

Voice onset time and onset f0 in L2 learners of French

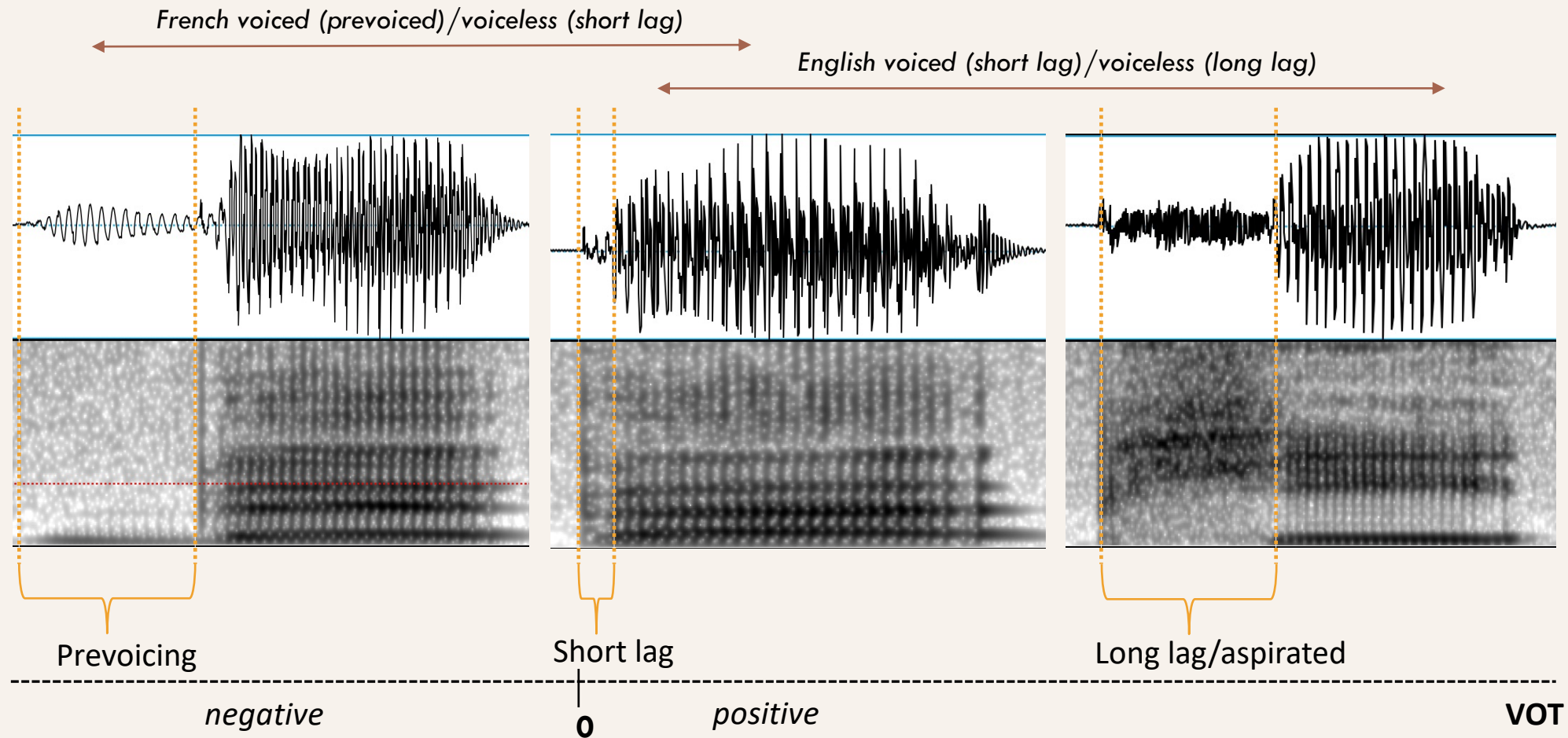
**Purdue Linguistics, Literature,
and Second Language Studies
Conference**

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Presentation Contents

1. Background
2. Literature
3. Research Questions
4. Methodology
5. Results
6. Conclusions
7. References

Background: Voice onset time



Background: Onset f_0

- Onset f_0 is defined as the fundamental frequency, f_0 , at the onset of the vowel following a stop consonant.

