- When the 1st fixation is short, late fixation durations co-determine RTs more.
- There seems to be a trade-off.

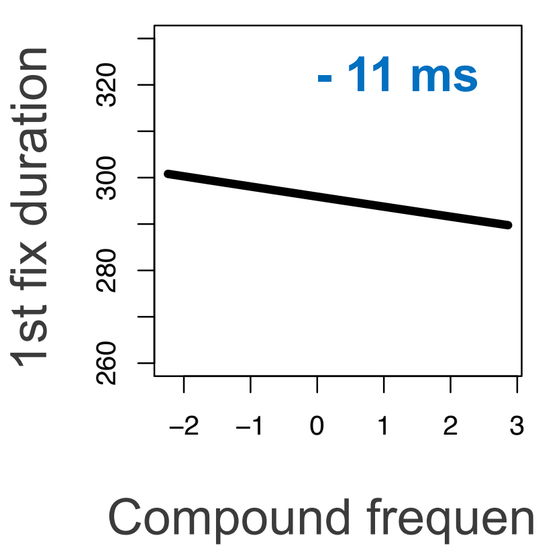


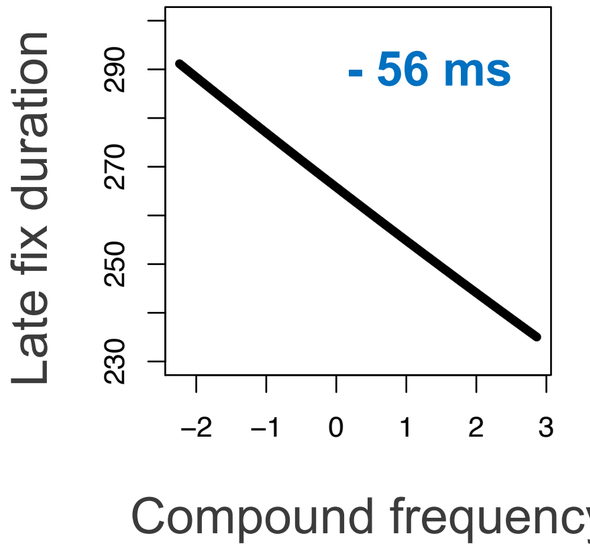
4

What phenomena are particularly interesting at the first fixation?

Early effects of whole word frequency

- In ALL experiments, we observed a whole word frequency effect already at the first fixation. It is always small but always significant.

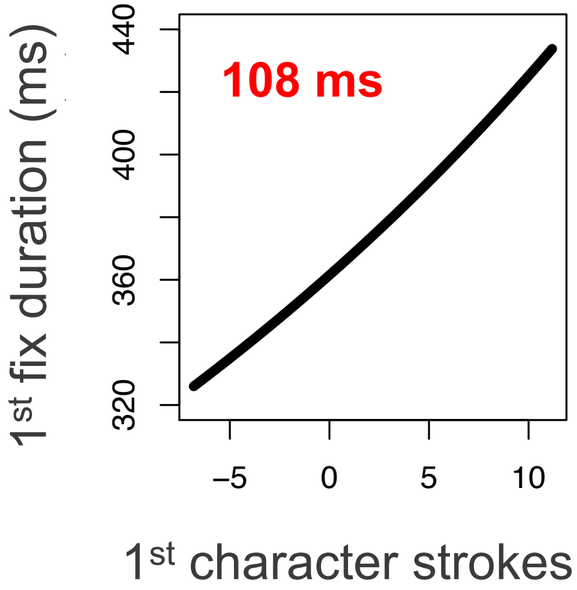




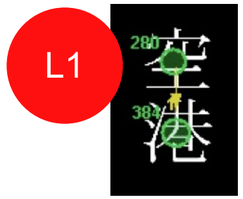
Facilitatory effects of visual complexity

