Not a start and an end but VOT at two timepoints in the life of a heritage speaker

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Abstract. This paper compares the voice onset times (VOT) of one heritage speaker's Dutch and English stops at two points in their adult life separated by 30 years. Previous research has shown bilinguals exhibit different outcomes in acquiring and maintaining the phonetics of both their languages with some speakers matching the native baseline in both languages and others displaying transfer/interference from one language to the other (Scontras et al. 2015). Further, adult language use can be plastic with some speakers showing more progressive, others more conservative, and others markedly stable language use over time compared to younger generations when experiencing social pressures (Sankoff 2019). The speaker examined here demonstrates both differences from the homeland phonetics of their two languages as well as change between recordings likely due to the social pressure of continued decreasing first language use (community already post-shift at time of first recording). In 1989, the speaker shows Dutch-influenced English VOTs with prevoicing present on voiced stops and voiceless stops in the short-lag range. However, by 2018, the English VOTs are more homeland-like with no prevoicing and voiceless stops with more aspiration. Their Dutch stops, conversely, start fairly homeland-like in 1989 with consistent prevoicing on voiced stops and short-lag voiceless stops, but the percentage of prevoiced voiced stop tokens decreases and aspiration increases on voiceless stops in 2018. These results concur with previous studies showing cross-language influence and adult language plasticity while also expanding on previous heritage language research by providing a rare, though not first, longitudinal look at how a heritage speaker's speech has changed over their lifetime.

Keywords. heritage language; Dutch; longitudinal; real-time; language change; voice onset time; phonetics; phonology

1. Introduction. While there has been more interest in longitudinal studies of the same speaker in recent years (see Riverin-Coutlée & Harrington 2022 for a good overview), there have been few such studies of heritage speakers. Two exceptions are Hjelde's (2018) study of Einar Haugen's last speaker and Wagener's (2004) examination of language change in two German speakers in Wisconsin. Wagener specifically calls for more "re-recordings" of individual speakers so that "a more comprehensive and accurate picture of language change and loss may emerge" (p. 303). However, few studies on re-recordings have emerged since then. Additionally, Polinsky (2018) notes that heritage language phonetics and phonology are an area "which has been subject to relatively little research" (p. 150). This study seeks to help fill this gap by providing a look at how the phonetics and phonology of a heritage speaker can change throughout their lifetime.

The speaker examined here is a heritage speaker of Dutch who was born, and resided their entire life, in the Fox River Valley of Wisconsin. This is an area that received several waves of Dutch immigration from 1848 through the 1960s (Swierenga & Krabbendam 2011). However, by

2018, Dutch had ceased to be a community language and had instead taken on a postvernacular role (Brown & Hietpas 2019). This, thus, provides a context where both the individual's and community's language use has changed over the speaker's lifetime.

The language pairing of Dutch and English is interesting as the two languages differ in laryngeal phonology (Iverson & Salmons 1995, 2003; Honeybone 2005). While both languages have a two-way laryngeal contrast in stops, they differ in the phonological features that mark this distinction. Dutch is a voicing language (like Spanish and Polish) in which speakers employ the dimension Glottal Tension (GT) (Table 1). This is marked on their "voiced" stops leaving their "voiceless" stops unmarked (Avery & Idsardi 2001). English, conversely, is an aspirating language (like German and Danish) in which speakers employ the dimension Glottal Width (GW) on their "voiceless" stops leaving their "voiced" stops unmarked.

	English	Dutch
/pʰ, tʰ, kʰ/	GW	
/p, t, k/	—	—
/b, d, (g)/[1]		GT

Table 1. Illustration of the active/marked phonological dimensions in English versus Dutch

This phonological distinction originates from differences in phonological activity. In English, there is assimilation to the "voiceless" stop, as in (1), while in Dutch there is assimilation to the "voiced" stop, as in (2). However, this difference is easily explained if we acknowledge a difference in phonology between the two languages. In each case, there is assimilation to the marked segment, GW for English and GT for Dutch.

