

Dialectal variation in obstruent voice and the Voicing Effect in English: An acoustic study on New Zealand English



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Theoretical background

Overview

Research questions

Data & results

Discussion

Conclusion



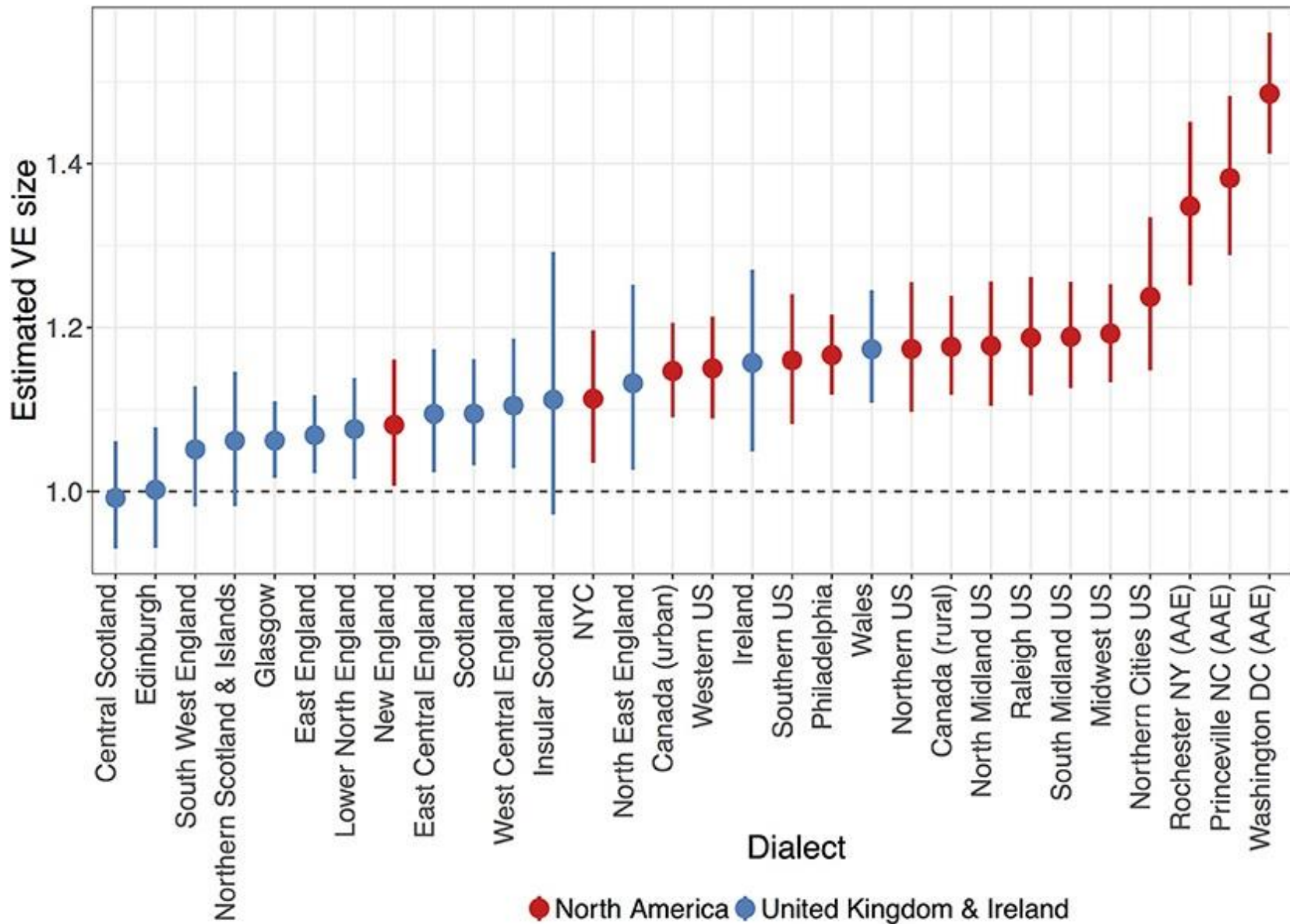
Theoretical background

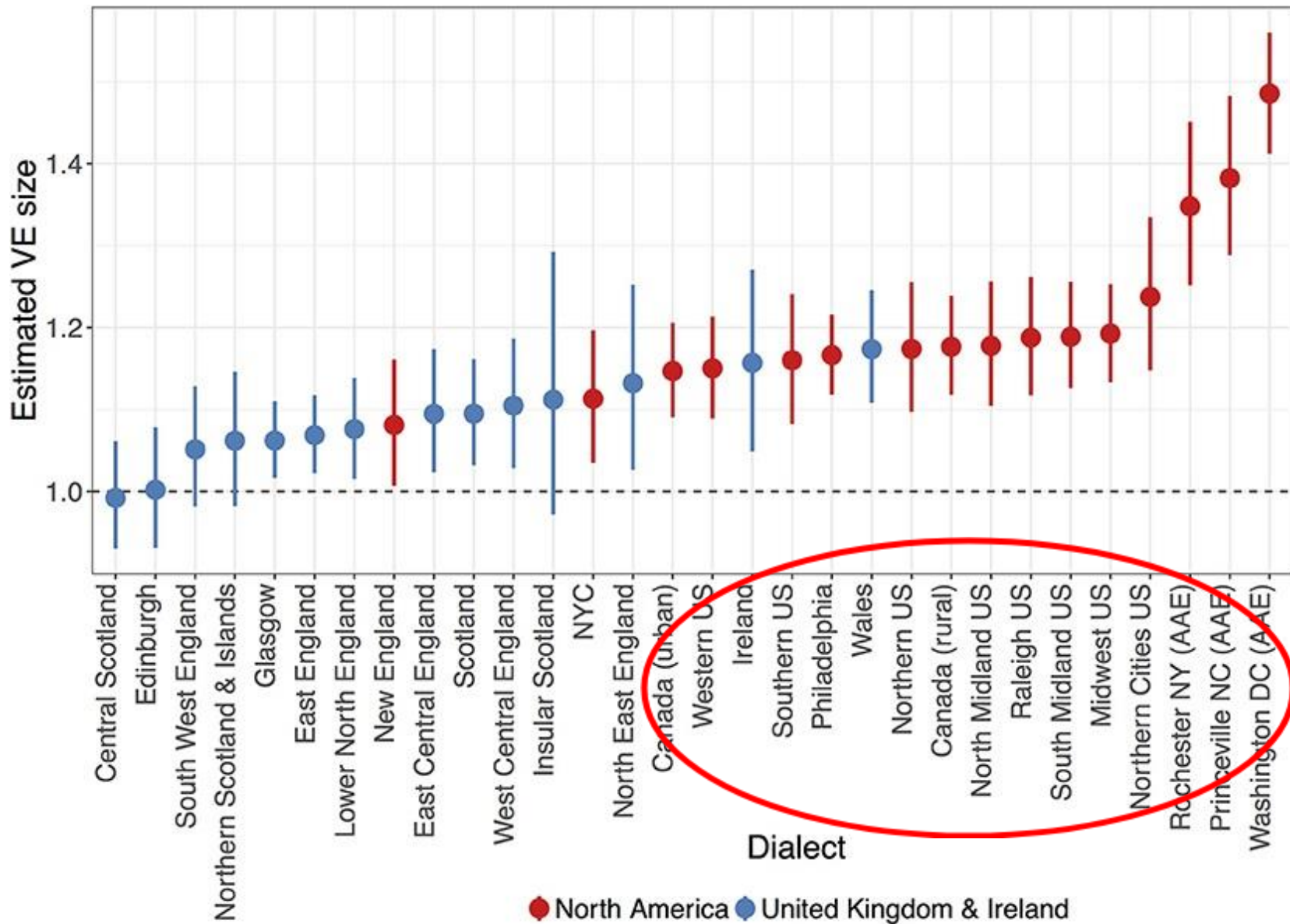
- the **Voicing Effect** (VE; aka **Pre-Fortis Clipping**)
- vowels are **shorter** before (voiceless)/**fortis** consonants (e.g., Chen 1970*)
 - more recent phonetic studies: Coretta (2020)** , Morley & Smith (2023), etc.
 - triggered by phonological rather than physiological ‘voicing’ (e.g., Fox & Terbeek 1977, Walsh & Parker 1981)
- **cross-linguistically**: its size is
 - considerably larger in **English (0.60-0.70)** (Chen 1970, Cho 2016, etc.)
 - than in other languages (0.80 [Norwegian, Korean, Russian]* - 0.90 [Spanish, German and French*, Italian and Polish**, Hungarian***])
- in English, preceding vowel duration (V/C ratio) serves as a **primary cue** to the perception of the obstruent’s fortisness (e.g., Jones 1950, Raphael 1972, Klatt 1976)

