Lexically-guided perceptual learning in Cantonese-English bilinguals: A web replication study

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Introduction

- Lab and online speech perception studies typically draw from different populations—it is unclear whether results differ because of platform or population.
  - Online: General public via Amazon Mechanical Turk, Prolific Academic, and/or social media recruiting, etc.
  - Laboratory: Undergraduate student body, and/or other university-affiliated individuals
- Perceptual learning is a well-established paradigm [6], previously used in web studies [5].
- In a lab study [3], we found that Cantonese-English bilinguals successfully retuned their perception of ambiguous /f/ sounds in Cantonese, compared to control participants who heard unambiguous tokens during the exposure task.

Research Question

For a perceptual learning task, do participants from the same subject pool perform similarly in the lab and on the web?

Methods: Perceptual Learning

- **Participants:** 160 Cantonese-English bilinguals in Vancouver with Cantonese understanding rated 2+ (of 6). Language dominance was assessed with the Bilingual Language Profile [2].
- **Lexical decision exposure:** Participants hear four types of items, and respond with whether or not it was a word:
  - Critical /f/: CVCV words where /f/ was expected at onset of second C (e.g. 豆腐 *dau6fu6* 'tofu'). Control heard [f]; Experimental heard ambiguous [f]-[s].
  - Control /s/: CVCV words with /s/ at onset of second syllable as reference for Critical /f/ words.
  - Filler words: CVCV words with no fricatives.
  - Filler nonwords: Phonologically legal CVCV nonwords.
- **Categorization test:** Participants hear items from 6 steps of ambiguous [f]-[s] nonword-nonword continua.
- **Lab study:**
  - Control: $n = 50$, Experimental: $n = 48$
  - E-Prime 2.0
  - AKG-240 Studio Headphones
  - Serial response box buttons 1 and 5
- **Web study:**
  - Control: $n = 30$, Experimental: $n = 32$
  - Browser with jsPsych [4]
  - 3AFC headphone test before study [7]
  - Participant's keyboard keys 1 and 0

Due to experimenter error, only the lexical decision task was replicated correctly in the online study. Stay tuned!

Language Dominance

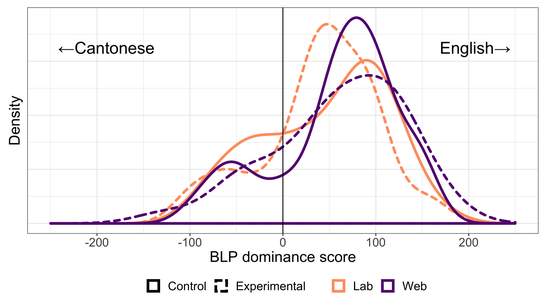

Figure 1: Bilingual Language Profile dominance scores are based on self-reported proficiency, history, use, and attitudes [2]. Cantonese-English bilingual participants in the Experimental and Control conditions of both the Lab and Web study have comparable language dominance profiles.

Response Times

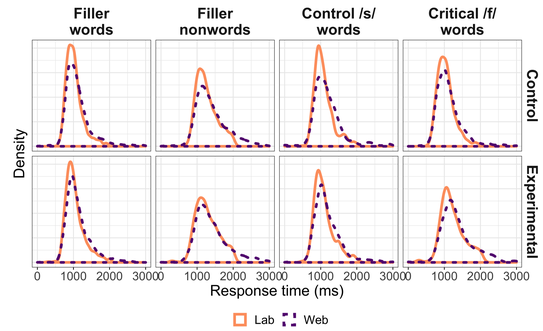

Figure 2: Response times were filtered to exclude non-responses, responses faster than 200 ms, and responses greater than $2 \times \sigma$. Participants in both conditions and platforms had comparable response times across Types.