(1)   /wɔkʰ/ + /d/   →   ['wɔkt]   'walked'

(2)   /eː t/ + /baːr/   →   ['eː d.baːr]   'edible'

This phonological distinction leads to phonetic differences particularly in voice onset time (VOT), the variable examined here. Figure 1 shows spectrograms and waveforms of stops in Praat (Boersma & Weenink 2020) exemplifying the differences in stop VOT between Dutch and English. Prevoicing (negative VOT), voicing which occurs before the release of the stop, among other characteristics, distinguishes /b, d/ from /p, t, k/ in adult Dutch speech. According to van Alphen (2004) and Simon (2009), more than 86% of Dutch voiced stop tokens are produced with prevoicing with a mean VOT greater than -115 ms. These prevoiced stops are distinguished from the Dutch voiceless stops, /p, t, k/, which instead are typically produced with a small puff of air following the burst of the stop, positive VOT, in the range of 0–20 ms (Flege & Eeftink 1987; Simon 2009).

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[1] The stop /g/ is marked in parentheses as in Dutch it is found only in non-native words or as an allophone of /k/ (Booij 1999).
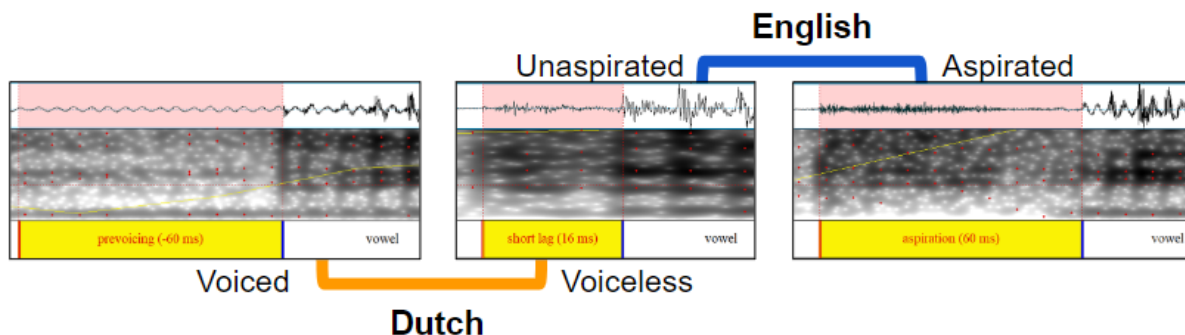
Figure 1. Labeled spectrograms detailing differences between English and Dutch based on VOT

In contrast to Dutch, English contrasts aspirated and unaspirated stops. English speakers produce "voiced" stops, /p, t, k/ with a VOT similar to that of the Dutch voiceless stops, in the short-lag range of 0–25 ms (Lisker & Abramson 1964; Simon 2009). They produce voiceless stops, /pʰ, tʰ, kʰ/, on the other hand, with an even longer puff of air than that of Dutch /p, t, k/ and English /p, t, k/, in the range of 60–90 ms (Simon 2010). This long, positive VOT and the phonological difference between GT and GW languages has led to the English "voiceless" stops often being called "aspirated" rather than voiceless and the "voiced" stops "unaspirated" rather than voiced. I will still refer to them as voiced and voiceless for ease of comparison between the two languages while recognizing the phonetic and phonological differences between them.

Prevoicing is a characteristic that has recently been demonstrated to be both associated with and produced by speakers of Southern US English (Walker 2020; Hunnicutt & Morris 2016). Litty (2017) also notes negative VOTs for /d/ for two of the four monolingual English speakers from Sauk and Richland counties in Wisconsin whose speech she examined. Consequently, prevoicing could also be a characteristic of some kinds of Wisconsin English. However, the average VOTs for the voiced stops of each monolingual speaker when examined together were all positive and between 5–25ms, the typical short-lag, unaspirated range. Additionally, past studies of English voiced stops found that speakers prevoiced them only 7–28% of the time (much less often than Dutch speakers' >86% of the time) (van Alphen 2004). Further, prevoicing appears to be a phonetic enhancement in English rather than a phonological feature as it has not been shown to be phonologically active in Southern US English or Wisconsin English. Prevoicing, therefore, still has a different phonological status in Dutch than in English.