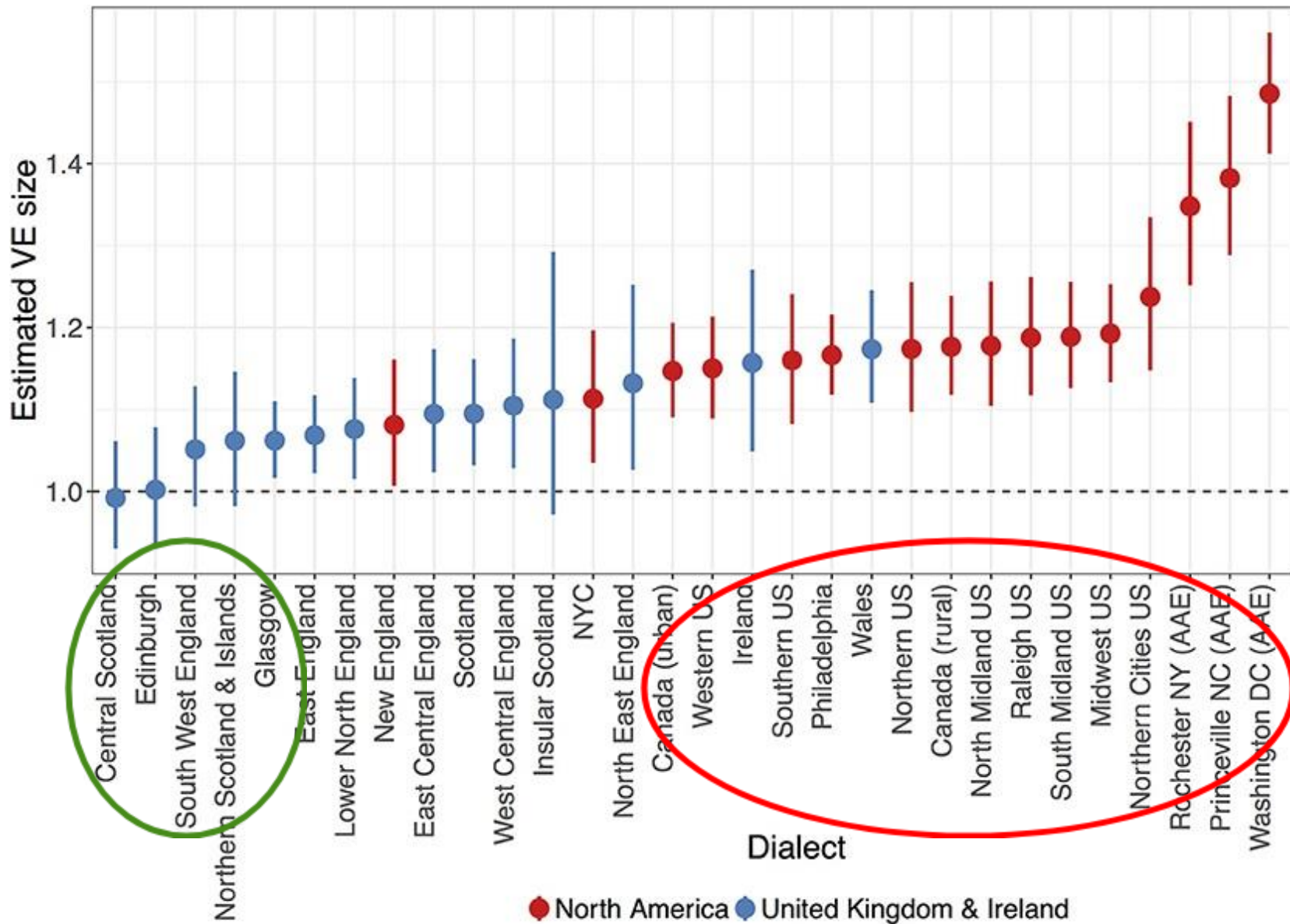
(***based on Kovács 2002)

