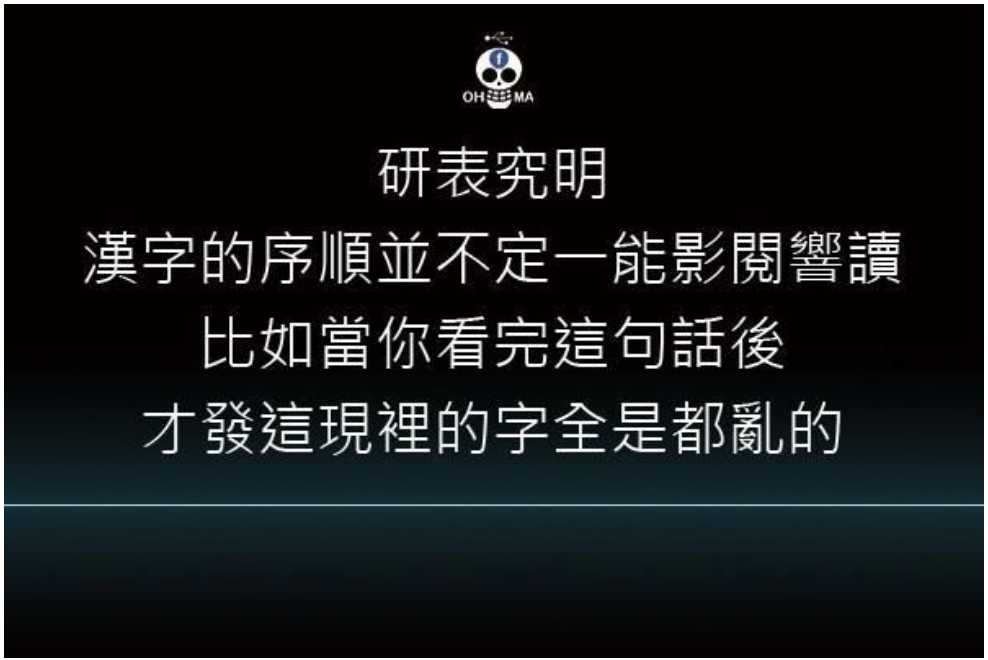
Does Character Order Affect Reading Comprehension in Mandarin?

Tutorial 2, Group 2

楊泰萱, 古雲軒, 朱紹瑜, 莊詠東

Motivation



Research Question

1. What types of "mess" can we tolerate in reading comprehension?

2. How "messy" can an understandable sentence be?

Swap Type

- Unordered characters within words

  傳播→播傳；相似→似相

- Unordered characters between words

  大幅減少→大減幅少；重要因子→重子因要

- Unordered words

  研究顯示→顯示研究；詹姆士鼾聲大作→鼾聲詹姆士大作

Number of Swaps

- Swap 3 times

  氣候變遷的主要推手是集體企業，例如力電網、工業、大規模業農與運輸系統。在人類排放的溫室氣體中，近半來自於電發與工業使用的化石燃料。

- Swap 6 times

  氣候變遷的主要推手是體集企業，例如力電網、工業、大規模業農與運輸統系。在人類排放的溫室體氣中，近半來自於電發與工業使用的化石燃料。

Experiment Design

- Conditions
  - **3 swap types**
  - **2 number of swaps**
  - 4 stimulus
  - 2 questions
  - 48 questions in total

- With no counter-balance design, use full randomization instead.

	Within words	Between words	Unordered words
3 swaps	3 within words swaps	3 between words swaps	3 unordered words swaps
6 swaps	6 within words swaps	6 between words swaps	6 unordered words swaps

Where do questions come from?