In sum, the two languages differ in how speakers produce the contrast between their two sets of stops. Dutch speakers distinguish between prevoiced and short-lag stops while English speakers distinguish between short-lag and aspirated stops. Dutch-English bilinguals (e.g., heritage speakers) are, therefore, tasked with acquiring and maintaining two distinct phonetic and phonological systems.

Previous studies on bilinguals have shown that the phonetics of one language can be influenced by the phonetics of their other language (see Polinsky 2018 on heritage languages). However, the direction of change is not always the same in all cases. Scontras et al. (2015) posit four possible outcomes for heritage grammars: matching the native baseline, transfer/interference from another grammar, divergent attainment (previously incomplete acquisition), and attrition over the lifespan. Conceptualizing these in terms of VOT, matching the native baseline would imply homeland-like VOT values. For transfer/interference, if English phonetics are transferred onto the Dutch system, we would expect to see very English-like Dutch VOTs (short-lag and aspirated stops). This situation is hard to disentangle from attrition. If Dutch phonetics are being

transferred onto English stops, we would expect very Dutch-like English VOTs (prevoiced and short-lag stops). Divergent attainment would be change in some other way such as compromise/convergence of the VOT values (both Dutch and English change/are different from their baselines, but their values become more similar to each other).

In addition to bilingual acquisition, adult language plasticity and change across the lifespan is an issue of note here. When faced with social pressures and the changing language of younger generations, post-adolescent speakers do not all react in the same way. Some speakers maintain their earlier acquired patterns, some participate in the language change present in the community, and others reject the change and instead adopt a more conservative norm from previous generations (Sankoff 2019). The speaker here was faced with the social pressure of a change in which of her languages, Dutch and English, could be and were used in different domains of her life, which in turn changed how much she spoke each language overall. Already in 1989, the time of the first recording, the speaker reports hardly speaking Dutch anymore, indicating that these recordings come at a time which is post-shift for the community, where Dutch is hardly, if ever, used as a daily language of communication and where younger generations have limited conversational knowledge of Dutch. Therefore, the Dutch speech of the younger generations could be vastly different from that of the homeland and previous generations (although that is not investigated here). How the adult speaker examined here reacts to this change, whether conservatively or progressively, is of interest here.

Lastly, while my focus in this study is largely phonetic in examining VOT, changes in the phonetics may indicate either changes to or maintenance of the phonology depending on the exact nature of the change. This should be treated with caution as different phonological systems can lead to the same surface phonetics (Natvig 2021).

Consequently, this study has the following research questions:

1. Do the phonetics of the speaker (here examined through VOT) change across a span of 30 years?
2. If the phonetics do change, how do they change?
3. What do the changes in the speaker's phonetics over their lifespan, if present, say about their phonological system?

These questions frame a case study of a single individual. However, these questions and this case study can help answer the larger questions of how languages change over time, what domains are maintained versus changed, and especially how language contact and bilingualism play a role in language change, even in the language of just one individual.

2. Methods. This study examines word-initial English and Dutch stops produced by one speaker recorded at two different points in her life: first in 1989 when she was 58 years old and second in 2018 when she was 87. As noted above, in 1989, the speaker reported hardly speaking Dutch anymore, and these sentiments are both repeated and strengthened in 2018 as the speaker reported having lost one of her sisters in the time between the two recordings, one of the few individuals she spoke Dutch with. We, therefore, do not know what the VOT distributions were at an earlier time point in her life when she spoke Dutch more regularly. Consequently, this study is not a comparison between a start and end point of language use, but rather a comparison between two timepoints in an individual linguistic history, a real-time panel study following the definition from Sankoff (2006) since I compare recordings of the same speaker from two time periods in their life. While this type of study can provide us with important insights into how the languages of a heritage speaker can change throughout their lifetime, especially in the context of decreased heritage

language use, it should not be taken as representative of the community as a whole, especially given that not all post-adolescent speakers change in the same way or at all (Sankoff 2019).