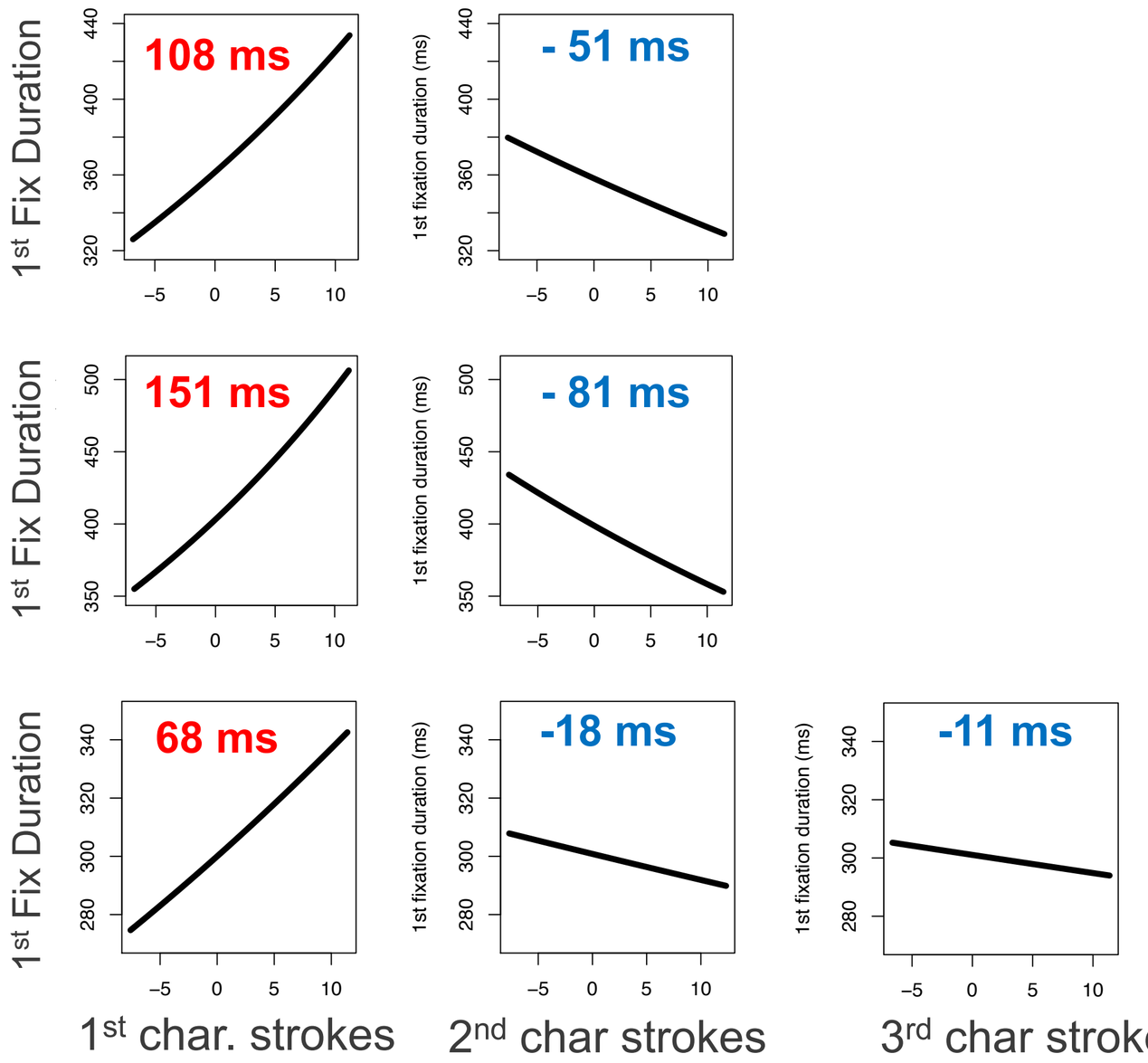
- Visual complexity usually elicit processing cost.

  However, visual complexity at unattended location facilitates processing.



Facilitatory effects of visual complexity



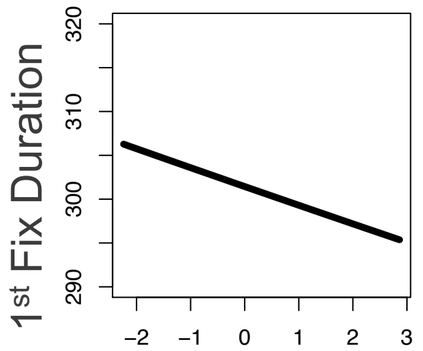


5

What does LD with eye-tracking tell us about morphological processing?

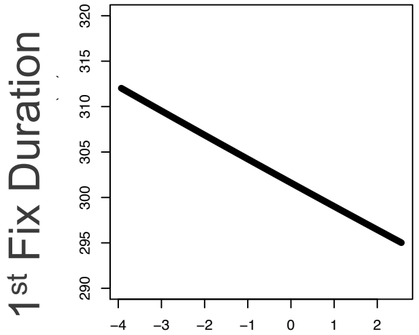
Morphological processing

- The eye is not guided strictly by morphemes (e.g., trimorphemic words are read with 2 fixations).

