University of York
Department of Language and Linguistic Science

The Effect of Bilingualism on Filled Pauses and their Discriminatory Power

Justin Jing Hoi Lo
jl2355@york.ac.uk

FPs in Forensic Voice Comparison

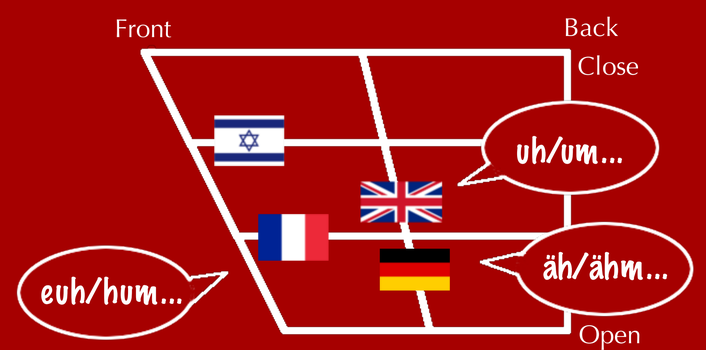
Frequent [4] — Less susceptible to coarticulation [7]

... Um. This is about, uuuuh, hesitation ...

Stable *f*0 & formants [9] — Long [16]

Discriminatory Power:
- ✔ SSBE (*um*: EER 4.08%, Cllr 0.12) [7]
- ✔ York English [3]

Crosslingual FPs [2,15,17]



FPs for Bilinguals?

Contradictory predictions:

(1) Speaker-specific hesitation sounds [10]

(2) Language-dependent variation [19]

→ Indirect support: bilinguals adopt different language-specific articulatory settings [5,21]

Method

- HABLA corpus [11,12]
- 6 out of 14 female speakers with L1s German & French

- NCCFr corpus [18]
- 10 out of 22 female monolingual French speakers

↓

FP duration & F1–F3 dynamics [8,13]

↓

LR Testing (FPs in French)

Sys.	*Test Data*	*Reference Data*
1	Monolingual	Mono+Bilingual
2	Bilingual	Mono+Bilingual
3	Bilingual	Bilingual

↓

LRs from MVKD [1,14]

↓

Iterate through all speaker-pairs [8] (cross-validated where needed)

↓

Measures of validity: EER, C_{llr}

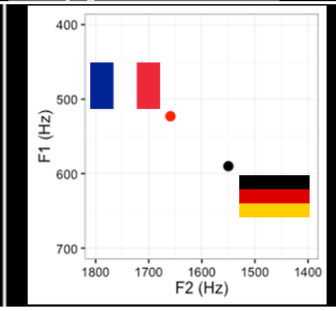
Research Questions

1. How do FPs of G-Fr bilinguals in German and French differ?

2. How do FPs in French differ between G-Fr bilinguals and Fr monolinguals?

3. How is the discriminatory power of FPs affected by bilingualism in the test & reference data?

Hypotheses

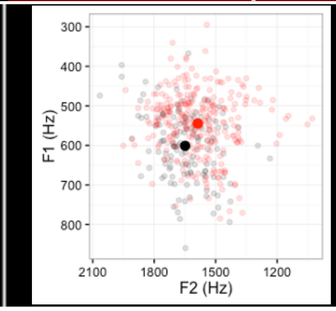


[2]

No significant differences

No significant effect

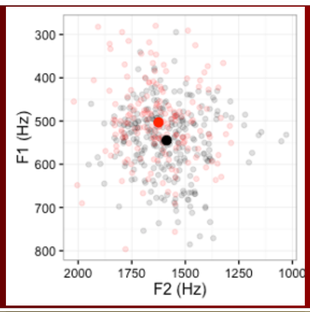
Preliminary Results



(mean F1, F2 reported)

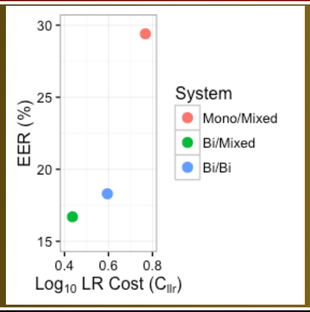
FPs in French (545,1587 Hz)
- more **back**,
- more **close**

than in German (601, 1649 Hz) ($p < 0.0001$)



FPs by Fr monolinguals (503, 1624 Hz):
- more **front** ($p = 0.012$),
- more **close** ($p < 0.0001$)

than by G-Fr bilinguals (545, 1587 Hz)