Lexical Decision Accuracy

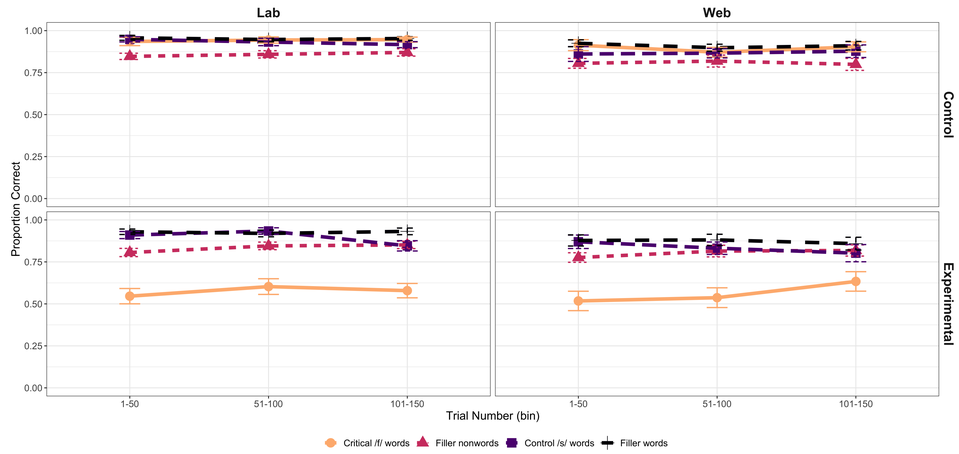

Figure 3: Web participants had slightly lower accuracy than Lab participants ($\beta = -0.83$, $p < 0.01$), but generally followed the same pattern of results. The exception—Web participants had higher accuracy on nonwords than Lab participants ($\beta = 0.41$, $p < 0.05$)

Table 1: Significant effects for the logit mixed effects model fit with *lme4* [1] in R: *Accuracy* ~ *Platform* × *Condition* × *Type* × *Trial* + *(1|Subject)* + *(1|Word)*.

Main Effect	β	SE	p	**Interpretation**
Intercept	3.59	0.20	< 0.001	Overall, items were accurately identified
Platform:Web	−0.83	0.26	0.001	Accuracy was lower in the Web study
Condition:Experimental	−0.54	0.23	0.02	Accuracy was lower in the Experimental condition
Type:Nonword	−1.41	0.17	< 0.001	Accuracy was lower for Filler nonwords compared to Filler words
Interactions				
Platform:Web–Type:Nonword	0.41	0.16	0.013	Accuracy for Filler nonwords was higher for Web participants
Condition:Experimental–Type:Nonword	0.31	0.16	0.045	Accuracy for Filler nonwords was higher for the Experimental condition
Condition:Experimental–Type:Critical /f/	−2.27	0.23	< 0.001	Accuracy for critical /f/ items was lower in the Experimental condition
Type:Nonword–Trial	0.23	0.12	0.048	Accuracy for identifying nonwords improved over the task

Lab Categorization Results

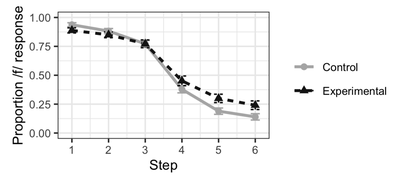

Figure 4: The categorization functions for lab study demonstrate that the Experimental condition participants categorized significantly more of the ambiguous fricatives in nonword-nonword continua as /f/. No web comparison is available.

Discussion & Conclusion

- The results are qualitatively the same across platforms for response time and accuracy, giving support for conducting online speech perception studies in general, and synthesized fricatives in particular [as in 5].
- Lower accuracy online suggests the web study was more difficult for participants, but uniformly so, as error bars appear relatively similar. This may be due to more divided attention online.
- Higher accuracy for Nonwords in the Experimental condition and Web platform suggest that an increase in task difficulty leads to a Nonword bias; alternatively, participating in the lab may lead to a Word bias (performance nervousness).

Take Home Points

1. Lexical decision works online with synthesized fricatives.
2. Lab and web response times are remarkably similar!
3. The web platform depresses accuracy for participants from the same subject pool, but does not lead to drastically increased variation in performance.

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