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Contact effects on voice-onset time (VOT) in Patagonian Welsh

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Contact effects on voice-onset time (VOT) in Patagonian Welsh

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in Linguistics

by

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December 2015

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ABSTRACT

Contact effects on voice-onset time (VOT) in Patagonian Welsh

by

Morgan Thomas Sleeper

The effects of language contact extend well beyond the borrowing of lexical items, and can include morphosyntactic, phonetic, and phonological changes over time (Thomason & Kaufman 1998). One especially common structural outcome of long-term contact is phonetic transfer (Matras 2009:222). The Welsh spoken in Patagonia, which has been in close contact with Spanish for the past 150 years, offers one potential example of this phenomenon: Jones (1984) observes that younger speakers of Patagonian Welsh may be developing unaspirated voiceless stops /p t k/ as a result of Spanish contact.

This paper measures the voice-onset time (VOT) of the Welsh voiceless stops /p t k/ using contemporary conversational speech data from both Patagonia and Wales, for male and female speakers in three age groups (0-29, 30-59, and 60+), to examine the effects of Spanish contact on Patagonian Welsh. Results indicate that the tendencies seen in Jones (1984) have held true, and in fact have generalized to become a feature of Patagonian Welsh for speakers of all ages: Patagonian speakers produce the Welsh stops /p t k/ with significantly shorter VOT values than speakers from Wales.

I. Introduction

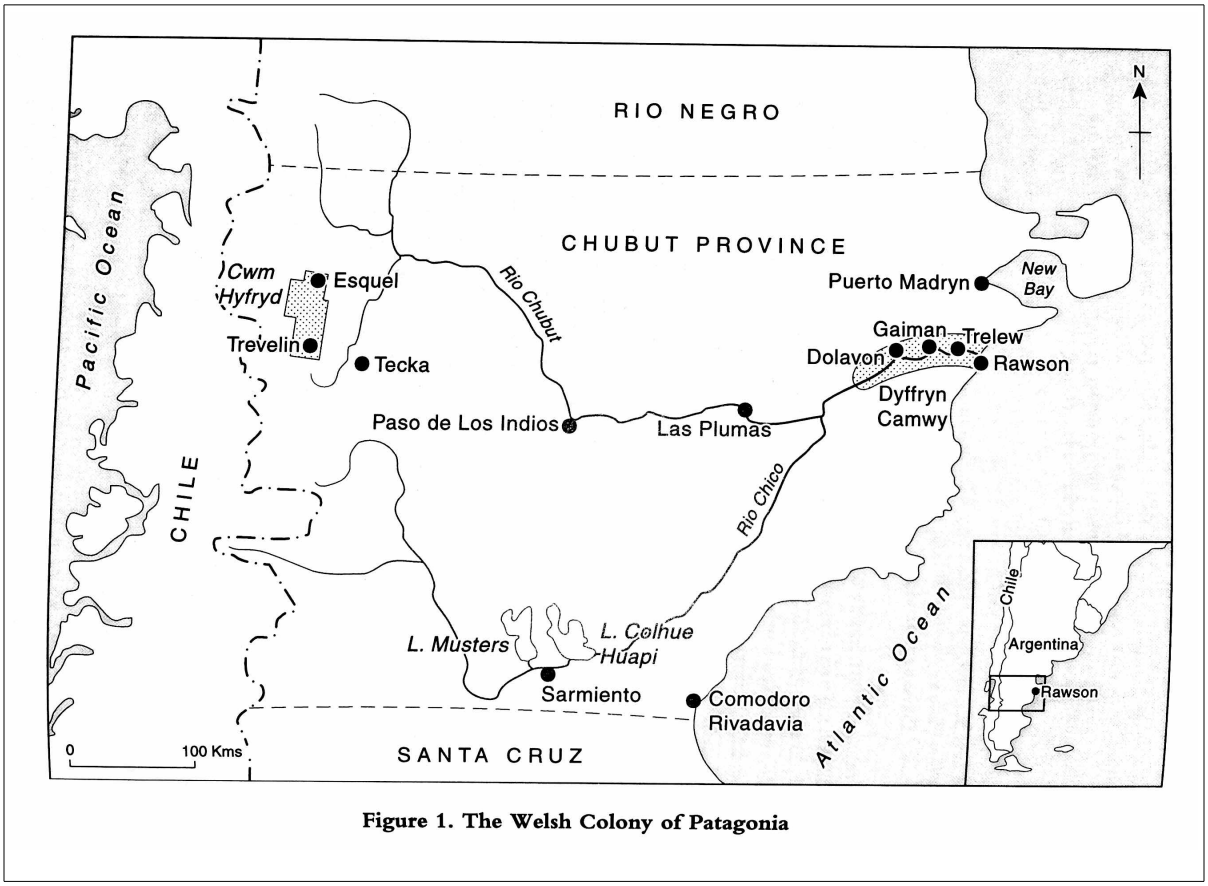
The effects of language contact are varied and far-reaching, and the fact that languages can 'borrow' much more than lexical items is well-documented in contact situations around the globe (Thomason & Kaufman 1988). Phonetic and phonological transfer are especially common structural results of long-term contact (Matras 2009:222), and one example of this phenomenon can be observed in Jones (1984), which indicates that younger speakers of Patagonian Welsh may be innovating unaspirated voiceless stops as a result of increasing contact with Spanish. The unique situation of Welsh – spoken as a minority language on two continents, in two different social contexts, and under the influence of two different superstrate languages – allows us to observe the process of language contact "in action". In particular, we can see how language contact unfolds with respect to both social and structural factors by examining how a single phonetic feature – the aspiration of voiceless stops – varies under the influence of different contact languages.