- Passage (50-70 characters)
  from 關鍵評論 and 科學人雜誌

- Question (true / false)
  Hand made by our members and reviewed by TA

1. 關鍵評論 https://www.thenewslens.com/ 2. 科學人雜誌 https://sa.ylib.com/index.aspx

Data Collection

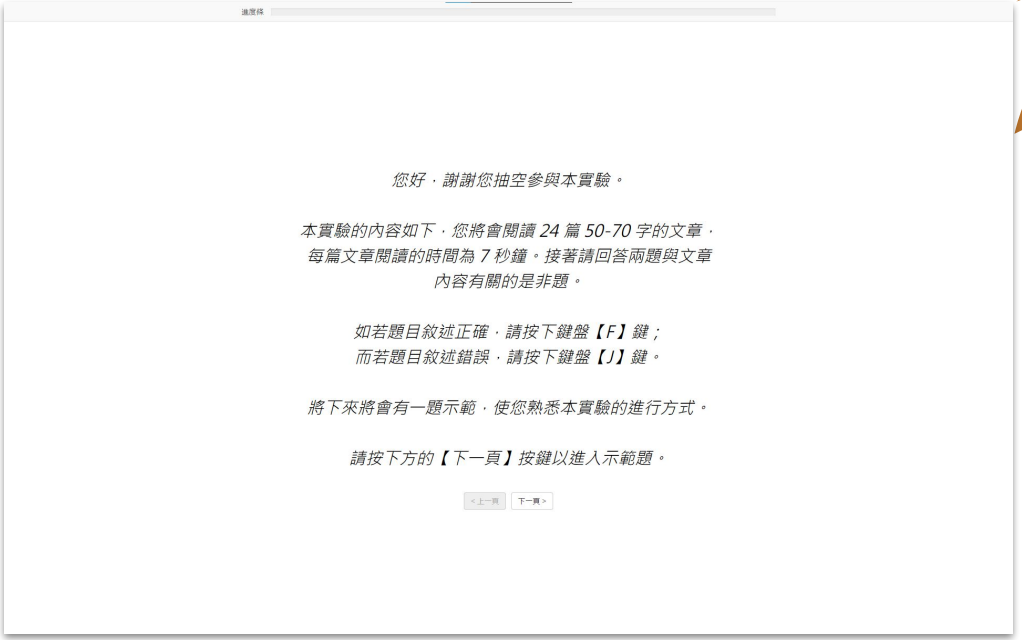
- Form
  - Interactive webpage (mini-experiment)

- Source
  - NTU 台大學生交流版
  - Our friends

- What did we collect?
  - Response (true / false)

Experiment Flow

- **Instructions**
- Sample trial
- Go through trials
  - Fixation (0.5s)
  - Stimulus (7s)
  - Question 1
  - Question 2
- Show a simplified result of the experiment
- Upload data



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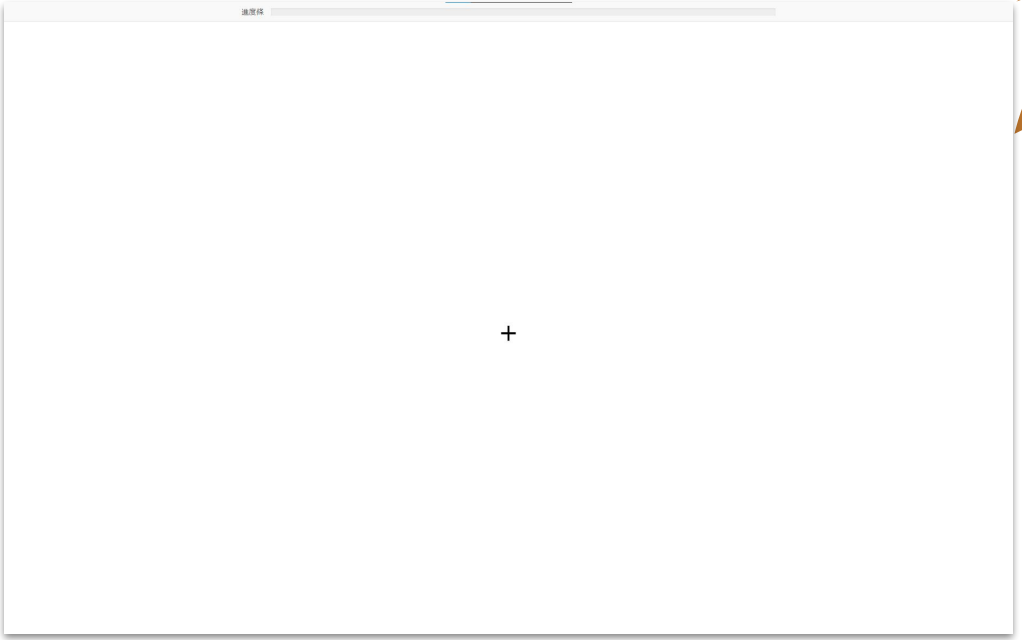