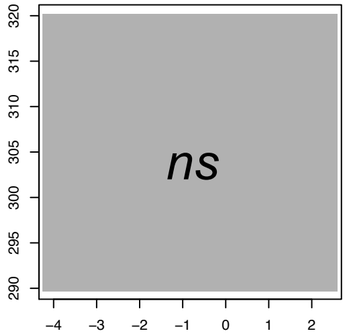


Compound freq.

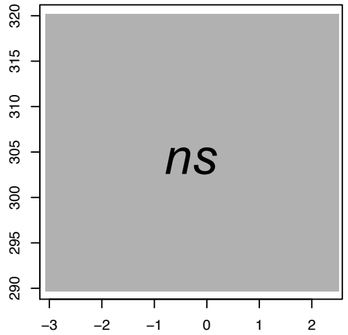
- However, eye movements reflect morphological processes.



1st char. freq.



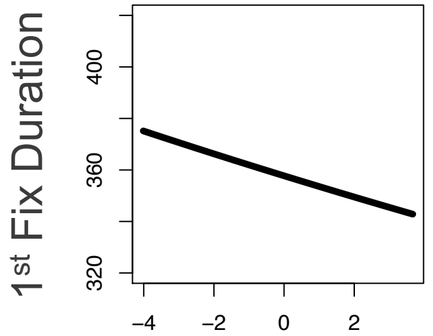
2nd char. freq.

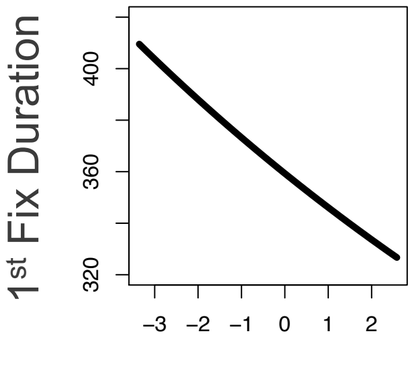


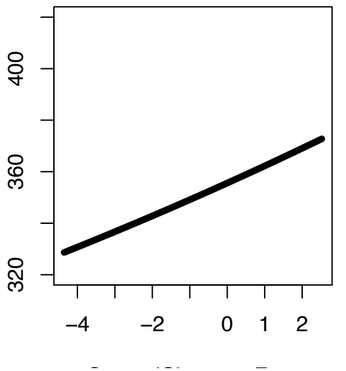
3rd char. freq.

Morphological processing

- Frequency effects for the left character and the compound units have been observed consistently.

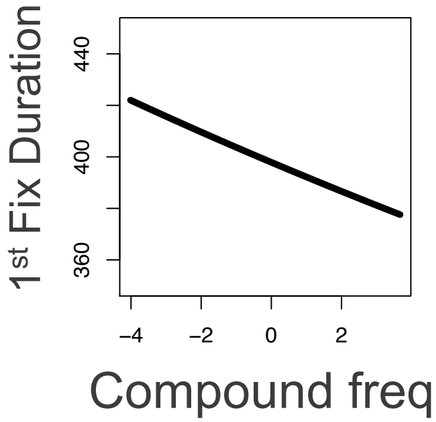


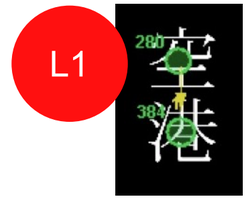


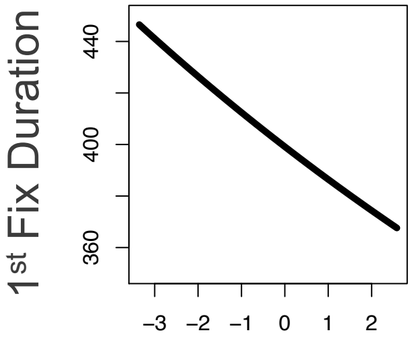


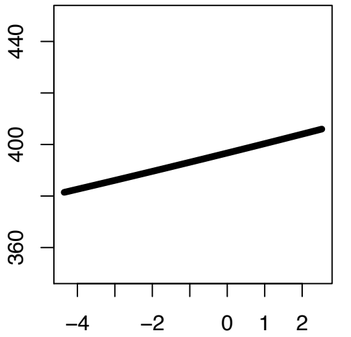
Morphological processing

- Frequency effects for the left character and compound units have been observed consistently.