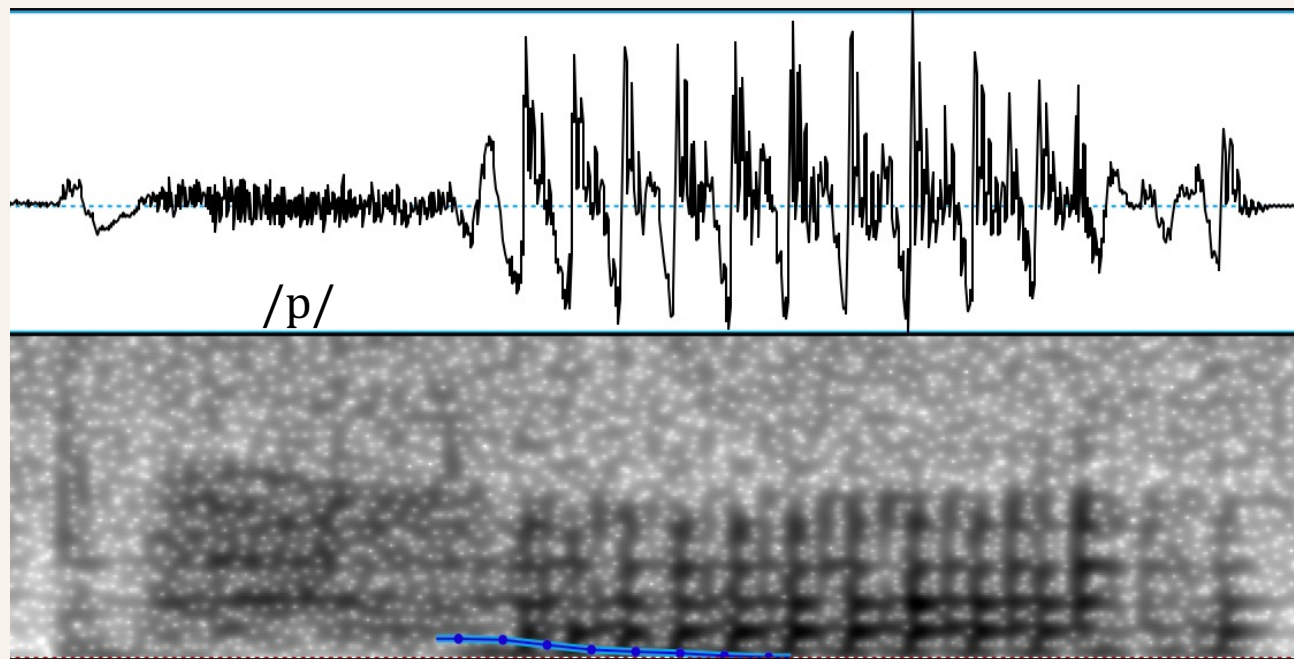


Figure 1: f_0 in 'pat' as indicated by Praat pitch tracker

Acoustic cues cross-linguistically

	[+voice]	[-voice]
French	Prevoiced, lower f0	Short lag, higher f0
English	Short lag, lower f0	Long lag, higher f0

Literature Review: Key Points

- Voice onset time (VOT) and onset f0 are known correlates of voicing distinctions in stops, and both contribute to the production and perception of voicing (House & Fairbanks, 1953; Abramson & Lisker, 1965).
- VOT and onset f0 implementation of voicing categories in terms of VOT and onset f0 vary cross-linguistically.
 - A second language (L2) learner must acquire novel use of these acoustic cues necessary for correct production and perception of their L2
- VOT has been studied quite extensively in the acquisition of L2 speech (Flege & Eefting, 1988; Flege, 1991; Birdsong et al. 2007), but there is a gap in the research regarding the acquisition of secondary cues, including onset f0.
- Chang (2013), suggests that beginner learners might experience back transfer (L2->L1) in a complete immersion environment.

Literature Review: SLA

- Models of Transfer:
 - *Speech Learning Model* (Flege, 1995)
 - Identical/very similar sounds will be assimilated to the L1 sound and new/not very similar sounds will form a new, separate L2 phonetic category.
 - **Similar sounds are assimilating to the L1 category and will be the most difficult to perceive and produce in the L2.**
 - *Perceptual Assimilation Model* (Best, 1995)
 - For L2 learners with low proficiency, L2 phonetic segments will be perceptually assimilated to a L1 phonetic category if they are similar to the L1 phonetic segments.
 - Single Category Pattern: If two L2 speech sounds are mapping to the same L1 speech sound they will be perceived as a single L1 category because they are phonetically similar. **Therefore, discrimination of the two sounds will be the most difficult.**

Literature Review: SLA

- Acquisition of VOT:
 - **Total separation** (Flege & Eefting, 1988; Flege, 1991)
 - Advanced L2 learners **can** separate VOT categories and make distinctions between their L2 and L1
 - Dependent on various individual differences, especially L2 input (Flege & Eefting 1988), age and proficiency (Flege 1991)
 - **Merged system** (Birdsong et al., 2007; Flege, 1987)
 - Advanced L2 learners produce a **mixed** VOT type, somewhere in the middle of their L1 and L2 (i.e. shorter long lags in French than in English)
- Acquisition of Onset f0:
 - Many studies done with Korean bilinguals (Kang & Guion, 2006; Lee & Iverson, 2011) and second language learners (Chang, 2009) showing similar results as the **merged system** in acquisition of VOT.