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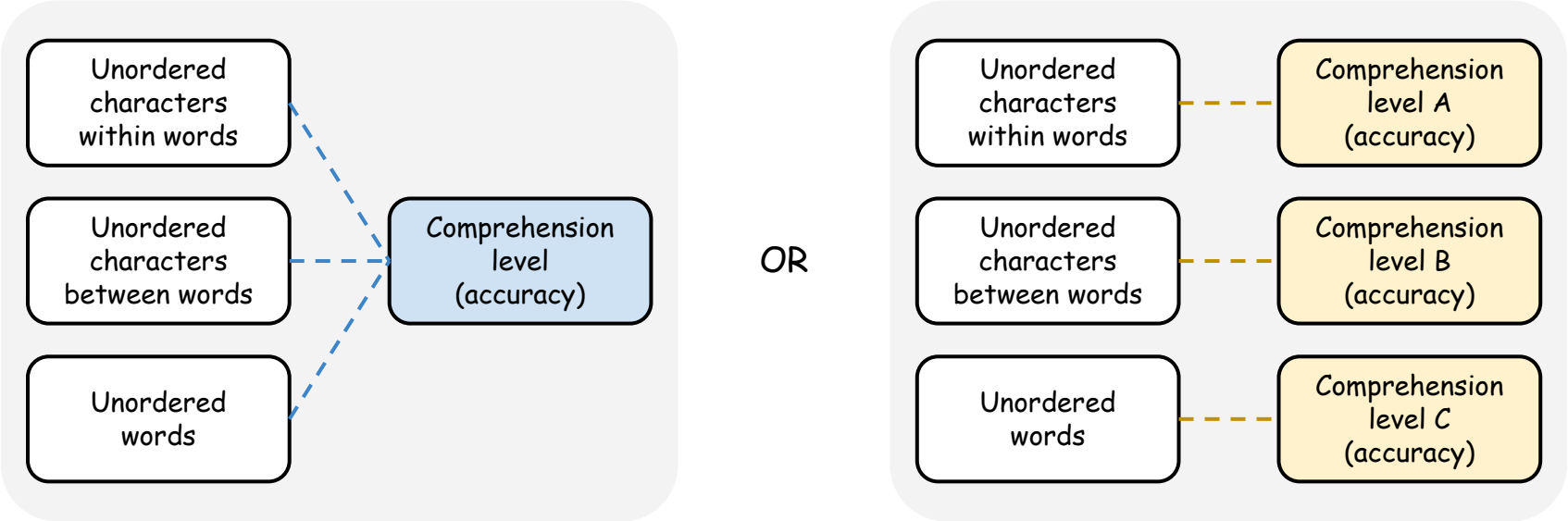
Results

107 responses

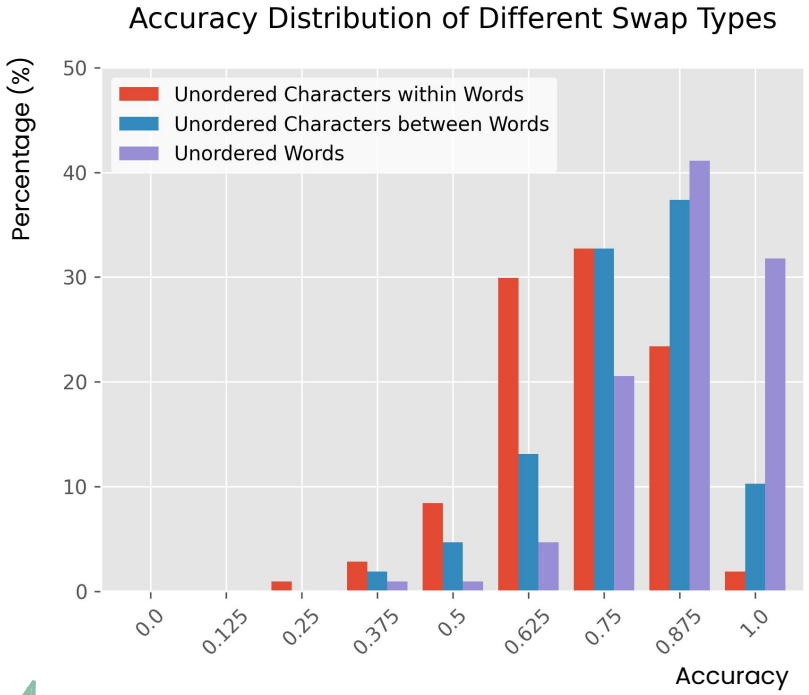
Results - [RQ1] What types of "mess" can we tolerate in reading comprehension?