Take-home messages

1. “Eye movement control in word recognition” makes sense.
2. Isolated words are read with two fixations.
3. RTs correlate with the late fixation durations.
4. Early effects of word frequency and facilitatory effects of visual complexity were found.
5. Eye movements reflect morphological decomposition.

References

Miwa, K., & Dijkstra, T. (2017). Lexical processes in the recognition of Japanese horizontal and vertical compounds. *Reading and Writing: An Interdisciplinary Journal, 30*, 791-812.

Miwa, K., Dijkstra, T., Bolger, P., & Baayen, R. H. (2014). Reading English with Japanese in mind: Effects of frequency, phonology, and meaning in different-script bilinguals. *Bilingualism: Language and Cognition,17*, 445-463.

Miwa, K., Libben, G., Dijkstra, T., & Baayen, R. H. (2014). The time-course of lexical activation in Japanese morphographic word recognition: Evidence for a character-driven processing model. *Quarterly Journal of Experimental Psychology, 67*, 79-113.

Miwa, K., Libben, G., & Ikemoto, Y. (2017). Visual trimorphemic compound recognition in a morphographic script. *Language, Cognition and Neuroscience, 32*, 1-20.

Rayner, K. (1998). Eye movements in reading and information processing: 20 years of research. *Psychological Bulletin, 124*, 372-422.

Taylor, J., Mukai, Y., & Miwa, K. (in preparation). Comparing the time-courses of lexical processes in L1 and L2 word recognition: A lexical decision eye tracking study with Japanese-English bilinguals

Thank you

Another presentation on lexical decision with eye-tracking

October 20, 16:30-17:40

Jamie Taylor, Yoichi Mukai and Koji Miwa

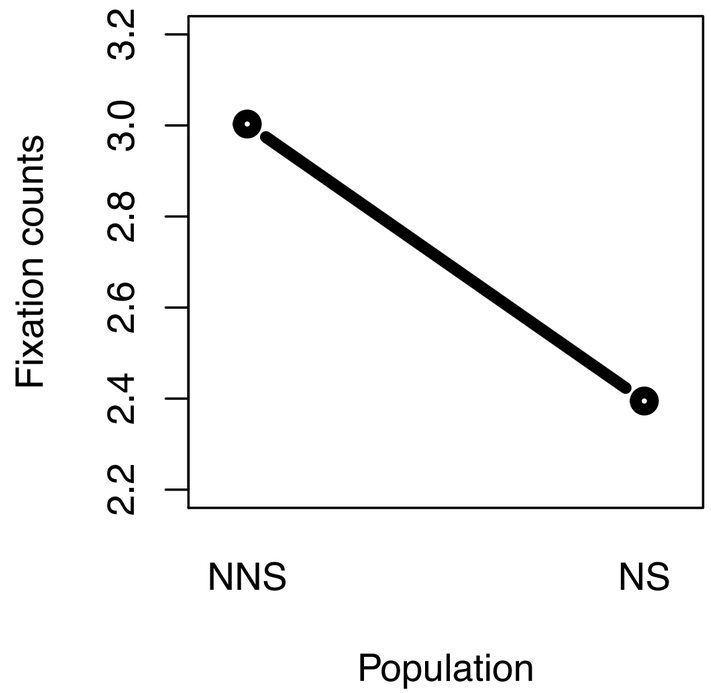
Comparing the time-courses of lexical processes in L1 and L2 word recognition:

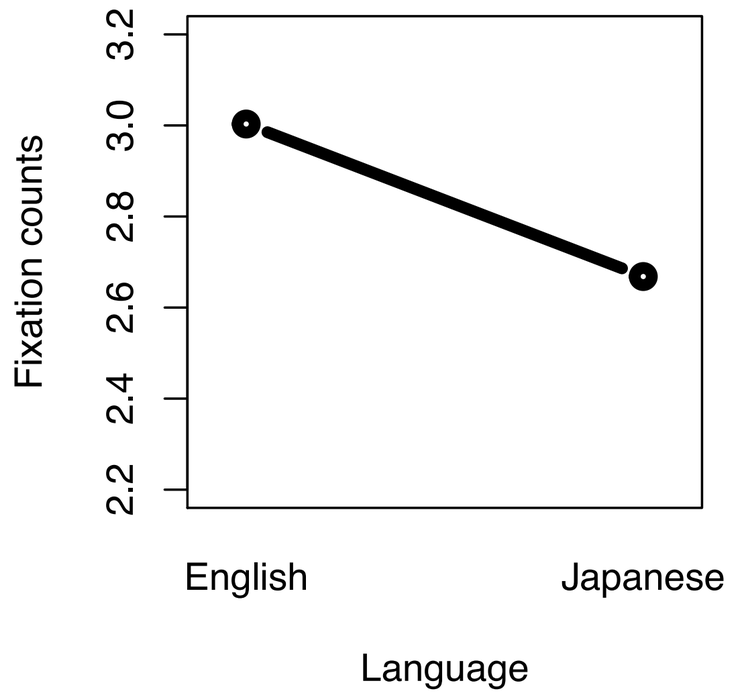
A lexical decision eye tracking study with Japanese-English bilinguals