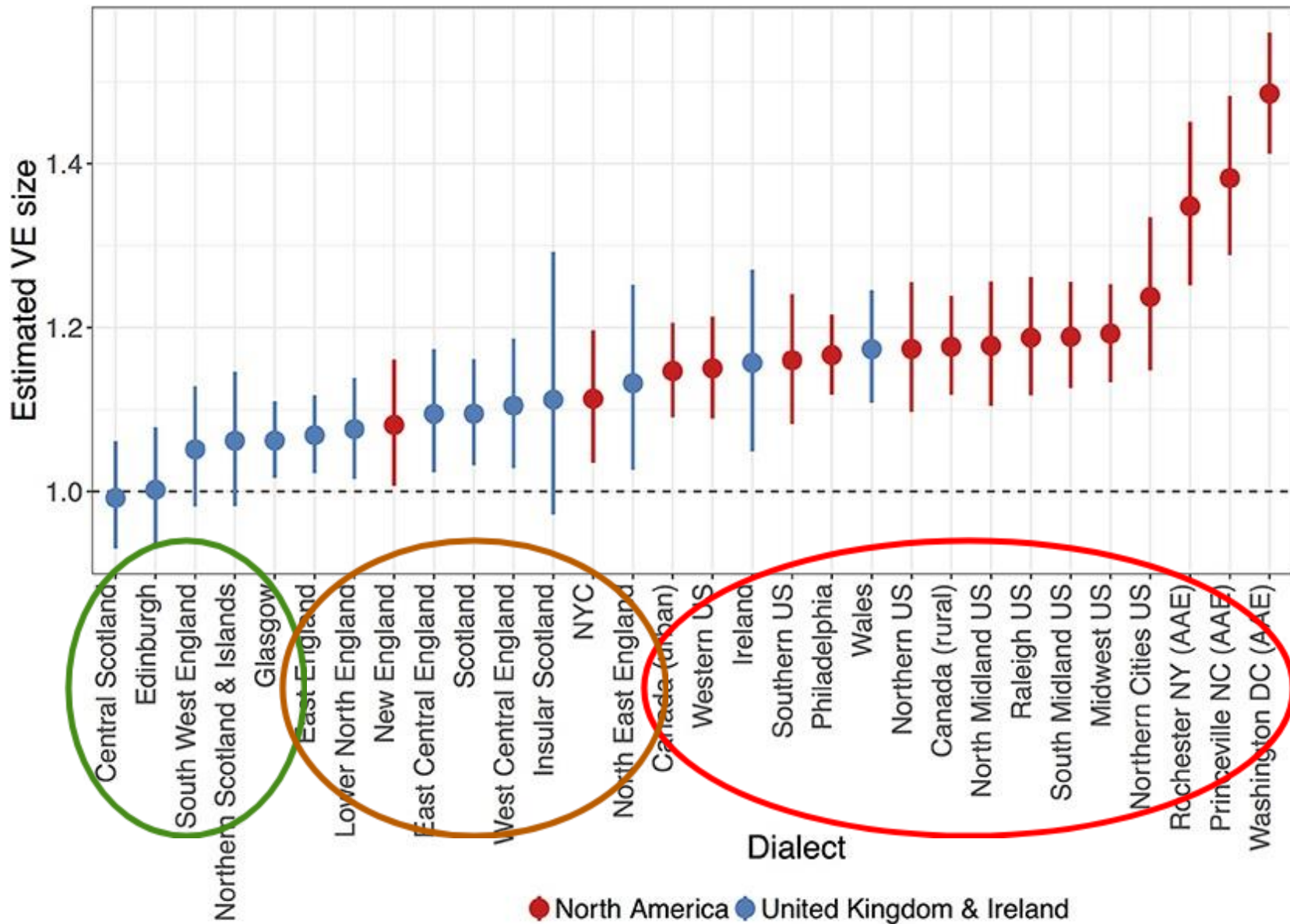
Theoretical background

- more recently, research on the English VE has turned to:
 - its size in **spontaneous** speech (rather than isolated, read words) and **non-pre-pausal** positions; and
 - its non-uniformity in **English varieties**
- Tanner et al. (2020): a scale:









- more recently, research on the English VE has turned to:
 - its size in spontaneous speech (rather than isolated, read words) and non-pre-pausal positions; and
 - its non-uniformity in English varieties
- Tanner et al. (2020): a scale: **VE size: US > England > Scotland**
- our interpretation:*
 - **US**: dialectal variation but generally heavy aspiration in fortis and voiceless lenis (+ final devoicing in regions/AAVE): phonetically, fortisness/lenisness is not cued in active voice but in vowel duration
 - **England**: dialectal variation but generally less heavy aspiration + voice languages in the North/North-East
 - **Scotland**: voice languages in Scots-speaking areas (the Lowlands) + SVLR
- the larger the functional load of vowel length, the larger the VE

*(Selected) literature

- Bailey, G. & E. Thomas. 1998. Some aspects of African-American vernacular English phonology. In S. S. Mufwene, J. R. Rickford, G. Bailey & J. Baugh (eds.), *African-American English: Structure, history, and use*. Routledge. 93–118.
- Balogné Bérce, K. 2022. Accent boundaries and linguistic continua in the laryngeal subsystems of English. *Linguistics Beyond and Within* 8: 24–36.
- Balogné Bérce, K. 2024. Dialectal variation in the laryngeal phonology of English. Ms.
- Herd, W. 2020. Sociophonetic voice onset time variation in Mississippi English. *J. of the Acoustical Society of America* 147.1: 596–605.
- Hunnicutt, L. & P. A. Morris. 2016. Prevoicing and aspiration in Southern American English. *U. Penn Working Papers in Linguistics* 22.1: 215–224.
- Jacewicz, E., R. A. Fox & S. Lyle. 2009. Variation in stop consonant voicing in two regional varieties of American English. *J. of the International Phonetic Association* 39.3: 313–334.
- Pfiffner, A. M. 2023. Acoustic cues and obstruent devoicing in Minnesotan English. *American Speech* 2023.
- Scobbie, J. M. 2005. Interspeaker variation among Shetland Islanders as the long term outcome of dialectally varied input: Speech production evidence for fine-grained linguistic plasticity. QMUC Speech Science Research Centre Working Paper WP2.
- Scobbie, J. M. 2006. Flexibility in the face of incompatible English VOT systems. In L. M. Goldstein, C. T. Best & D. H. Whalen. (eds.), *Laboratory Phonology 8: Varieties of phonological competence*. de Gruyter. 367–392.
- Sonderegger, M., J. Stuart-Smith, T. Knowles, R. Macdonald & T. Rathcke. 2020. Structured heterogeneity in Scottish stops over the twentieth century. *Language* 96.1: 94–125.
- Stuart-Smith, J. 2004. Scottish English: Phonology. In E. W. Schneider, K. Burridge, B. Kortmann, R. Mesthrie & C. Upton (eds.), *A handbook of varieties of English: Vol. 1. Phonology*. de Gruyter. 47–67.
- Stuart-Smith, J. M. Sonderegger, T. Rathcke & R. Macdonald. 2015. The private life of stops: VOT in a real-time corpus of spontaneous Glaswegian. *Laboratory Phonology* 6.3–4: 505–549.
- Watt, D. & J. Yurkova. 2007. Voice Onset Time and the Scottish Vowel Length Rule in Aberdeen English. In J. Trouvain & W. J. Barry (eds.), *Proceedings of the 16th International Congress of Phonetic Sciences*. Universität des Saarlandes, Saarbrücken. 1521–1524.
- Whisker-Taylor, K. & L. Clark. 2019. Yorkshire Assimilation: Exploring the production and perception of a geographically restricted variable. *J. of English Linguistics* 2019: 1–28.
- Wilhelm, S. 2018. Segmental and suprasegmental change in North West Yorkshire – A new case of supralocalisation? *Corela* [Online], HS-24. <https://doi.org/10.4000/corela.5203>
- Wolfram, W. 1994. The phonology of a sociocultural variety: The case of African American vernacular English. In J. Bemthal & N. Bankston (eds.), *Child phonology: Characteristics, assessment, and intervention with special populations*. Thieme. 227–244.
- Zee, T. 2015. Yorkshire Assimilation: An experimental investigation of gradient phonological alternation. BA Thesis, Utrecht University.