Tokens from 1989 come from an ethnolinguistic-style interview completed by researchers from the Netherlands interested in Dutch in North America. This recording (and others from North America) is available online via the Meertens Instituut Dialectenbank (https://ndb.meertens.knaw.nl/index.php#wereld). The recording consists mostly of the researchers asking questions and the speaker answering them and telling stories. However, the speaker's husband and daughter were also present, neither of whom report knowing Dutch, and can be heard a few times throughout the recording. The recording took place at the speaker's house, and the topics of the interview focused on Dutch culture and the roles of Dutch and English over time in the speaker's life. The speaker also completed a sentence translation task at the end of the interview. During the recording, the researchers attempted to ask questions in Dutch and then switched to English when the speaker had a difficult time understanding their Dutch. The researchers did note that they could "hear" in the speaker's Dutch that her ancestors came from Brabant, which I have confirmed with genealogical records from the speaker. Additionally, the speaker herself often switched from Dutch into English despite the researchers' prompting her to speak Dutch. I attempted to select tokens of stops that were not in the same utterance as a code-switch to avoid any language-switching effects, although past research is split on whether code-switching influences phonetics (e.g. Grosjean & Miller 1994; Muldner et al. 2019; among others).

Tokens from 2018 come from fieldwork recordings that Joshua R. Brown and I (two American researchers) completed in the Fox River Valley of Wisconsin in the fall of 2018. English tokens come from a similar ethnolinguistic-style interview to the 1989 recording where we asked the speaker about her use of Dutch across her lifetime, her connection to Dutch culture, and the use and visibility of Dutch in the community. This recording also took place in the speaker's home with various members of her family (husband, daughter, sister, brother-in-law, cousin, cousin's husband) present and who can be heard throughout the recording. Her sister and cousin reported being able to speak some Dutch and her brother-in-law and her cousin's husband reported having some passive knowledge of Dutch. The Dutch tokens come from a separate narrative picture book task of the book "Frog, Where are You?" by Mercer Mayer (2003) in which there are pictures of the story but no text to accompany them. The speaker was asked to tell the story in Dutch as if she were telling it to one of her grandchildren. The same protocol for excluding code-switched tokens was followed here.

352 tokens of word-initial stops were identified between the two recordings. Textgrid durations were then extracted via a Praat script. Prevoicing was marked if there was both a clear, consistent, and repeated wave before the release burst in the waveform and a clear dark stripe around F0 in the spectrogram. The start of prevoicing when a stop occurred after a vowel or nasal was marked based on the disappearance of the dark F2 and/or F3 bands in the spectrogram. The start of prevoicing after obstruents was marked based on the disappearance of frication and start of a clear F0 band in the spectrogram. Elsewhere, the start of VOT was marked at the release burst of the stop, pinpointed based on a dark striation in the spectrogram and a profound peak or valley in the waveform. The end of VOT was marked at the start of phonation of the following vowel, based on the start of a consistent and repeated wave in the waveform and the presence of a dark stripe around F0 in the spectrogram. The breakdown of tokens between the two recordings and two languages can be found in Table 2.

	b,d,(g)[2] (voiced)	p,t,k (voiceless)	Total
1989	127	103	230
- Dutch	48	34	82
- English	79	69	148
2018	69	53	122
- Dutch	42	17	59
- English	27	36	63
	196	156	352