This paper measures the voice-onset time (VOT) of Welsh oral plosives /p/, /t/, and /k/ using contemporary conversational speech data from both Patagonia and Wales, for male and female speakers from three different age groups (0-29, 30-59, and 60+), to investigate the effects of contact on the aspiration of Welsh stops in Patagonia. The results show that Jones' observation of younger Patagonian speakers' shorter VOT has held true, and in fact has now become a feature of Patagonian Welsh in general: Patagonian speakers produce the Welsh voiceless stops /p/, /t/, and /k/ with significantly shorter VOT values than speakers from Wales.

II. Background: The Welsh Language in Patagonia

The Welsh colony in Argentina (known as *Y Wladfa* in Welsh) was founded specifically to preserve the Welsh language, religion, and cultural values in a location far removed from English influence (Johnson 2009). Several locations were considered, including Vancouver Island and Brazil, but the emigrants eventually settled on the Chubut Valley in Argentina, a desert area which the Argentine government hoped to populate with European immigrants (Birt 2005). 160 colonists arrived at what is now Puerto Madryn on July 28th 1865, and 3,000 more followed over the next 50 years, founding several towns in two distinct settlement areas: Dyffryn Camwy (or Camwy Valley) in the east (Gaiman, Trelew, Rawson, and Dolavon), and Cwm Hyfryd (Lovely Valley) in the Cordillera region of the Andes to the west (Esquel and Trevelin) (Johnson 2009). These areas are shown below, in a map reproduced from Williams (1991):

Figure 1: Map of Welsh Patagonia (Williams 1991)



Welsh-language religious, educational, and local government institutions helped cement the status of the language in public life, and the colony remained largely Welsh-speaking until the end of the 19th century (Jones 1984; Birt 2005). Local and settlement-wide Eisteddfodau – Welsh-language music and culture festivals, which include competition in song, dance, instrumental music, poetry, drama, readings, and literature – were held often and drew large numbers of attendees, giving the language an important, continuous presence in local culture (Williams 1991; Birt 2005). As the central Argentine government began to extend its influence in the region and immigration from other parts of Europe and Argentina intensified, however, a diglossic situation arose. By the end of the second World War,

Spanish had become the language of public life, Welsh-language institutions dwindled, the Eisteddfodau were in decline, and the use of Welsh was restricted to Welsh-speaking homes, social circles, and religious services (Johnson 2009; Williams 1991).