Discriminatory power of F1–F3 from *euh* (EER, C_{llr}):
- Against mixed background:
  higher for bilinguals (16.7%, 0.436) than monolinguals (29.4%, 0.768)
- For bilinguals:
  higher against mixed background than specific bilingual background (18.3%, 0.595)

Reference: [1] Aitken, C.G.G. and Lucy, D. (2004). Evaluation of trace evidence in the form of multivariate data. *Applied Statistics*, 53(1), 109–122. [2] Candea, M., Vasilescu, I. and Adda-Decker, M. (2005). Inter- and intra-language acoustic analysis of autonomous fillers. *Proceedings of the 5th Workshop on Disfluency in Spontaneous Speech*, 47–52. Aix-en-Provence, France, Aug 2005. [3] Daley, A. (2015). The effect of dialect on the discriminatory value of formant trajectories: A comparison of York English and Standard Southern British English. Unpublished MSc Thesis, University of York. [4] de Leeuw, E. (2007). Hesitation Markers in English, German and Dutch. *Journal of Germanic Linguistics*, 19(2), 85–114. [5] Gick, B., Wilson, I., Koch, K. and Cook, C. (2004). Language-Specific Articulatory Settings: Evidence from Inter-Utterance Rest Position. *Phonetica*, 61(4), 220–233. [6] Harrison, P. (2011). *ss_ds_lr_loop.m*. [7] Hughes, V., Wood, S. and Foulkes, P. (2016). Strengthof forensic voice comparison evidence from the acoustics of filled pauses. *International Journal of Speech, Language and the Law*, 23(1), 99–132. [8] Hughes, V.S. (2014). The Definition of the Relevant Population and the Collection of Data for Likelihood Ratio-Based Forensic Voice Comparison. Unpublished PhD Thesis, University of York. [9] Karpinski, M. (2013). Acoustic Features of Filled Pauses in Polish Task-Oriented Dialogues. *Archives of Acoustics*, 38(1), 63–73. [10] Künzel, H.J. (1997). Some general phonetic and forensic aspects of speaking tempo. *International Journal of Speech, Language and the Law*, 4(1), 48–83. [11] Kupisch, T. (2011). *Hamburg Adult Bilingual Language*. Archived in Hamburger Zentrum für Sprachkorpora. Version 0.2. URL: http://hdl.handle.net/11022/0000-0000-5C64-9. [12] Kupisch, T., Barton, D., Bianchi, G. and Stangen, I. (2012). The HABLA-Corpus (German-French and German-Italian). In T. Schmidt and K. Wörner (Eds.), *Multilingual Corpora and Multilingual Corpus Analysis*, pp. 163–179. Amsterdam: John Benjamins. [13] McDougall, K. (2004). Speaker-Specific Formant Dynamics: An Experiment on Australian English /aI/. *International Journal of Speech, Language and the Law*, 11(1), 103–130. [14] Morrison, G.S. (2007). *Matlab implementation of Aitken & Lucy's (2004) Forensic likelihood-ratio software using multivariate-kernel-density estimation*. http://geoff-morrison.net/#MVKD. [15] Pätzold, M. and Simpson, A. (1995). An Acoustic Analysis of Hesitation Particles in German. *Proceedings of the 13th International Congress of Phonetic Sciences*. Vol. 3, 512–515. Stockholm, Sweden, Aug 1995. [16] Shriberg, E. (2001). To 'errrr' is human: ecology and acoustics of speech disfluencies. *Journal of International Phonetic Association*, 31(1), 153–169. [17] Silber-Varod, V., Weiss, A. and Amir, N. (2015). Can You Hear These Mid-front Vowels? Formants Analysis of Hesitation Disfluencies in Spontaneous Hebrew. *Proceedings of the 7th Workshop on Disfluency in Spontaneous Speech*. Edinburgh, Aug 2015. [18] Torreira, F., Adda-Decker, M. and Ernestus, M. (2010). The Nijmegen Corpus of Casual French. *Speech Communication*, 52(3), 201–212. [19] Vasilescu, I. and Adda-Decker, M. (2007). A cross-language study of acoustic and prosodic characteristics of vocalic hesitations. In A. Esposito, M. Bratanic, E. Keller and M. Marinaro (Eds.). *Fundamentals of Verbal and Nonverbal Communication and the Biometric Issue*, pp. 140–148. Amsterdam: IOS Press. [20] Wickham, H. (2009). *ggplot2: An Implementation of the Grammar of Graphics*. http://cran.r-project.org/web/packages/ggplot2/index.html. [21] Wilson, I. and Gick, B. (2014). Bilinguals Use Language-Specific Articulatory Settings. *Journal of Speech, Language, and Hearing Research*, 57(2), 361–373.