Table 2. Word-initial stop token separated by year, language, and voicing

3. Results. In 1989, both the speaker's *b, d, (g)*, voiced, and *p, t, k*, voiceless, stops display a large degree of overlap between the two languages (Figure 2 and Table 3). For the voiced stops, this comes from some English stops being produced with prevoicing (mean of -13.1 ms and first quartile of -34 ms) and some Dutch stops being produced with short-lag VOT (third quartile of 6.75). For the voiceless stops, the Dutch box (Q1, median, and Q3) is entirely contained within the English box. This indicates that the two sets of stops may not be distinct from one another. The values for both languages are longer than what is expected for Dutch voiceless stops (0–20 ms) but shorter than what is expected for English voiceless stops (60–90 ms).
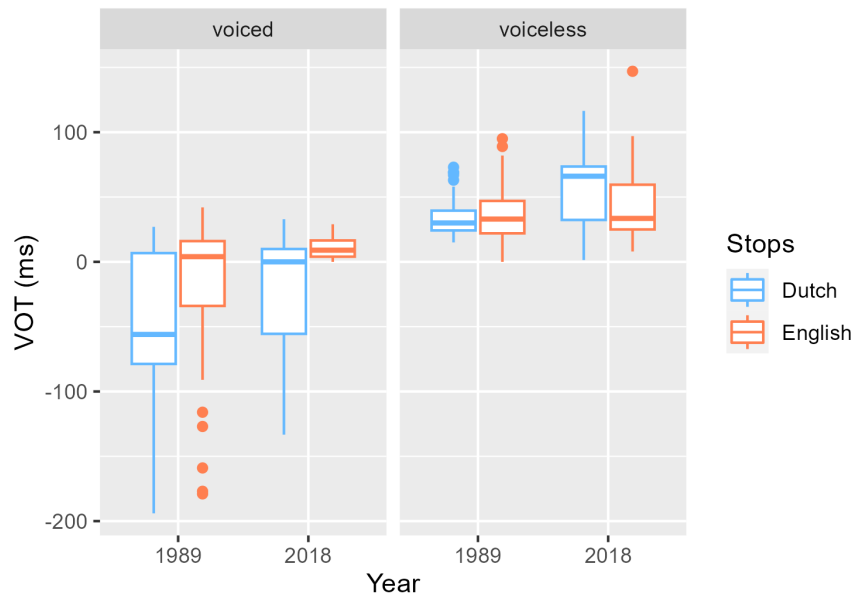

Figure 2. Box plots of VOT (ms) tokens by Year, Language, and Voicing

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[2] The dataset includes no tokens of /g/ for Dutch since, as noted above, it is not a native phoneme of Dutch.

		Mean	Q1	Median	Q3	% Prevoiced
Voiced	1989					
		Dutch	-50.3	-78.8	-56	6.75	64.58%
		English	-13.1	-34	4	16	32.91%
	2018					
		Dutch	-23.1	-55.5	0	9.9	45.24%
		English	10.5	4	9	16.5	0%
Voiceless	1989					
		Dutch	35.9	24.2	30	39.5	-
		English	35.2	22	33	47	-
	2018					
		Dutch	58.7	32.3	66.1	73.5	-
		English	42.9	25	33.5	59.5	-

Table 3. Mean, Quartile 1, Median, Quartile 3, and % Prevoiced VOT (ms) values by Year, Language, & Voicing

This presents a system in 1989 in which the English stops appear to be affected by the Dutch stops as there are English voiced stops produced with prevoicing and voiceless stops produced with shorter aspiration than expected. However, the amount of prevoiced tokens in Dutch is less than what is found for homeland Dutch (~65% vs. >84%), and the Dutch voiceless tokens are longer than what is expected for homeland Dutch. Consequently, the Dutch stops appear to be influenced by the English stops, as well. Therefore, in 1989, there appears to be bi- directional influence leading to overlap between the two languages.

However, by 2018 there is a greater degree of differentiation. Prevoicing disappears for the English voiced stops with 0% of tokens being prevoiced compared to ~33% in 1989. While prevoicing also decreases for the Dutch voiced stops, 45% of tokens are still produced with prevoicing. There is still some overlap between the VOT values for the voiced stops in both languages, as indicated by the overlap in boxes and whiskers, but the overlap is much less than in 1989. For voiceless stops, the mean and median values in 1989 are nearly identical between the two languages, while the Dutch stops lengthen more than the English ones in 2018. The mean for Dutch is nearly 16 ms longer and the median almost 33 ms longer than those of English. There is still overlap between the VOT values of the two languages but the box for Dutch is no longer contained entirely within the box for English.