Research Questions

1. How do English learners of French use VOT to realize French voicing categories?
2. How do English learners of French use onset f0 to realize French voicing categories?
3. What role do individual trends, like proficiency, play in the acquisition of acoustic cues to voicing?
4. Is there a back transfer effect occurring in English learners of French and if there is, are these effects happening with both VOT and onset f0?

Methodology: Data elicitation

- Performed in a sound-proof room located in the Phonetics and Phonology lab at Purdue University.
- Conducted in one-hour sessions with optional breaks to avoid fatigue effects.
- Procedures:
 1. General instructions, signing IRB consent form
 2. Priming text (sections of Little Red Riding Hood/Le petit chaperon rouge)
 - Order in which English and French reading tasks were completed was counterbalanced across participants
 3. Stimuli presentation
 - Stimuli were presented one by one on a computer screen (using ePrime), and participants were asked to read the words into the microphone in their normal speaking voice.
 - The set of 8 stimuli and 16 distractor items were presented three times to each participant (randomized for every presentation), resulting in a total of 72 (24 stimuli and 48 distractor) items elicited from each participant.
 - Between each block, participants were presented with the option to take a short break.
 4. Short break, repetition of task in other language (starting with priming text).
 5. Language background questionnaire
- A control group of monolingual native speakers of English completed a comparable task (in English only) in similar experimental settings (Shultz, 2011)

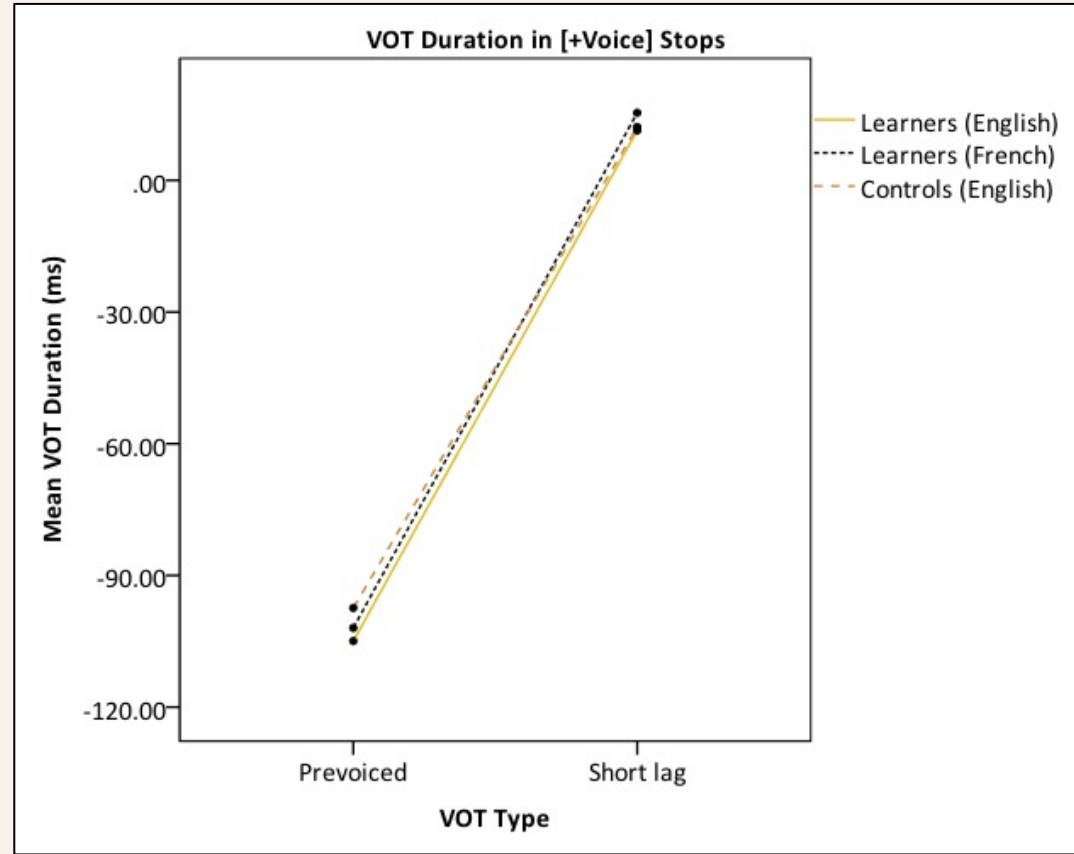
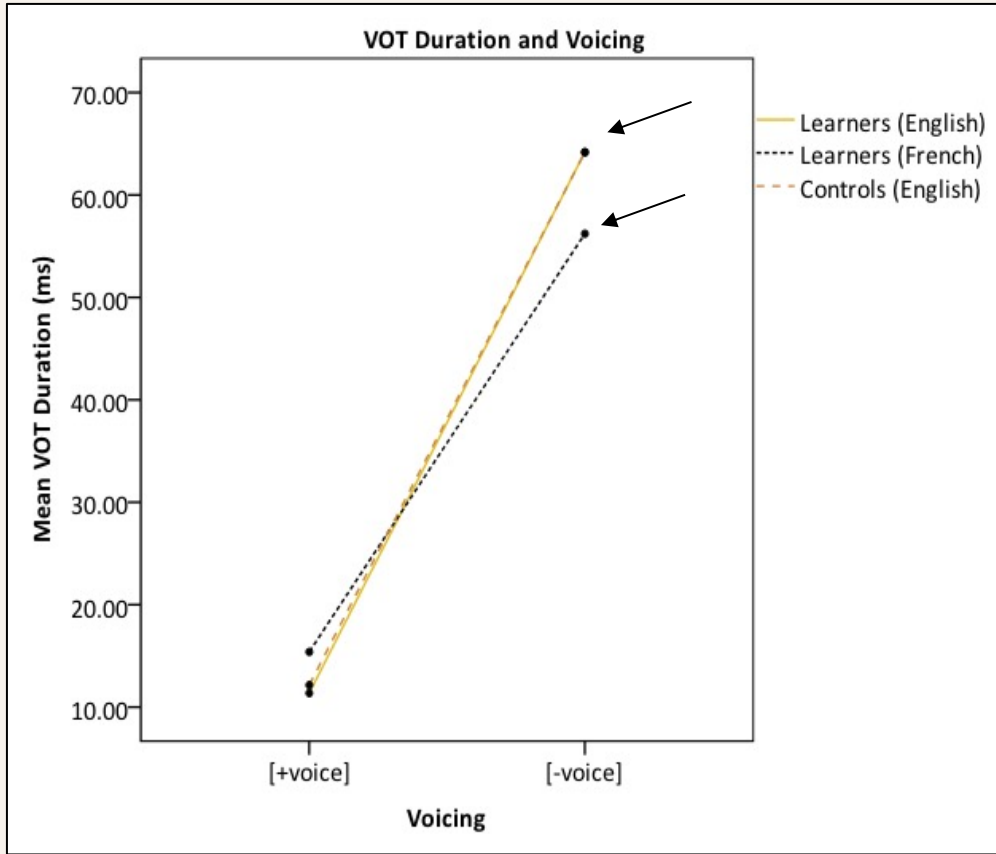
Methodology: French stimuli