Acknowledgment

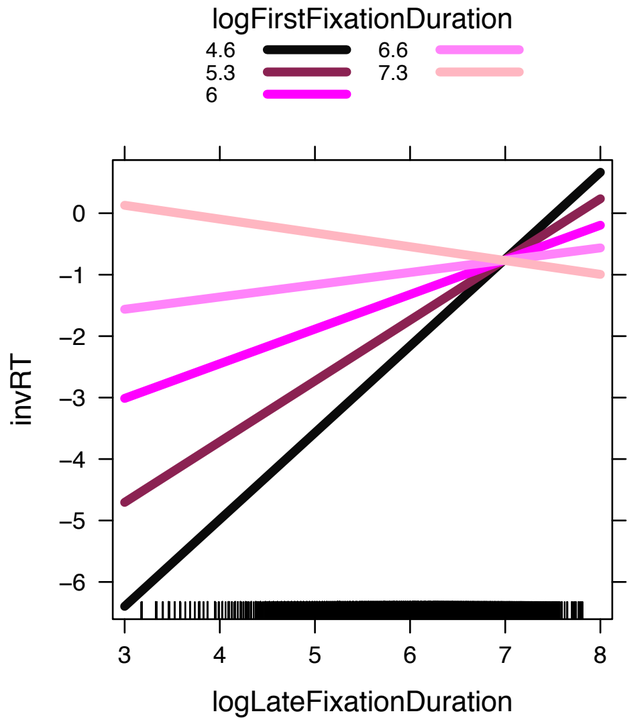
How many fixations are needed?

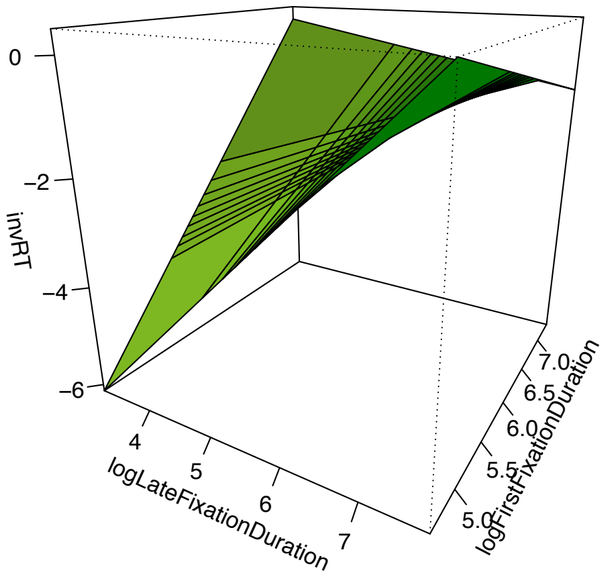
- Fewer fixations are needed when reading L1 words, compared to L2 words.

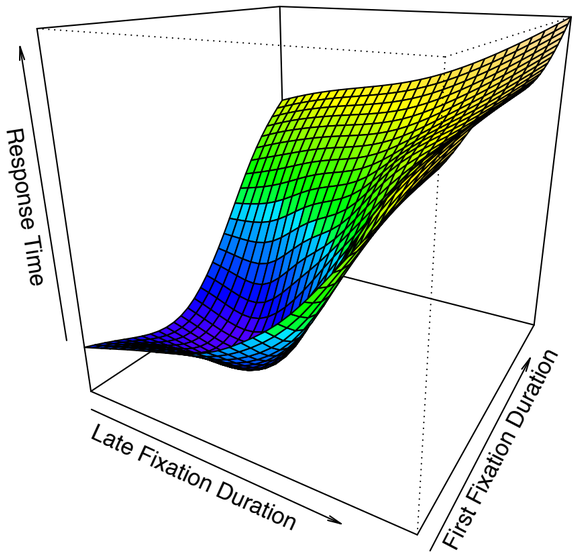




LME and GAMM







partial effect