Thus, the speaker appears to have a Dutch-influenced English system in 1989, where a decent percentage of voiced stops were prevoiced and voiceless stops were produced with less aspiration. Phonologically, this could mean that, in this speaker's English, GT was an active

dimension. A future study targeted at assimilatory environments could test this. However, by 2018, the speaker displays a more "standard" English (GW) system with short-lag (no prevoiced) voiced stops and slightly longer (though still shorter than average) voiceless stops.

Something different happens with the speaker's Dutch, where she maintains prevoicing on nearly half of her voiced stops (much greater than the 0% of English stops which were prevoiced). This is still quite a bit less than the reported >84% of prevoiced stops in homeland Dutch. Therefore, her Dutch voiced stops are becoming more English-like. Still, she makes a notable difference between Dutch and English through prevoicing leading me to believe that GT is still an active dimension in her Dutch. The speaker also appears to have enhanced the contrast between her two sets of stops in Dutch beyond that of homeland Dutch and beyond the contrast she made in 1989. Aspiration increases on her Dutch voiceless stops between the two time periods so that the difference between Dutch voiced and voiceless stops is even greater in 2018. This could mean that the speaker's Dutch is moving towards being a GW language, but again analysis of assimilatory contexts is needed to test this.

A similar enhancement of contrast between stops has been reported in Heritage Frisian in Wisconsin (Ehresmann & Bousquette 2021) and a non-longitudinal but still real-time study of heritage Dutch speakers in WI from 1966 to 2018 (Hietpas 2023). Thus, enhancement of the unmarked category could be a general strategy employed by heritage speakers in maintaining a contrast between their stops. This is a claim that requires more data and contexts to test it. It could indicate an influence of English (or whichever societally dominant language) on the heritage language. Ehresmann & Bousquette (2021) found aspirated stops in heritage Frisian and the speaker here also exhibited aspiration on her voiceless stops, a feature which is more typical of English, the societally dominant language, than it is of either West Frisian or homeland Dutch. It is worth noting that the Dutch voiceless stop median and mean VOT values for the speaker examined here are longer than those of her English voiceless stops. However, when examined by place of articulation (Figure 3), this is almost entirely from the speaker's voiceless *velar* stops with the distributions of the voiceless bilabial and alveolar stops mostly overlapping between Dutch and English in 2018 but the Dutch voiceless *velar* stops lengthening beyond their English counterparts. Thus, influence from English may not fully explain this situation. It could be that the speaker realizes that her Dutch and English stops should be different and employs an articulation she is familiar with, increasing VOT, and lengthens her Dutch voiceless velar stops beyond that of her English ones to distinguish them. However, it remains unclear why this enhancement occurs for the voiceless velars alone. I remain open to suggestions on why this over-enhancement occurs.
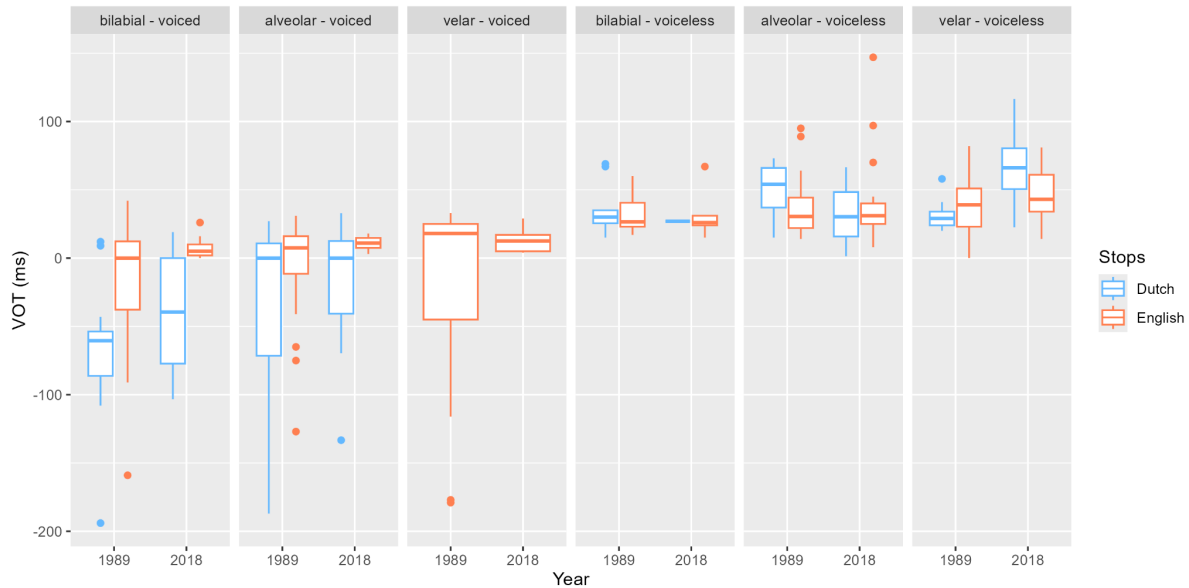
Figure 3. Box plots of VOT (ms) tokens by Year, Language, Voicing and Place of Articulation