- Consisted of four monomorphemic, mostly monosyllabic, minimal pairs that contrasted in the voicing of the initial bilabial stops /b/ and /p/
 - French vowels: /i/, /ε/ and /a/
- French stimuli were of high familiarity as judged by a native French speaker (mean familiarity on a Likert scale from 1-5 was 3.6)
- All stimuli were also examined in terms of their frequency.
 - Mean frequency of French stimuli was 22.8 words/million, ranging from 2.02 (*bêche*) to 55.28 (*billet*)
 - There was no significant difference between voiced and voiceless stimuli in terms of frequency
- Eight distractor minimal pairs (16 words total) of similar structure were also included in the list of French stimuli.
 - Frequency with *faire* and *doit*: 520 words/million
 - Remaining filler item frequency without *faire* and *doit*): 168 words/million

Methodology: Participants & Analysis

- Participants
 - Experimental group: 23 native speakers of Midwestern American English who are learning French as a foreign language.
 - Only students enrolled in FRE 201 or higher were recruited. Range in proficiency from intermediate to advanced.
 - Control group: 32 monolingual speakers of Midwestern English (Schulz, 2011)
- Data analysis
 - VOT and onset f0 of stimuli was annotated in Praat version 6.0.36.
 - Onset f0 was normalized in order to allow comparisons across genders.
 - A Repeated Measures ANOVA was conducted in SPSS to assess the effects of voicing and language of reading (English or French) on VOT and onset f0 of L2 learners of French.
 - VOT and onset f0 of learners were compared to the monolingual speakers of English to determine back transfer effect