The 1965 centenary of the colony marked somewhat of a turning point for the Welsh language in Patagonia, with a renewed interest in Welsh as a heritage language for those of Welsh decent, and as a cultural icon for all inhabitants of the historically Welsh settlements. The centenary also saw the rebirth of the Eisteddfodau – this time as bilingual Welsh-Spanish events – which have continued annually ever since, and a rise in contact and cultural visits between Patagonia and Wales (Williams 1991; Birt 2005). This shift led to a marked improvement in the status of the language in Patagonia, especially since the 1990's (Jones 1996; Johnson 2009).

While current estimates of fluent speakers are difficult to obtain, in 1973, 15% of the population of Gaiman spoke Welsh regularly (Jones 1984:240), and in 2005 at least “several thousand” people in Chubut had “some knowledge of Welsh with varying degrees of fluency” (Ó Néill 2005:429). In terms of identity, most members of the Welsh-speaking Patagonian community consider themselves “both Argentinian and Welsh … Welsh being considered an ethnic identity and being Argentine as a civic identity” (Johnson 2009).

Access to Welsh-medium education has also increased significantly in the decades following Jones' survey, with Ysgol Feithrin Gaiman and Ysgol yr Hendre in Trelew providing full Welsh-immersion nursery and primary schooling, and Ysgol Gymraeg yr Andes in Trevelin and Ysgol Camwy in Gaiman offering successful after-school programs for older children and adults (Kiff 2013).

Figure 2: Ysgol yr Hendre (Trelew) (L) and Ysgol Gymraeg yr Andes (Trevelin) (R)

Since 2008, a program known as Menter Patagonia, sponsored by the Welsh National Assembly, has also sent young Welsh speakers from Wales to both Dyffryn Camwy & Cwm Hyfryd to act as community language teachers, mentors, and cultural ambassadors (Chriost 2012). Most recently, the colony's 150th anniversary celebrations in 2015 drew in a large number of visitors from Wales, including organized visits from the Welsh-language youth organization Yr Urdd (Cymdeithas Cymru-Arianinn 2015), and links between Patagonia and Wales – especially Welsh-speaking Wales – are expected to increase following the celebrations.

I spent five weeks in these communities in October-November 2011 as a Thomas J. Watson Fellow as part of a wider project investigating how communities use music to help revitalize endangered languages, focusing specifically on Celtic languages. I spoke with community members, local musicians, and Menter Patagonia teachers from Wales, sat in on Welsh-language classes and choir rehearsals, attended the Eisteddfod del Chubut in Trelew, and visited Ysgol Feithrin and Ysgol Camwy in Gaiman, Ysgol yr Hendre in Trelew, and Ysgol Gymraeg yr Andes in Trevelin.

III. Literature Review

Voice-onset timing

Much previous research on voice-onset time has focused on inter-language variation in VOT values, beginning with Lisker & Abramson's (1964) seminal cross-linguistic study. Using data from 11 languages, they showed that voicing, aspiration, and force of articulation are all “predictable consequences” of differences in voice-onset time, and showed that languages broadly select from three categories of VOT: voicing lead (~-30ms or lower), zero-onset or short-lag (0 to ~30ms), and long-lag (~50ms or greater). Their data also point to place of articulation playing a role in VOT values: the velar stops in their study consistently display longer VOT values than their alveolar or bilabial counterparts, and for most languages in their sample – excepting Tamil, Cantonese, and Eastern Armenian – alveolar stops have longer VOT values than bilabial stops.

Cho & Ladefoged (1999) presents VOT data from 18 endangered and less-studied languages, showing that, within languages, VOT values for different stop consonants vary based on place of articulation, extent of articulator contact, and articulator movement speed. In terms of inter-language variation, they identified four categories of positive VOT values: unaspirated (~30ms for velar stops), slightly aspirated (~50ms), aspirated (~90ms), and highly aspirated (reserved for Navajo and Tlingit plosives, with average velar values over 120ms). Despite these clusterings, however, they note that no languages contrast more than three categories of VOT distinctions, which they represent phonologically as [voiced], [voiceless unaspirated], and [aspirated].