4. Conclusion. This study expands on previous heritage language research by providing a rare, though not the first, longitudinal look at how a heritage speaker's speech has changed over their lifetime. In regards to my three research questions, the speaker's phonetics do change over time. In 1989, her English voiced stops are Dutch-like with prevoicing present on a third of voiced stops while her Dutch stops largely align with homeland norms, albeit with a lower percentage of prevoiced tokens. However, by 2018, the prevoicing on English voiced stops is gone along with decreased prevoicing on Dutch voiced stops and increased aspiration on voiceless stops. This presents a more English-influenced system. Nonetheless, because she maintains some level of prevoicing in both time periods on her Dutch voiced stops, a cue associated with GT in Dutch, I argue her phonology remains stable, while her phonetics vary. The speaker does also display enhancement of the contrast between her Dutch stops with mean and median aspiration values on her Dutch voiceless velar stops beyond those of their English counterparts. The exact reason for this over-differentiation warrants further consideration as well as more studies of heritage language phonetics to see how common this type of over-differentiation is.

Turning to this volume's focus on methodology, longitudinal studies are not always feasible nor possible due to time, money, and/or limited information available about speakers in past recordings due to (understandable) privacy policies. However, smaller-scale studies such as this one where only one or even a few speakers are studied and restudied are often possible and provide us with invaluable insights into both how adult speakers and heritage languages change.

An even more accessible methodology comes from the secondary focus of this study on phonetics and phonology. Recordings are often part of data collection on heritage language linguistics. While these recordings may not be made with the original purpose of phonetics research, they nonetheless have the possibility of being used for this purpose. There may be some limitations due to infrequent sounds or environments or recordings with poor audio quality. However, some measurements, such as VOT studied here, are relatively robust to poor recording quality. Thomas (2017) points to formants as being an especially useful and viable measure to analyze in older recordings. Formant measurements allow for analyses of clear versus velarized /l/, rhoticity, and vowel quality among other variables. Heritage language phonetics and phonology is an area where more work is still needed, and this study demonstrates how recordings not

originally made for the purpose of phonetics research can successfully be used to tell us something about heritage languages. Additionally, archives of heritage language recordings are being made publicly available online more and more (such as the one used to access the 1989 recording here) allowing research without the cost-prohibitive need to travel to a physical archive or complete field research (although more community-focused field research is always welcome). As the field of heritage linguistics continues to expand, Mark Lauersdorf's (2018) principle of "use all the data" (112) will become ever more important.

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