Results: VOT



Background

Literature Review

Research Questions

Methodology

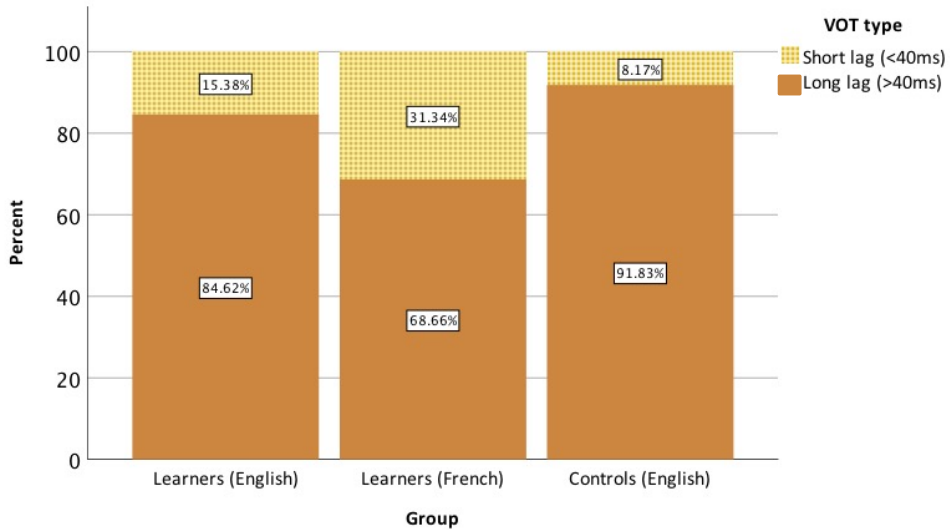
Results

Conclusions

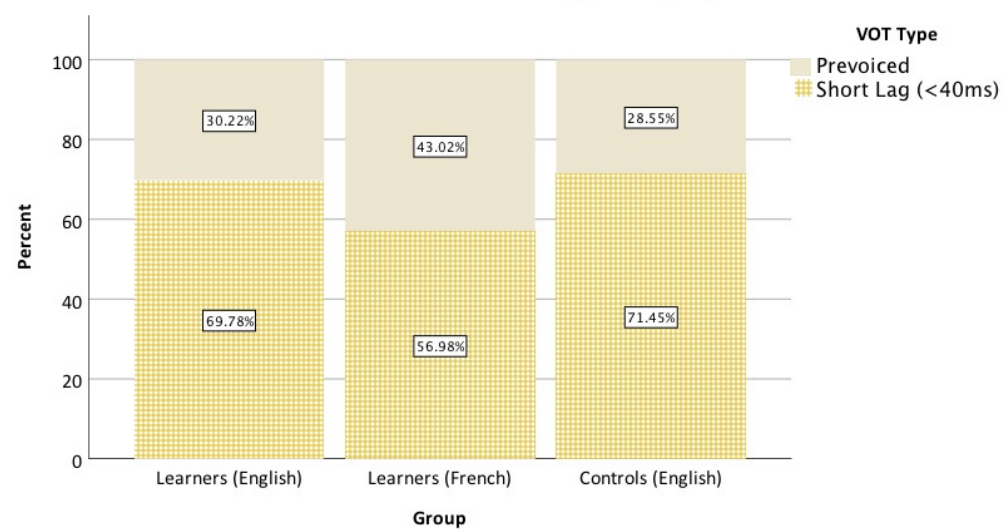
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Results: VOT

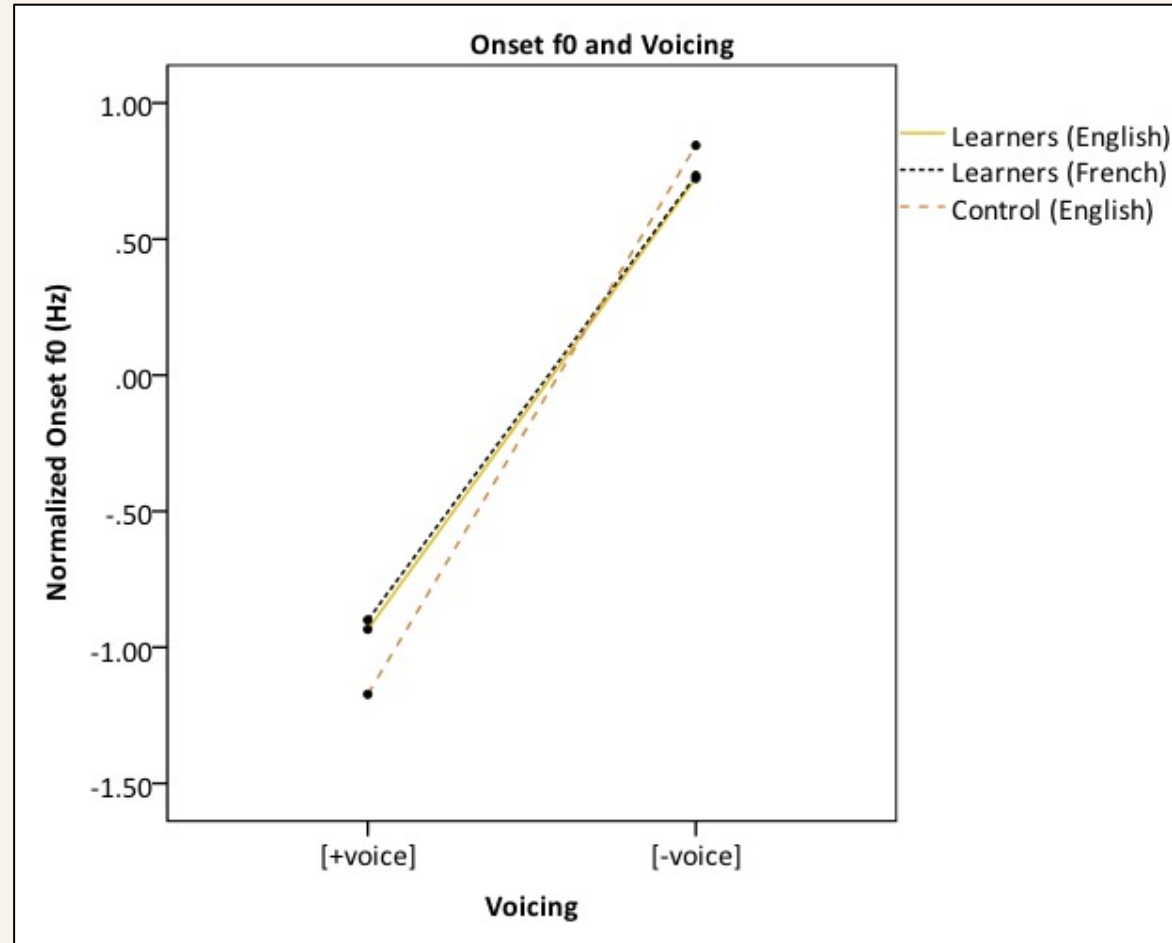
Percent Short Lag Among [-Voice Stops]