Importantly, the three languages of interest to the present study – English, Spanish, and Welsh – contrast the 'voiced' and 'voiceless' stop series /p t k/ and /b d g/ using these

phonological categories in different ways. For English, for instance, Lisker & Abramson (1964) lists the following word-initial VOT values, based on four speakers:

Table 1: Average VOT (ms) in English (Lisker & Abramson 1964)[1]

	/p/	**/t/**	**/k/**
VOT	58	70	80
	/b/	**/d/**	**/g/**
VOT	1	5	21

Thus English, at least word-initially, contrasts [aspirated] /p t k/ with [voiceless unaspirated] /b d g/ (Cho & Ladefoged 1999).

For Argentinian Spanish, as spoken in Buenos Aires, Borozone de Manrique (1980) found the following VOT values in a study of six male speakers:

Table 2: Average VOT (ms) in Buenos Aires Spanish (Borozone de Manrique 1980)

	/p/	**/t/**	**/k/**
VOT	10	15	25
	/b/	**/d/**	**/g/**
VOT	-70	-50	-40

Spanish, unlike English, contrasts [voiceless unaspirated] /p t k/ with [voiced] /b d g/, indicated by the negative VOT values for the (both phonetically and phonologically) voiced series.

For Welsh, an acoustic study of initial stops by Ball (1984) using 1 male and 5 female speakers from Carmarthen, Wales, gave the following VOT values:

1 Lisker & Abramson's data also includes one speaker who consistently produced /b d g/ as truly voiced, with negative VOT values; these are reported separately in their data, and excluded here.

Table 3: Average VOT (ms) in Carmarthen Welsh (Ball 1984)

	/p/	**/t/**	**/k/**
VOT	62	82	97
	/b/	**/d/**	**/g/**
VOT	15	33	32

In Carmarthen Welsh, then – as in English, but unlike Spanish – /p t k/ and /b d g/ are distinguished by VOT, as opposed to by voicing, with /p t k/ being [voiceless aspirated] and /b d g/ being [voiceless unaspirated] (Ball 1984:15).

Along with cross-linguistic diversity in the realization of voice-onset timing, socially-conditioned VOT variation has become an important area of study, especially with regards to gender. Swartz (1992) looked at VOT of the English stops /t/ and /d/ in 16 speakers of American English, 8 female and 8 male, and found that women produced both stops with longer average VOT values than men. Whiteside & Irving (1998) examined VOT values in 5 female and 5 male adult British English speakers, finding that, on average, the female speakers displayed longer VOT values for voiceless stops /p t k/ and shorter VOT values for voiced stops /b d g/. A later study by Whiteside et al. (2004) found the same tendencies in data from young British English speakers (between 5 and 13 years old), showing that these differences may develop before adulthood.

Fewer studies have specifically examined the effects of language contact on VOT, though Fowler et al. (2008), in which the authors measured VOT in the speech of bilingual French-English speakers in Montréal, is a notable exception. Their results showed that bilingual speakers produced French voiceless stops with longer VOT values than monolingual French speakers, and English voiceless stops with shorter VOT values than monolingual English speakers. Since English voiceless stops are normally aspirated in initial

position, and French voiceless stops are not (Cho & Ladefoged 1999), these results indicate cross-linguistic phonetic contact effects: bilingual speakers produce voiceless stops with longer VOT in French and shorter VOT in English.