Same

Different

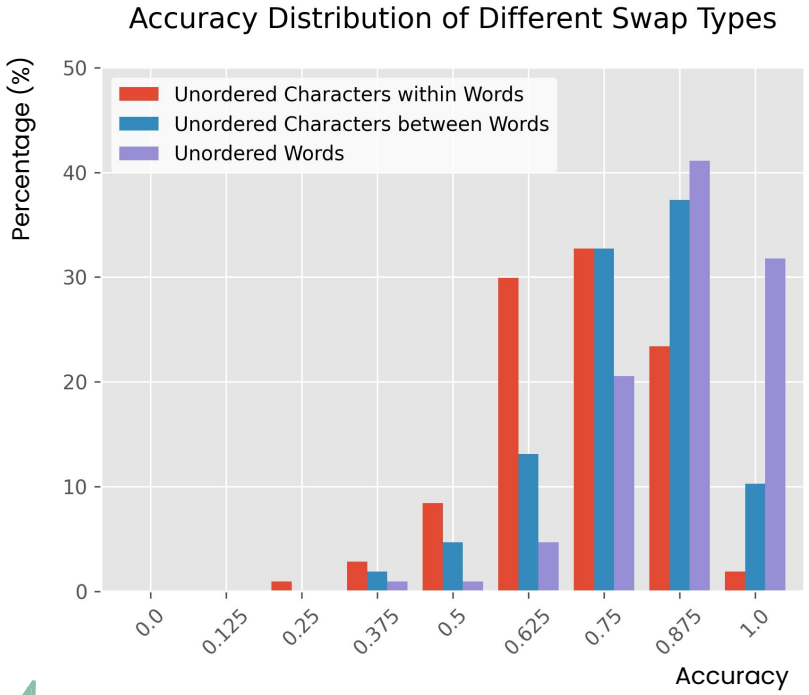
Results - [RQ1] What types of "mess" can we tolerate in reading comprehension?



(3 swaps)	Mean	SD
Unordered characters within words	0.71	0.14
Unordered characters between words	0.79	0.14
Unordered words	0.87	0.12

"Are the three accuracy distributions the same?"

Results - [RQ1] What types of "mess" can we tolerate in reading comprehension?



"Are the three accuracy distribution the same?"

- NOT normal distribution
- non-parametric tests
- "Kruskal-Wallis test" + "Dunn's test with Bonferroni correction" for post-hoc test

Results - [RQ1] What types of "mess" can we tolerate in reading comprehension?

Unordered characters within words
vs.
Unordered characters between words
vs.
Unordered words