Percent Prevoiced Among [+Voice] Stops



Results: Onset f0



Background

Literature Review

Research Questions

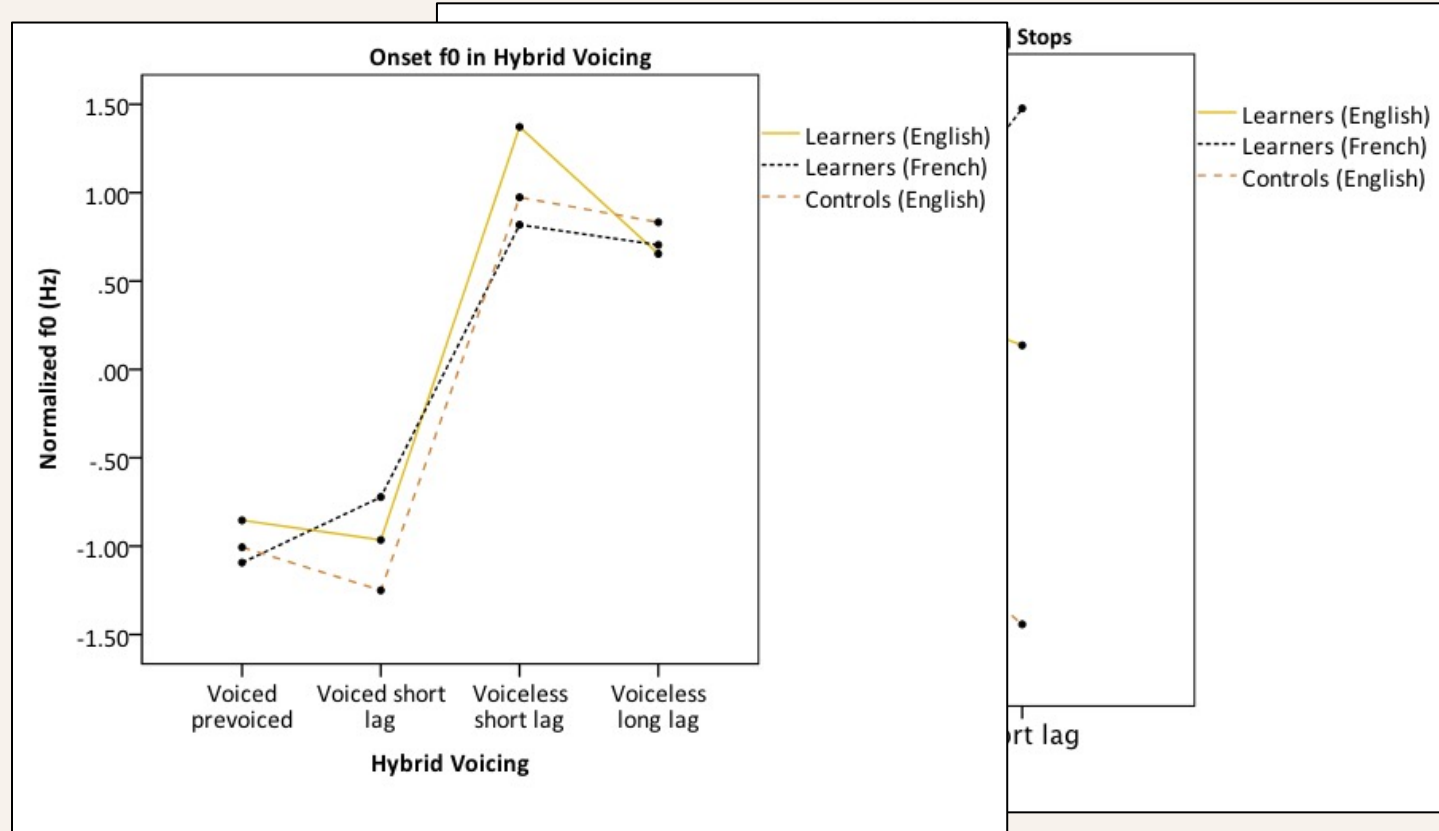
Methodology

Results

Conclusions

References

Results: Onset f0



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Literature Review

Research Questions

Methodology

Results

Conclusions

References

Conclusions

- VOT values in French were heavily influenced by English, demonstrating VOT values that were largely in line with English norms (Flege, 1987; Birdsong et al., 2007).
- Onset f0 production in French was distributed as expected: lower onset f0 in [+voice] and higher onset f0 in [-voice]
- Learners were able to maintain the correct distribution of f0 values independently of VOT realization.
 - VOT and onset f0 as correlates of voicing are relatively independent of each other and can be manipulated separately by speakers.
 - Onset f0 is a more stable and reliable correlate of voicing in a second language context, despite its status as a secondary cue.
- No back transfer occurred in these data.

References

- Abramson A. S., & Lisker, L. (1965). Voice onset time in stop consonants: Acoustic analysis and synthesis. In *Proceedings of the 5th international congress of acoustics* (Vol. 51). A51, Liege.
- Birdsong, D., Bohn, O. S., & Munro, M. J. (2007). Nativelike pronunciation among late learners of French as a second language. In O.S. Bohn & M.J. Munro (Eds.), *Language experience in second language speech learning*, (99-116): Philadelphia, PA: John Benjamins.
- Chang, C. B. (2009). *The implementation of laryngeal contrast in Korean as a second language* (Unpublished annual lab report). University of California, Berkeley, California, USA.
- Cho, T., & Ladefoged, P. (1999). Variation and universals in VOT: Evidence from 18 languages. *Journal of Phonetics*, 27(2), 207-229.
- Dmitrieva, O., Jongman, A., & Sereno, J. (2010). Phonological neutralization by native and non-native speakers: The case of Russian final devoicing. *Journal of phonetics*, 38(3), 483-492.
- Dmitrieva, O., Llanos, F., Shultz, A. A., & Francis, A. L. (2015). Phonological status, not voice onset time, determines the acoustic realization of onset f0 as a secondary voicing cue in Spanish and English. *Journal of Phonetics*, 49, 77-95.
- Flege, J. E. (1987). The production of “new” and “similar” phones in a foreign language: Evidence for the effect of equivalence classification. *Journal of phonetics*, 15(1), 47-65.