Patagonian Welsh

While there has been substantial interest in the Welsh spoken in Patagonia in the Welsh-language popular press, and several sociocultural investigations of Welsh language vitality, maintenance, and use in Patagonia (Johnson 2009; Birt 2005; Coupland & Garrett 2010; Trosset et al. 2007) very few studies have attempted to systematically examine unique linguistic features of Patagonian Welsh. Those that have focus primarily on potential contact effects from Welsh-Spanish bilingualism. Agozzino (2006) explores the folkloric traditions of Welsh Patagonia through ethnographic interviews, and touches briefly on lexical contact features unique to Patagonian Welsh, including calques, loanwords, and Welsh-Spanish hybrid idioms. In terms of phonology, Bell (2015) examines the production of phonemic vowel length in Patagonian Welsh as a possible locus of contact-induced phonological change, finding that – contrary to predictions based on L1 Spanish phonology – Welsh-Spanish bilinguals in Patagonia retain the phonemic vowel length distinctions of Standard Welsh, regardless of order of language acquisition (Welsh L1 or Spanish L1).

As one of the first studies to focus on potentially unique phonetic features of Patagonian Welsh, Jones (1984) provides a variationist account of the production of several phonemes in the Welsh spoken in Gaiman, Chubut, including /x/ vs. /χ̥/, /ʃ/ vs. /s/, /ə/ vs. /ɪ/, and, notably, /p^h t^h k^h/ vs. /p t k/, with each of these secondary realizations said to be contact-influenced developments from Spanish. Without providing specific VOT values, Jones'

survey indicates that the speakers in his “Young” (under 30) and “Young Middle-aged” (30-45) categories “consistently” produced the Welsh /p t k/ using “the Spanish unaspirated phones”, “Elderly” (60+) speakers used the “Welsh aspirated phones”, and “Middle-aged” (45-60) speakers differed on the basis of their level of affiliation with the Welsh cultural community: speakers more active in Welsh religious and social life were more likely to produce aspirated stops when speaking Welsh (Jones 1984:247).

Jones calls this age-graded change in aspiration “an indicator of the growth in the importance of Spanish and consequent bilingualism within the life of the community” (Jones 1984:248), and it patterns predictably with linguistic trends in education. Jones' elderly speakers were educated when the community was still monolingual Welsh-speaking, the middle-aged group might or might not have attended the Welsh-language Ysgol Ganolraddol secondary school, and the younger speakers would have been educated entirely in Spanish (Jones 1984:248).

Thirty years on from Jones' initial investigation, the sociolinguistic situation of Welsh in Patagonia has shifted yet again, resulting in increased access to Welsh-language education and a notable rise in prestige for the language since the 1990's, at the same time that Spanish has become the unmarked language of daily life for nearly everyone in Welsh Patagonia. This current study aims to quantitatively investigate whether the contact-induced changes in VOT impressionistically noted in Jones (1984) have indeed become a phonetic feature of modern Patagonian Welsh, and increase our understanding of both phonetic contact effects in general and a distinguishing feature of this unique, underdescribed variety of Welsh.

IV. Data & Methods

The data for this study are drawn from two corpora of contemporary, conversational Welsh speech: the Bangor Patagonia Corpus (for the Patagonian data) and the Bangor Siarad Corpus (for the Wales data), both assembled by the ESRC Centre for Research on Bilingualism in Theory & Practice at Bangor University, licensed under the Free Software Foundation's General Public License, and available at http://www.bangortalk.org.uk (Deuchar et al. 2014). Conversations were recorded in speakers' homes, schools, and workplaces, in 2006 (Wales) and 2009 (Patagonia).

Most phonetic studies of VOT have utilized data elicited from wordlists, to provide maximum control over potentially influencing factors, including the effects of speech rate, differing phonetic environments, and stress and intonational patterns. While all these factors can affect VOT measurements, there are also benefits to using naturalistic speech data to examine phonetic phenomena, as this study does for VOT, particularly when sociocultural and/or stylistic factors may influence phonetic production. No single speaker always uses a single style, and speakers are more or less attentive to their speech depending on the context and type of interaction in which they find themselves (Eckert 2001:122). As Labov (1981:3) rightly points out, “any systematic observation of a speaker defines a formal context where more than the minimum attention is paid to speech”. Though this is certainly true, different types of observation are more or less formal, and more or less systematic, and Eckert (2001) and others have argued that different observational contexts influence speakers' language use to a greater or lesser degree, especially with respect to standard language ideologies.