Theoretical background

- southern-hemisphere Englishes: crucially missing from the scale!
- our aims:
 - New Zealand (Pākehā) English (NZE)
 - Māori English (ME)
 - our next phase: Australian English



Theoretical background

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<https://www.thoughtco.com/geography-of-australia-1434351>



<https://www.mapsland.com/oceania/new-zealand/large-detailed-map-of-new-zealand-with-cities>

Theoretical background

New Zealand (Pākehā) English

- a group of islands, little interaction
- a relatively **homogeneous** variety (Bauer & Warren 2004)
- slightly different regional and social accents (Hay et al. 2008)
 - Southland and South Otago
- 3 **social** (and **stylistic**) accents:
 - broad: the most consistent typical NZ pron.
 - general
 - **cultivated**: the closest to RP/SSBE



Theoretical background

Māori English (ME)

- proficiency in te reo Māori ('the Māori language', Austronesian) steadily declining (+ passive knowledge), revival efforts
- **all Māori people speak English, and it is the dominant language of almost all of them**
- distinctive varieties:
 - **standard**
 - vernacular
- all varieties of ME share many features with varieties of (Pākehā) NZE



(Pākehā) NZE

- fortis are **aspirated**, lenes have very **little voicing** (Bauer & Warren 2004)
- **overall vowel duration is shorter and VE is larger (0.59)** than AmE/BrE (Cho 2016)
- VE from other studies:
 - older: 0.56
 - younger: 0.60
 - (on the basis of Maclagan & Hay 2007)
- speakers tend to prefer American or even Australian accents, and **the prestigious model is now AmE rather than RP** (Bayard 2000)

Māori English (ME)

Previous studies

(Pākehā) NZE

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Māori English (ME)

- **the Maori lang.:** single series of unaspirated (tenuis) obstruents
- initial /t/ non-aspiration (Holmes & Ainsworth 1996, Bell 2000, Warren & Bauer 2004), **changing under the influence of English** (Bauer 1997, etc.)
- (the frequent **affrication** of /t/ in general NZE is a confusing factor)
- increase in aspiration over time:

TABLE 1. *Voice onset time (VOT) in milliseconds for /p/, /t/, and /k/ in English and Māori for one speaker from the MU, K, and Y groups (from Maclagan & King, 2007)*

	MU		K		Y	
	Māori	English	Māori	English	Māori	English
/p/	23	36	30	58	50	61
/t/	26	42	43	69	53	78
/k/	28	52	42	71	66	66
Mean	25	43	41	66	57	68
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n	135	98	246	98	114	101

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Research questions



Research questions

1

Previous, smaller-scale studies report larger VE in (Pākehā) NZE than in either BrE or AmE (0.56-0.60; Maclagan & Hay 2007; Cho 2016). Do our results confirm this? Does this correlate with a relatively/considerably long VOT in NZE?

Our hypothesis: NZE is aligned with US English, being closer to the maximal end of the scale in terms of both VOT and the VE, although with lower values, due to the more spontaneous speech style in our sample.

Research questions

2

Descriptions of Māori English (ME) (e.g., Warren & Bauer 2004) attribute traditionally weaker/less frequent aspiration to it (as a substrate effect). Do the ME speakers in our database preserve this feature? Where does ME's laryngeal system locate it on the VE scale?

Our hypothesis: ME's moderate aspiration assigns it to the lower end of the scale, i.e., close to Scotland, in terms of both VOT and the VE.



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Data & results



- sound recording **corpora** of spontaneous NZE/ME speech:
 - Tauranga City Libraries: <https://paekoroki.tauranga.govt.nz>
 - digitalNZ radio archives:
<https://digitalnz.org/records?tab=Audio&text=#>
- sentences extracted
- acoustic analysis in **Praat** (Boersma & Weenink)
 - vowel duration: FLEECE, FACE, GOAT, LOT, TRAP, KIT, DRESS
 - VOT
- **statistical** analysis



Speakers

Speaker	Age	Gender	Education	Occupation
M1	67	male	tertiary	writer
M2	47	female	tertiary	university professor
P1	54	female	tertiary	broadcaster/writer
P2	59	male	tertiary	reporter/journalist

- Mean age: 57 (8)
- Pakeha speakers: cultivated accent
- Maori speakers: standard accent, actively use the Maori language



Model & variables

multiple measurements of vowel duration/VOT for the same speaker



dependency



linear mixed effects model (lme4)
(Bates et al. 2015)

Fixed effects:

- voice (fortis/lenis)
- ethnicity (Pakeha/Maori)
- prosodic context (intervocalic/coda)
- height (high, non-high)

Random effect:

- speaker





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Results



Factors affecting vowel duration

	Coefficient	St. error	t-value	<i>p</i> -value
Intercept	94	10	9.7	<0.0001***
Voicing (fortis)	-11	3	-4.1	<0.0001***
Ethnicity (Pakeha)	-15	6	-2.5	<0.0001***
Prosodic context (coda)	1	2	0.4	0.0002463***
Vowel height (high)	-12	3	-4.6	<0.0001***

All *p*-values were generated via likelihood ratio tests.

Vowel duration

	n	All vowels	Fortis	Lenis	Fraction/ratio
Pakeha	148	76 (41)	68 (30)	92 (54)	0.74/1.36
Maori	151	106 (46)	101 (42)	124 (53)	0.83/1.21