- Flege, J. E., & Eefting, W. (1988). Imitation of a VOT continuum by native speakers of English and Spanish: Evidence for phonetic category formation. *The Journal of the Acoustical Society of America*, 83(2), 729-740.
- Flege, J. E. (1991). Age of learning affects the authenticity of voice-onset time (VOT) in stop consonants produced in a second language. *The Journal of the Acoustical Society of America*, 89(1), 395-411.

Flege, J. E. (1995). Second language speech learning: Theory, findings, and problems. In W. Strange (Ed.), *Speech perception and linguistic experience: Issues in cross-language research* (233-277). Timonium, MD: York Press.

Hombert, J. M. (1976). The effect of aspiration on the fundamental frequency on the following vowel. In *Proceedings of the 2nd annual meeting of the BLS* (pp. 212-219)

House, A. S., & Fairbanks, G. (1953). The influence of consonant environment upon the secondary acoustical characteristics of vowels. *The Journal of the Acoustical Society of America*, 25, 105-113.

Kang, K. H., & Guion, S. G. (2006). Phonological systems in bilinguals: Age of learning effects on the stop consonant systems of Korean-English bilinguals. *The Journal of the Acoustical Society of America*, 119(3), 1672-1683.

Kingston, J., & Diehl, R. (1994). Phonetic knowledge. *Language*, 70, 419-454.

Kirby, J., & Ladd, D. R. (2015). Stop voicing and f₀ perturbations: Evidence from French and Italian. In The Scottish Consortium for ICPhS 2015 (Ed.), *Proceedings of the 18th International Congress of Phonetic Sciences*. University of Glasgow, Glasgow, United Kingdom.

Lee, S. A. S., & Iverson, G. K. (2012). Stop consonant productions of Korean–English bilingual children. *Bilingualism: Language and Cognition*, 15(02), 275-287.

Maddieson, I. (1984). *Patterns of sounds*. Cambridge: Cambridge University Press.

Ohde, R. (1984). Fundamental frequency as an acoustic correlate of stop consonant voicing. *The Journal of the Acoustical Society of America*, 75, 224-240.

Repp, B. H. (1982). Phonetic trading relations and context effects: New experimental evidence for a speech mode of perception. *Psychological Bulletin*, 92(1), 81.

Shultz, A. A. (2011). *Individual differences in cue weighting of stop consonant voicing in perception and production* (Master's thesis). West Lafayette, IN: Purdue University.