The conversations in the Patagonia and Siarad corpora, for instance, in which participants recorded themselves without a researcher present (in most cases), represent a

context where speakers are far less attentive to their speech than when recording a wordlist in a laboratory setting. Because of the prestige which Welsh from Wales carries in Patagonia, and the popular perception that Patagonian speakers speak Welsh with a “Spanish accent” or “Spanish-influenced rhythm” (Agozzino 2006), it could be that speakers recording a wordlist may be more conscious of their self-presentation (Eckert 2001:122) and trying to sound authentically “Welsh”, potentially altering their phonetic production as part of a style-shift. Since aspiration vs. non-aspiration is a relatively salient feature of Welsh vs. Spanish phonology, this could conceivably affect speakers' productions of VOT. In the naturalistic speech of the corpus recordings, however, any effects of the consciousness of observation would be significantly reduced due to both the less formal nature and longer duration of the recording.

Phonetic Methods

Nine female and nine male speakers from each of three age categories – Early (0-29), Middle-aged (30-59), and Older (60+) – were selected from both corpora, yielding eighteen Patagonian speakers and eighteen speakers from Wales, for a total of thirty-six. Speakers were selected based on the availability of tokens in their recorded discourse suitable for measuring the VOT of word-initial Welsh stops /p/, /t/, and /k/. Since vowel quality has been shown to affect VOT (Klatt 1975), all tokens consisted of words with word-initial /p/, /t/, or /k/ followed by the vowel /a/. In addition, in order to minimize the effects of different domain positions and stress on VOT (Jun 1993; Keating et al. 2003), tokens were taken from non-prominent words in phrase-medial domains, and with initial world-level stress wherever possible. A selection of example tokens is given below:

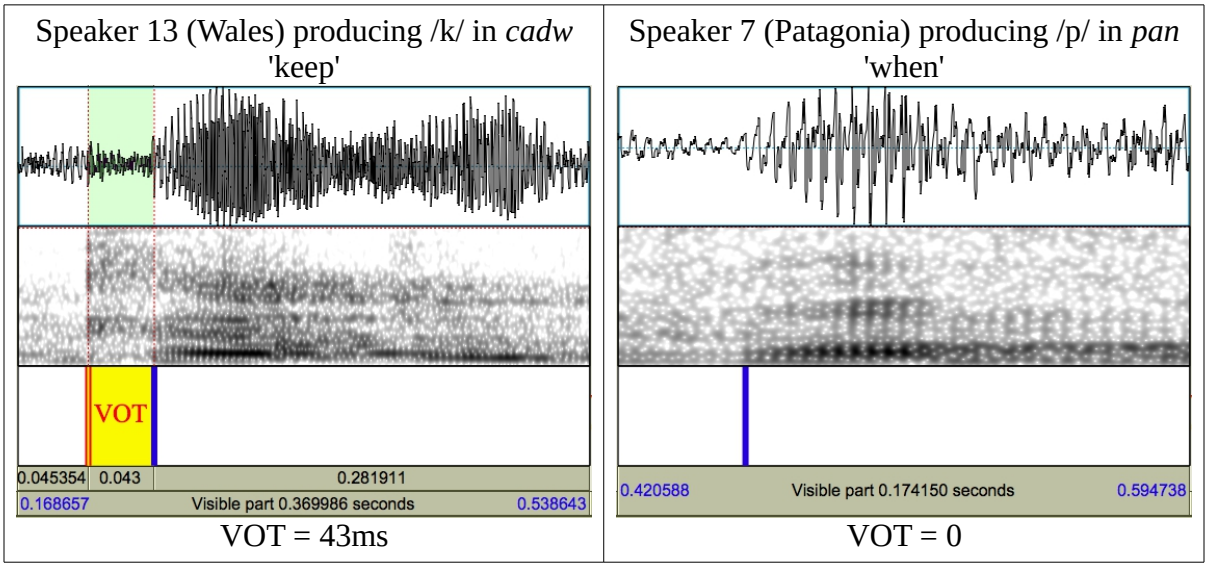
Table 4: Example tokens produced by speakers