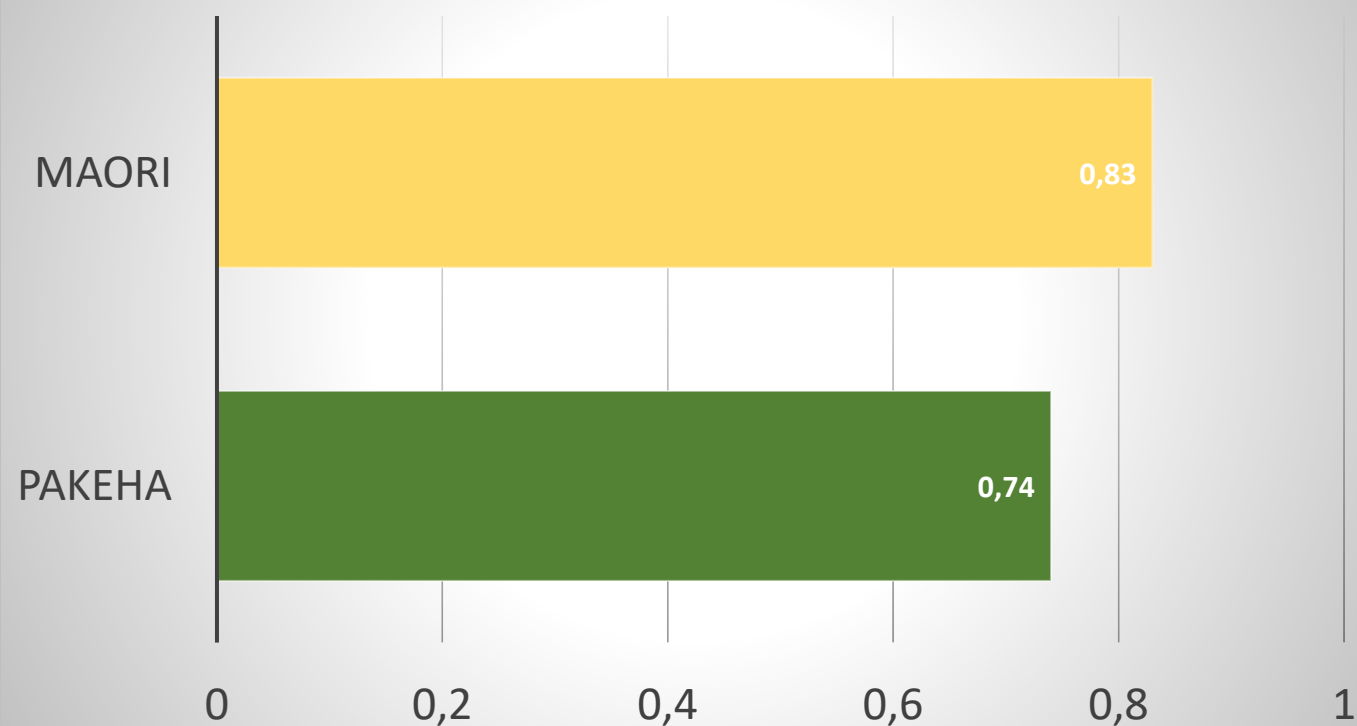
Duration fraction by ethnicity



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Duration fraction by ethnicity



Authors	Speech style	Fraction
Maclagan & Hay 2007	word list	0.56-0.6
Cho 2016	minimal pairs	0.59
our data	running speech	0.74

Factors affecting VOT

	Coefficient	St. error	t-value	<i>p</i> -value
Intercept	61	3	19	0.32 (ns)
Ethnicity (Pakeha)	-4	3	-1	0.32 (ns)
Gender (female)	4	3	1	0.33 (ns)

All *p*-values were generated via likelihood ratio tests.

similar values
BUT
interesting patterns regarding gender

Voice onset time

**Maori
female**

**Maori
male**

**Pakeha
female**

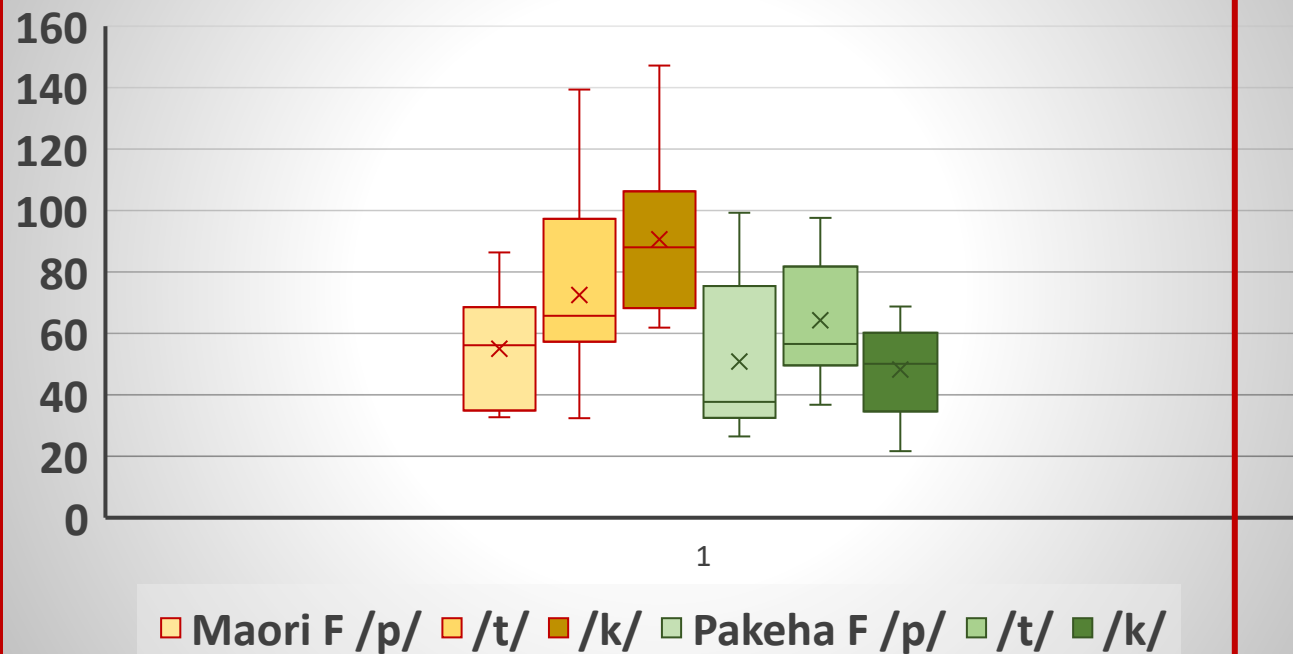
**Pakeha
male**

/p/	55	35	51	43
/t/	73	64	64	83
/k/	91	55	48	63
Mean	76	55	54	60
SD	28	20	20	23
n	47	59	37	49

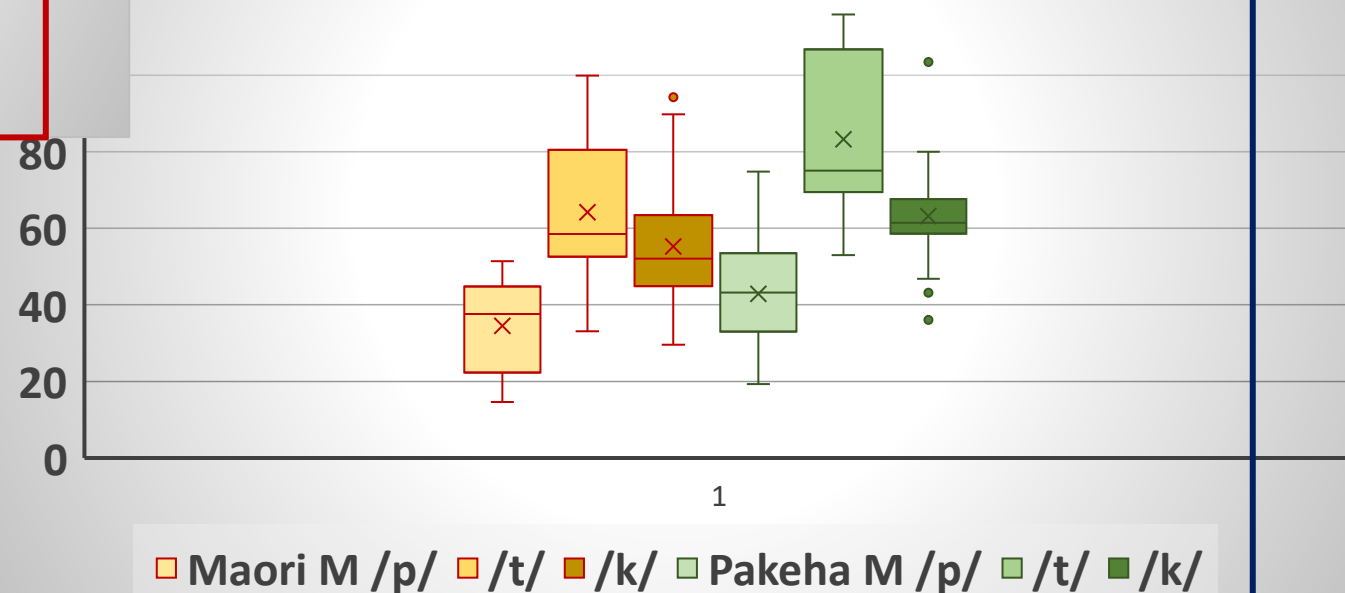
- Male speakers: longer VOT for the Pakeha speaker
- Female speakers: Maori speaker, affrication → longer VOT