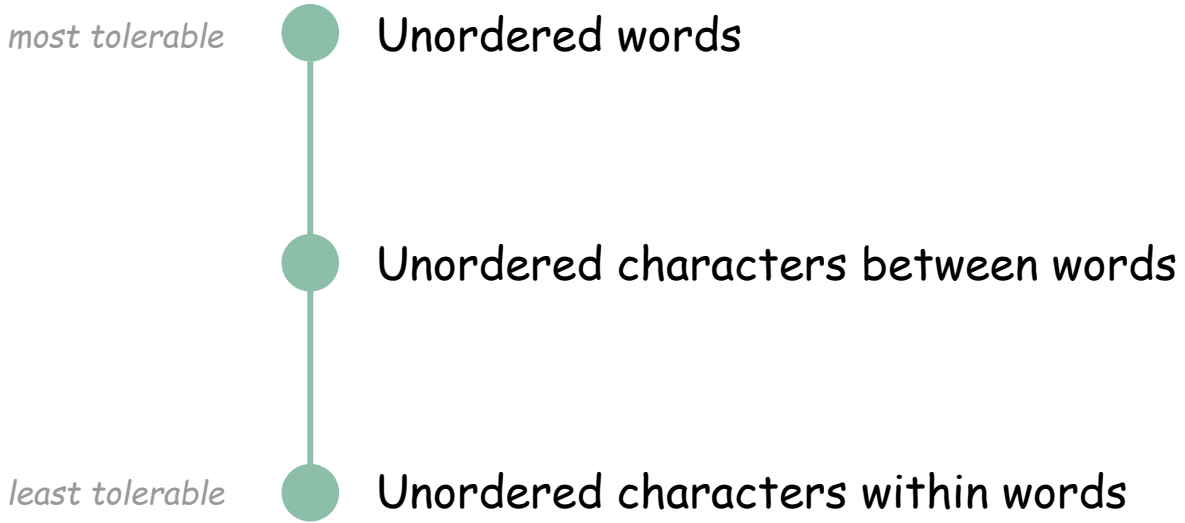
[Kruskal-Wallis] p-value = 2.41e-15 < 0.05

Unordered characters within words vs. Unordered characters between words
[Dunn's] p-value = 3.42e-4 < 0.05

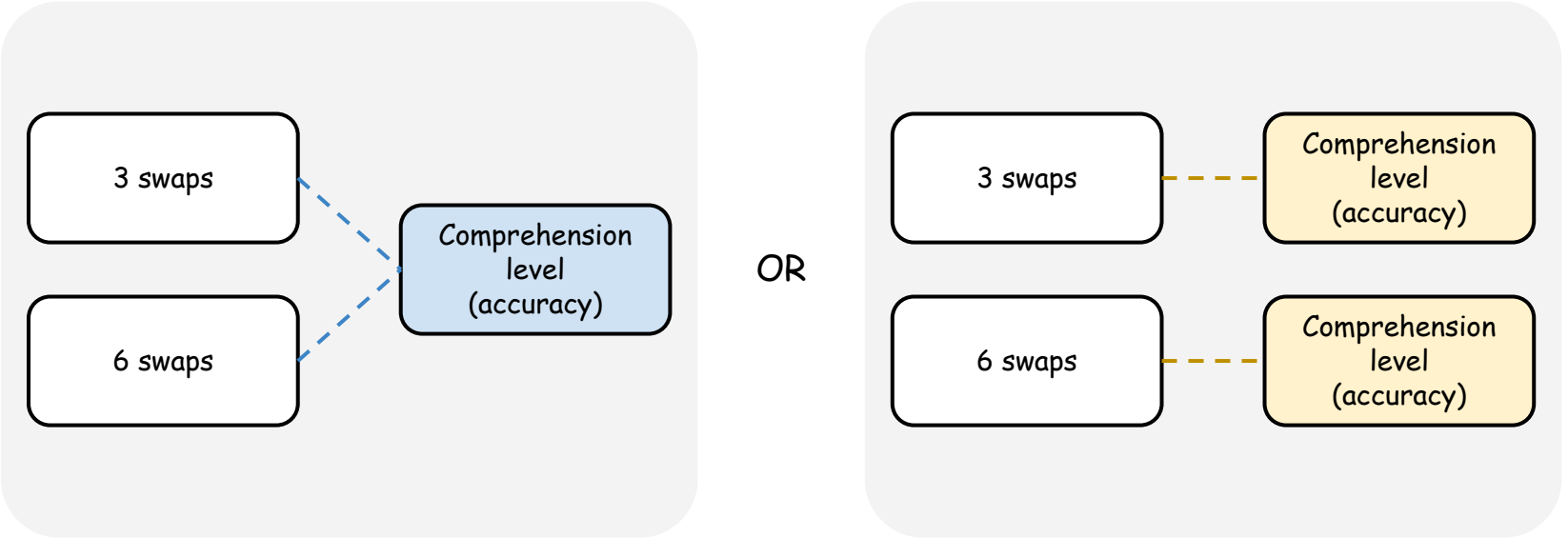
Unordered characters within words vs. Unordered words
[Dunn's] p-value = 7.21e-16 < 0.05

Unordered characters between words vs. Unordered words
[Dunn's] p-value = 4.25e-5 < 0.05

Results - [RQ1] What types of "mess" can we tolerate in reading comprehension?