Whalen, D. H., Abramson, A. S., Lisker, L., & Mody, M. (1990). Gradient effects of fundamental frequency on stop consonant voicing judgements. *Phonetica*, 47(1-2), 36-49.

Questions?

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Experiment Title: _____
 Subject # _____
 Date: _____
 Investigator: _____

LANGUAGE BACKGROUND QUESTIONNAIRE
For in class learners

- How old are you (in years)?
- Are you a man or a woman (circle one)? Man / Woman
- Have you ever had a vision problem, hearing impairment, language disability, or learning disability? (Circle all applicable).

If yes, please explain (including any corrections):

- Where were you born (country, town/state or region)? _____
- Where did you grow up? (give each location and # of years you lived there)

<i>Location</i>	<i>Years</i>

- Was English the first language you spoke? Yes ___ No ___

If "No", what age were you when you started speaking English _____

If "No", what was the first language you spoke? _____

- Think of the adults who raised you. Was English their first language?
 (Write "Yes" or "No" for each person, and, if "no" write in their first language):

<i>Person</i>	<i>English?</i>	<i>Language</i>

- How old were you when you started learning French? _____

- How long have you studied French? _____ years/semesters

- How did you learn French up to this point?

(Mainly Mostly Occasionally) through formal classroom instruction
 (Mainly Mostly Occasionally) through interacting with people
 A mixture of both, but (More classroom More interaction Equally both)
 Other (specify: _____)

- Have you lived in, or visited any French-speaking country? Yes ___ No ___

If "Yes", indicate the place, the age you were when living/visiting, and the amount of time spent there (treat separate trips as distinct):

<i>Location</i>	<i>Language(s)</i>	<i>Age</i>	<i>How long there?</i>

- Rate your proficiency in French using the following scale (write down the number in the table).

Very poor Poor Fair Functional Good Very good Native-like
 1 2 3 4 5 6 7

	<i>French Proficiency</i>
<i>Speaking Fluency</i>	
<i>Listening Ability</i>	
<i>Writing proficiency</i>	
<i>Reading proficiency</i>	
<i>Grammar</i>	

- In your perception, how much of a foreign accent do you have when speaking French? Please rate the strength of your accent according to the following scale (circle appropriate):

Very strong Strong Moderate Mild Very mild No Accent
 1 2 3 4 5 6

12. Estimate in terms of hours per week, how often you speak (or used to speak) French.

Spouse/partner: ____ (hrs)

Other family members: ____ (hrs)

Friends: ____ (hrs)

Classmates: ____ (hrs)

Co-workers: ____ (hrs)

13. Estimate, in terms of hours per week, how often you are engaged in the following activities in French.

Listen to Radio/ Watching TV: ____ (hrs)

Reading for fun: ____ (hrs)

Reading for work: ____ (hrs)

Reading on the Internet: ____ (hrs)

Writing emails to friends: ____ (hrs)

Writing articles/papers: ____ (hrs)

14. Have you studied any spoken language other than English and French?

Yes ____ No ____

If “Yes”, indicate each language, your age when you started studying it, and how long you have studied it, whether and how long you lived in any country where the language is spoken, and your overall proficiency rating for that language (use scale in 10 above).

<i>Language</i>	<i>Age started</i>	<i>No. years/semesters studied</i>	<i>No. years in country where spoken</i>	<i>Proficiency</i>

15. If there is anything else that you feel is interesting or important about your language background or language use, please comment below.

French filler words

Word	Translation	IPA	Frequency
faire	to do (v)	/fɛʁ/	4608.3925
chaud	hot (adj)	/ʃo/	73.5225
quoi	what (pron)	/kwa/	331.2975
corps	body (nm)	/kɔʁ/	365.245
donne	give (verb)	/dɔn/	664
queue	line (nf)	/kø/	47.4625
goutte	drop (nf)	/gut/	33.82
doter	provide (vtr)	/dɔte/	3.555
guerre	war (nf)	/gɛʁ/	281.9275
faux	false (adj)	/fo/	97.34
doit	must (devoir v)	/dwa/	1357.545
fort	strong (adj)	/fɔʁ/	192.34
tonne	metric ton (nf)	/tɔn/	9.4
feux	lights (nmpl)	/fø/	131.2425
doute	doubt (nm)	/dut/	121.9075
coté	popular (adj)	/kɔte/	3.9675

French stimuli

Word	Translation	IPA transcription
Vowel /i/		
pile	pile/heap	/pil/
bile	bile (anatomy)	/bil/
pillier	to pillage/to loot	/pijɛ/
billet	ticket	/bijɛ/
Vowel /ɛ/		
pêche	peach	/pɛʃ/
bêche	spade	/bɛʃ/
Vowel /ɑ/		
poisson	fish	/pwasɔ̃/
boisson	drink	/bwasɔ̃/

English stimuli: bat/pat, bet/pet, beat/Pete, and bit/pit