Voice onset time

VOT duration for females in ms

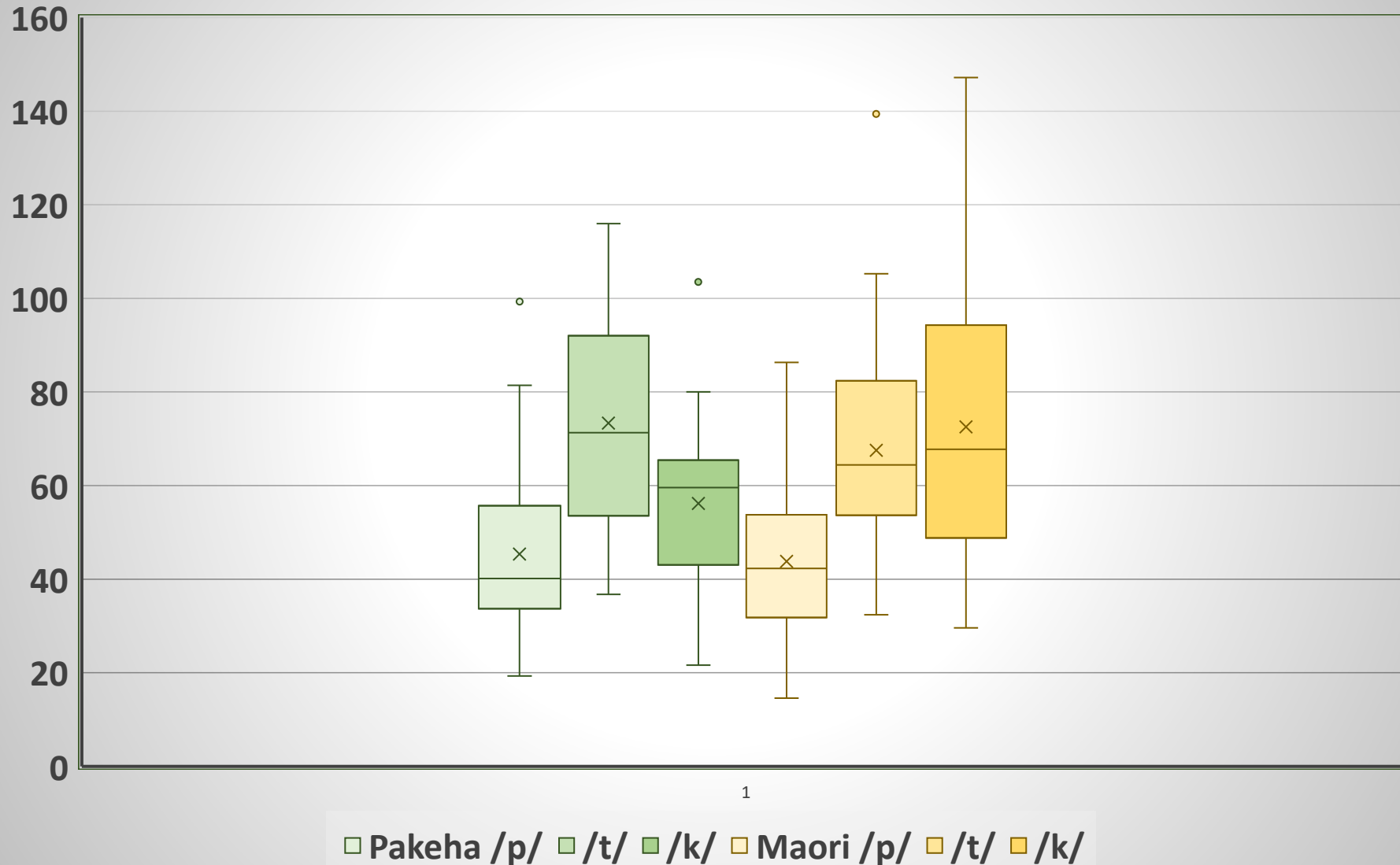


VOT duration for males in ms



Voice onset time

Maori and Pakeha VOT duration in ms



Voice onset time

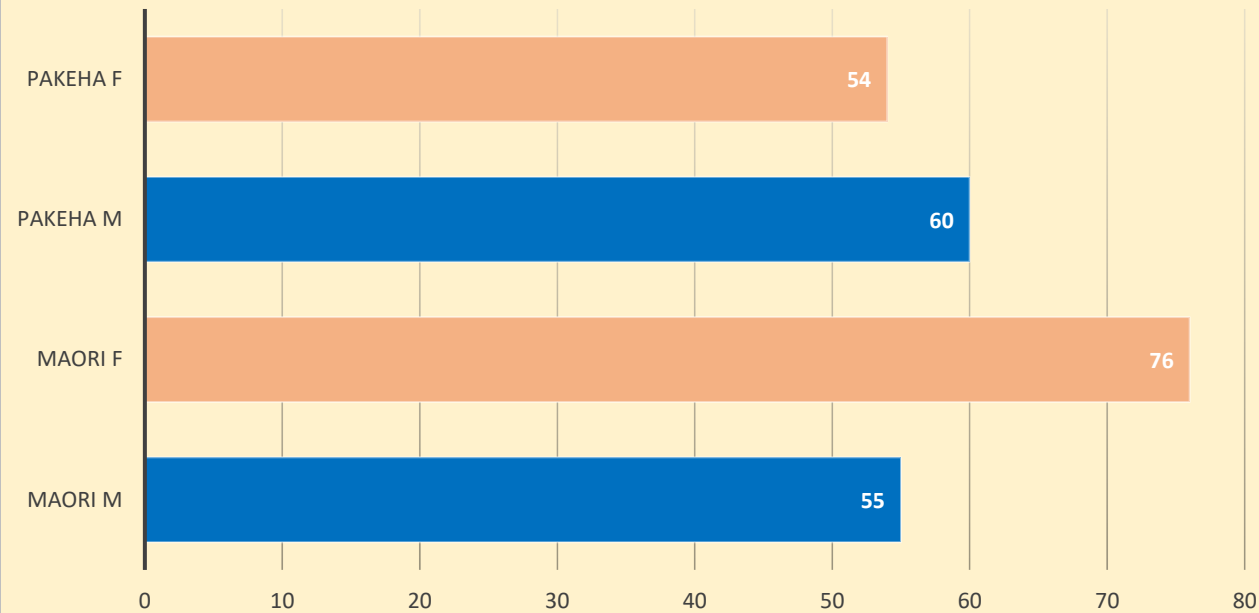
VOT: /p/ -> /t/ -> /k/

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VOT & ratio/fraction

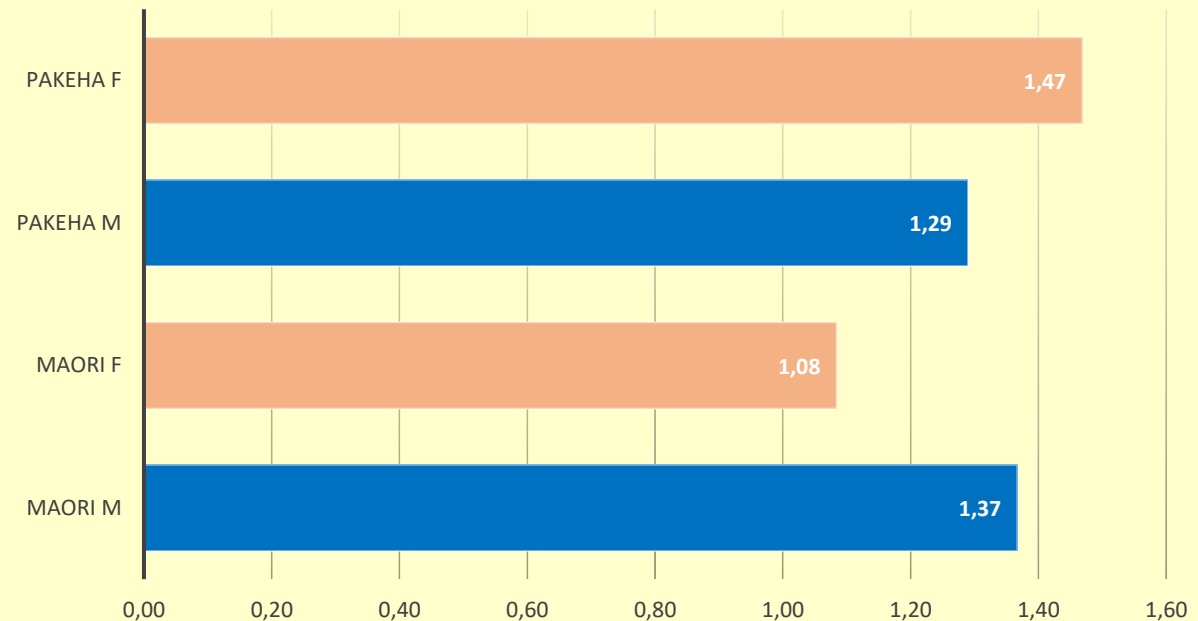
Voice onset time for the speakers



Maori M Maori F Pakeha M Pakeha F

	Maori M	Maori F	Pakeha M	Pakeha F
VOT	55	76	60	54
Ratio/fraction	1.37/0.73	1.08/0.92	1.29/0.78	1.47/0.68

Vowel duration ratio for the speakers



the longest VOT duration for the Maori female speaker
 BUT
 the smallest VE effect
 ↓
 strong affrication results in smaller VE size?