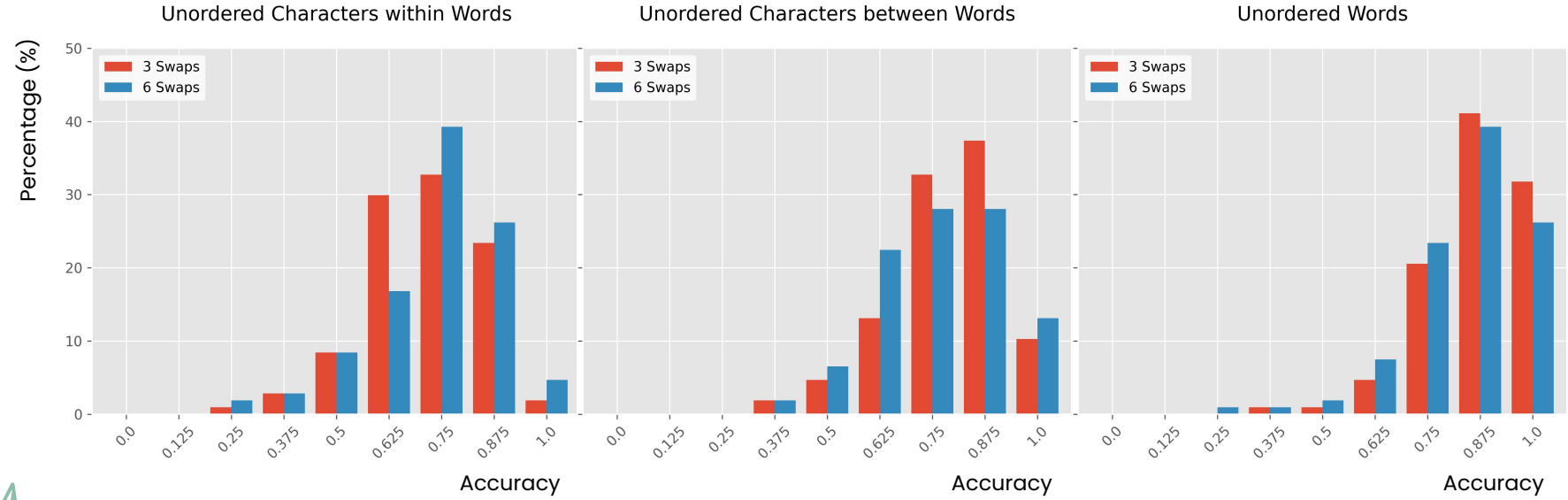
Results - [RQ2] How "messy" can an understandable sentence be?