RQ1

Previous, smaller-scale studies report larger VE in (Pākehā) NZE than in either BrE or AmE (0.56-0.60; Maclagan & Hay 2007; Cho 2016).

Do our results confirm this? Does this correlate with a relatively/considerably long VOT in NZE?

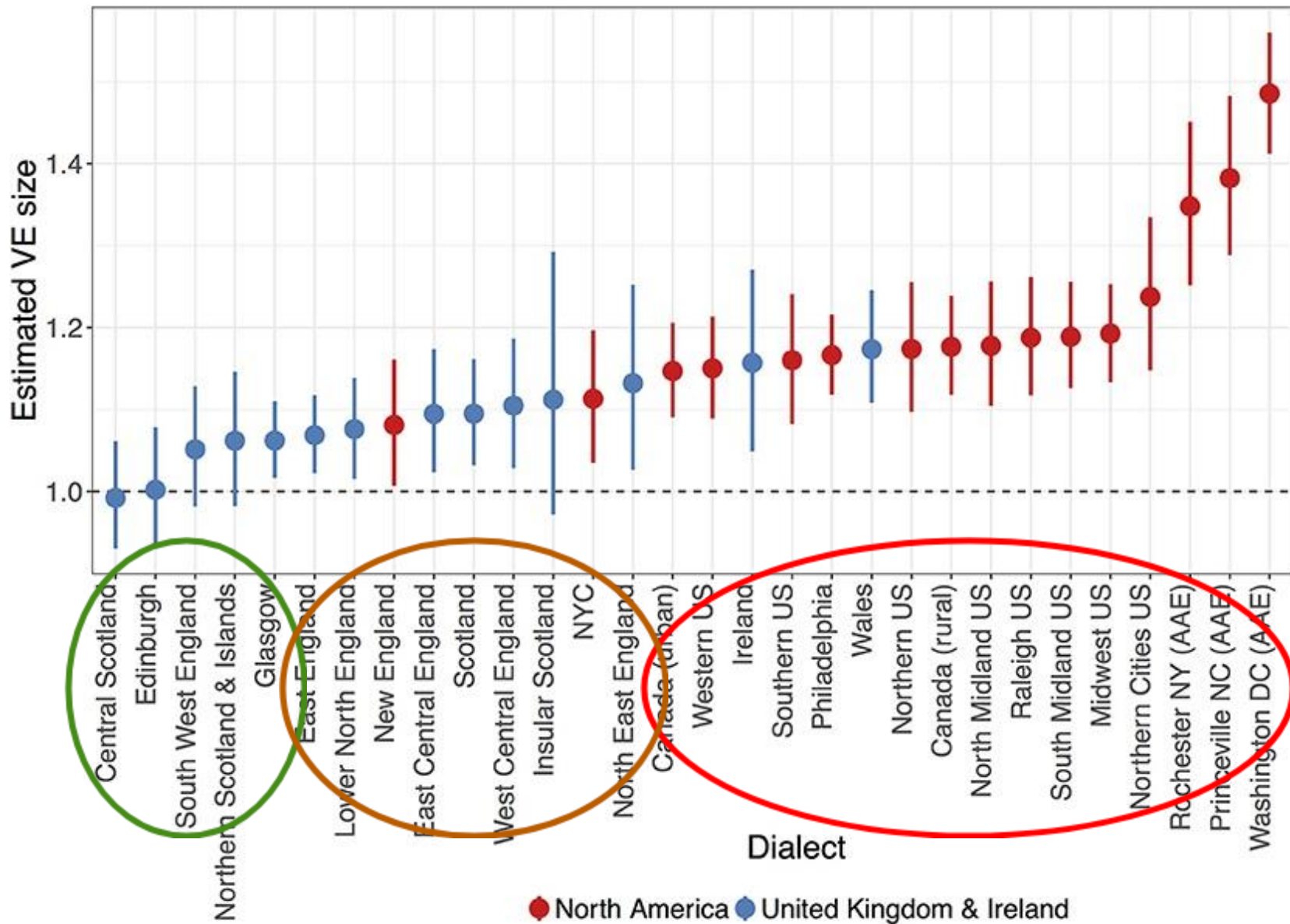
Our hypothesis

NZE is aligned with US English, being closer to the maximal end of the scale in terms of both VOT and the VE, although with lower values, due to our sample's more spontaneous speech style. -> **Our results support this hypothesis.**

Results

The Pakeha VE fraction/ratio is 0.74/1.36 -> the maximal end of the scale. VE size is smaller than in previous studies because of the speech style.

VOT is 60 ms for Pakeha speakers, consistent with previous measurements (Maclagan & King 2007).



Discussion

Philadelphia 1.17
 Southern US 1.17
 North Midland US 1.18
 Northern US 1.18
 Wales 1.18
 Raleigh US 1.19
 South Midland US 1.19
 Midwest US 1.20
 Northern Cities US 1.24
 Rochester NY (AAE) 1.35
New Zealand English 1.36
 Princeville NC (AAE) 1.39
 Washington DC (AAE) 1.49

	Fraction/ratio
Pakeha	0.74/1.36

RQ2

Descriptions of Māori English (ME) (e.g., Warren & Bauer 2004) attribute traditionally weaker/less frequent aspiration to it (as a substrate effect). Do the ME speakers in our database preserve this feature? Where does ME's laryngeal system locate it on the VE scale?

Our hypothesis

ME's moderate aspiration assigns it to the lower end of the scale, i.e., close to Scotland, in terms of both VOT and the VE. -> **Our results do not support this hypothesis.**

Results

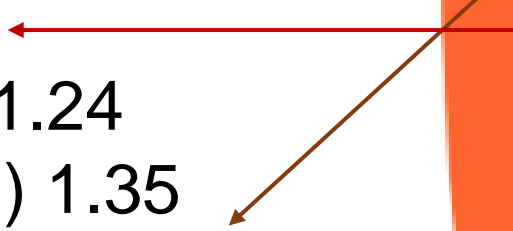
The Maori VE fraction/ratio is 0.83/1.21 -> the maximal end of the scale. No previous data to compare with.

The VOT is 76, higher than we expected. Strong aspiration/affrication, especially for the female speaker. (Maclagan & King 2007: 68 ms for young speakers)

Discussion

- Philadelphia 1.17
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- Maori English 1.21**
- Northern Cities US 1.24
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- Washington DC (AAE) 1.49

	Fraction/ratio
Pakeha	0.74/ 1.36
Maori	0.83/ 1.21



Conclusion

- We examined VE size in the speech of Pakeha and Maori speakers in spontaneous speech.
- We attempted to place these varieties on Tanner et al.'s VE scale.
- Our first hypothesis has been supported by our data
 - VE size in Pakeha speech is at the maximal end of the scale
 - with long VOT values
 - BUT with smaller VE size due to the speech style (spontaneous speech)
- Our second hypothesis has not been supported by our data
 - VE in Maori speech is also at the maximal end of the scale
 - with long VOT values
 - strong aspiration/affrication -> no substrate effect

References

- Bates, D., M. Maechler, B. Bolker & S. Walker. 2015. Fitting linear mixed-effects models using lme4. *Journal of Statistical Software* 67.1: 1–48.
- Bauer, L. & P. Warren. 2004. New Zealand English: Phonology. In B. Kortmann, E. W. Schneider, K. Burridge, R. Mesthrie & C. Upton (eds.), *A handbook of varieties of English: A multimedia reference tool*, vol. 1. Mouton de Gruyter. 580–602.
- Bauer, W. 1997. *The Reed reference grammar of Māori*. Reed.
- Bayard, D. 2000. New Zealand English: Origins, relationships, and prospects. *Moderna Språk* 1: 8–14.
- Bell, A. 2000. Māori and Pakeha English: A case study. In A. Bell & K. Kuiper (eds.), *New Zealand English*. Victoria University Press. 221–248.
- Boersma, P. & D. Weenink. [Computer program]. Praat: doing phonetics by computer. <http://www.praat.org/>
- Chen, M. 1970. Vowel length variation as a function of the voicing of the consonant environment. *Phonetica* 22: 129–159.
- Cho, H. 2016. Variation in vowel duration depending on voicing in American, British, and New Zealand English. *Phonetics and Speech Sciences* 8.3: 11–20.
- Coretta, S. 2020. *Vowel duration and consonant voicing: A production study*. University of Manchester PhD diss.
- Fox, R. A. & D. Terbeek. 1977. Dental flaps, vowel duration and rule ordering in American English. *J. of Phonetics* 5.1: 27–34.
- Hay, J., M. MacLagan & E. Gordon. 2008. *Dialects of English. New Zealand English*. Edinburgh UP.
- Holmes, J. & H. Ainsworth. 1996. Syllable-timing and Māori English. *Te Reo* 39: 75–84.

References

- Jones, D. 1950. The phoneme: Its nature and use. Hefner.
- Klatt, D. 1976. Linguistic uses of segmental duration in English: Acoustic and perceptual evidence. *J. of the Acoustical Society of America* 59: 1209–1221.
- Kovács, M. 2002. Tendenciák és szabályszerűségek a magánhangzó-időtartamok produkciójában és percepciójában. U. of Debrecen PhD diss.
- Maclagan, M. & J. Hay. 2007. Getting *fed* up with our *feet*: Contrast maintenance and the New Zealand English “short” front vowel shift. *Language Variation and Change* 19: 1–25.
- Maclagan, M. & J. King. 2007. Aspiration of plosives in Māori: Change over time. *Australian Journal of Linguistics* 27.1: 81–96.
- Morley, R. L. & B. J. Smith. 2023. A reanalysis of the Voicing Effect in English: With implications for featural specification. *Language and Speech* 66.4: 935–973.
- Raphael, L. J. 1972. Preceding vowel duration as a cue to the perception of the voicing characteristic of word-final consonants in American English. *The Journal of the Acoustical Society of America* 51.4: 1296–1303.
- Tanner, J., M. Sonderegger, J. Stuart-Smith & J. Fruehwald. 2020. Toward “English” phonetics: Variability in the pre-consonantal Voicing Effect across English dialects and speakers. *Frontiers in Artificial Intelligence* 3: 10.3389/frai.2020.00038.
- Walsh, T. & F. Parker. 1981. Vowel length and ‘voicing’ in a following consonant. *J. of Phonetics* 9.3: 305–308.
- Warren, P. & L. Bauer. 2004. Maori English: Phonology. In B. Kortmann, E. W. Schneider, K. Burridge, R. Mesthrie & C. Upton (eds.), *A handbook of varieties of English: A multimedia reference tool*, vol. 1. Mouton de Gruyter. 614–624.

Thank you for your attention!

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