Same

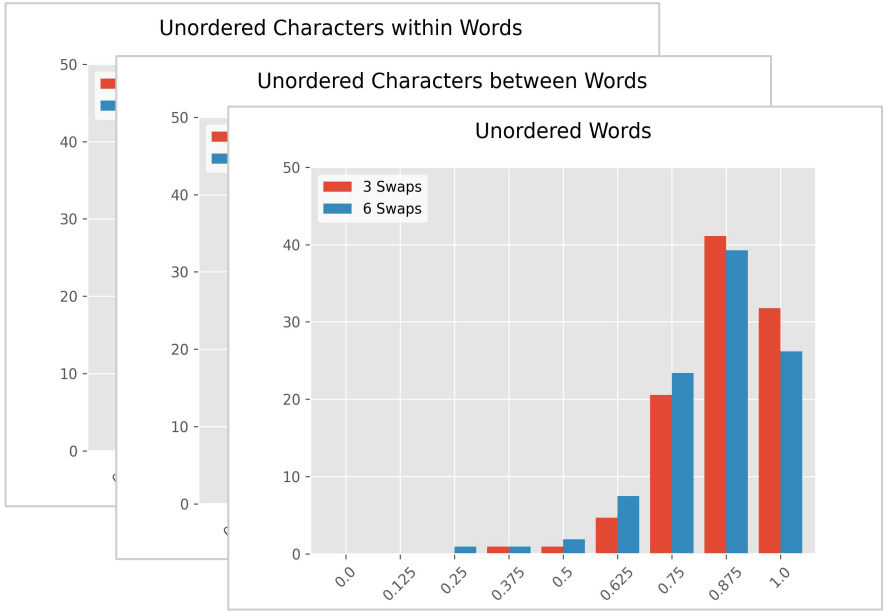
Different

Results - [RQ2] How "messy" can an understandable sentence be?



"Are the accuracy distribution of 3 swaps and 6 swaps the same?"

Results - [RQ2] How "messy" can an understandable sentence be?

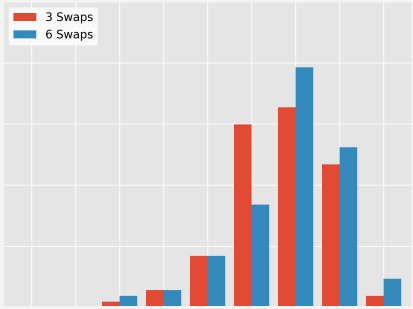


"Are the accuracy distribution of 3 swaps and 6 swaps the same?"

- NOT normal distribution
- non-parametric tests
- "Mann-Whitney U test"

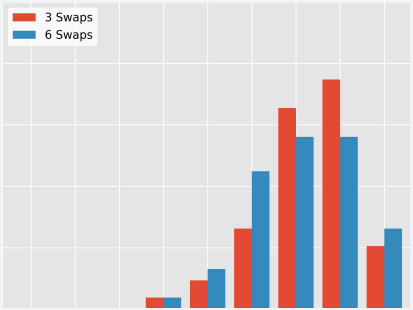
Results - [RQ2] How "messy" can an understandable sentence be?

Unordered Characters within Words



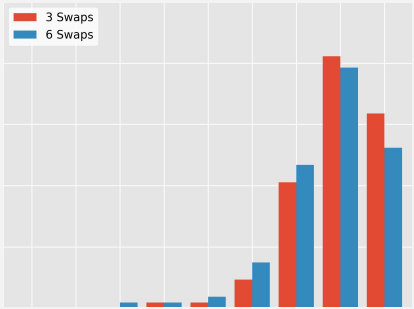
p-value = 0.15 > 0.05

Unordered Characters between Words



p-value = 0.25 > 0.05

Unordered Words



p-value = 0.18 > 0.05

For all three swap types, there are **NO** significant accuracy difference between 3 swaps and 6 swaps.

Conclusion

1. What types of "mess" can we tolerate in reading comprehension?
   a. within words < between words < unordered words
      Mean accuracy: 0.71 < 0.79 < 0.87

2. How "messy" can an understandable sentence be?
   a. In this study, there's no significant differences.

Interpretation

- For conclusion 1 (within words < between words < unordered words)
  - When we read, we comprehend "words" as units.
  - That is, completeness of words is relatively important.

- For conclusion 2 (no significant differences)
  - The number of swaps might not be enough to show significant difference.

References

1. de Leeuw, J. R. (2015). jsPsych: A JavaScript library for creating behavioral experiments in a web browser. Behavior Research Methods, 47(1), 1-12. doi:10.3758/s13428-014-0458-y.

2. 關鍵評論, https://www.thenewslens.com/

3. 科學人雜誌, https://sa.ylib.com/

4. Psycholinguistic evidence on scrambled letters in reading. Undated; Available from: www.mrc-cbu.cam.ac.uk/people/matt.davis/cma bridge/, accessed 7 May 2022

Q&A

Appendix

- Experiment website
  - https://linguisticsexperiment.z7.web.core.windows.net/
- Source code
  - https://github.com/shaoyuchu/linguistics-experiment