/p/:	pam	/'pam/	'why'
	pan	/'pan/	'when'
	pa	/'pa/	'which'
	pabell	/'pabɛɬ/	'tent'
/t/:	tan	/'tan/	'until'
	tatws	/'tatus/	'potatoes'
	tad	/'tad/	'father'
	talu	/'tali/	'to pay'
/k/:	canu	/'kani/	'to sing'
	capel	/'kapɛl/	'horse'
	cadw	/'kadu/	'to keep'
	castell	/'kastɛɬ/	'castle'

Each speaker produced up to four tokens representing each initial consonant under investigation. While ideally the data would include four tokens of each sound for every speaker, the realities of drawing data from a corpus of natural speech – including background noise, overlap, and other obfuscating environmental factors – in addition to the specificity of the token selection process – phrase-medial, non-prominent realizations – meant that often speakers produced fewer than four tokens for at least one initial consonant.

Individual tokens were extracted from longer conversations using ELAN (Brugman & Russel 2004), and analyzed in Praat (Boersma & Weenink 2015) in the original .wav format at a sampling rate of 22050 Hz. VOT was measured from waveforms and spectrograms in seconds. Positive VOT was measured from the first stop burst (in cases with multiple bursts) to the first peak at the onset of the following vowel, 0 VOT was marked as such, and no negative VOT was recorded in the tokens examined. Examples of positive and 0 VOT are given below:

Figure 3: Sample measurements for positive and 0 VOT



Statistical Methods

In total, 291 tokens were analyzed. Once isolated, each token was coded for the following features:

Table 5: Features coded

Feature	**Description**	**Levels**
SpeakerID	Numeric identifier	1-36
Country	Dialect of Welsh spoken, determined by corpus	Patagonia Wales
Sex	Gender of speaker	Female Male
Age	Age of speaker, categorical	Early (0-29) Middle (30-59) Old (60+)
Sound	Initial consonant measured for VOT	/k/ /p/ /t/
Word	Lexical item in which the initial consonant appears	–
VOT	Measurement of voice-onset time in seconds	–

The data were analyzed in R (R Core Team 2015) through a linear mixed-effects model using the *lme4* package (Bates et al. 2014), with VOT as the dependent variable. Since previous cross-linguistic research has shown that VOT is consistently longer for velar stops than for both alveolar or bilabial stops, while alveolar stops can have longer or shorter VOT than bilabial stops depending on language and articulatory factors (Cho & Ladefoged 1999; Lisker & Abramson 1964), contrasts were set *a priori* between /k/ and /p t/ on the one hand, and between /p/ and /t/ and the other (Gries 2013). Similarly, as a result of an initial modeling process which showed that Age:Middle and Age:Old speakers in this study pattern together in terms of VOT, user-defined contrasts were also set in the predictor Age between Early and Middle/Old on the one hand, and between Middle and Old on the other.

Following Zuur et al. (2009:127), the optimal random-effects structure of the model was first determined using restricted maximum likelihood estimation (REML), with the result that SpeakerID was included as a random effect, as an adjustment to intercepts, and Word was discarded. Next, the fixed-effects structure was determined starting from a maximal model with all main effects and their pairwise interactions using maximum likelihood estimation (ML), with p-values calculated via the *lmerTest* package (Kuznetsova et al. 2015), resulting in two significant predictors of VOT being retained: Country ($Pr(\chi^2)$=3.44e-06), and the interaction of Sound and Age ($Pr(\chi^2)$=0.01512). With the fixed-effects structure set, the final model was re-computed using REML.

IV. Results

The results of the final mixed-effects model (R^2marginal=0.36; R^2conditional=0.43) are as follows:

Table 6: Highest-level predictors

	DF	*AIC*	*LRT*	*Pr(χ^2)*
Country	1	-1512.3	21.554	3.44e-06
Sound x Age	4	-1527.5	12.320	0.01512

Table 7: Random effects

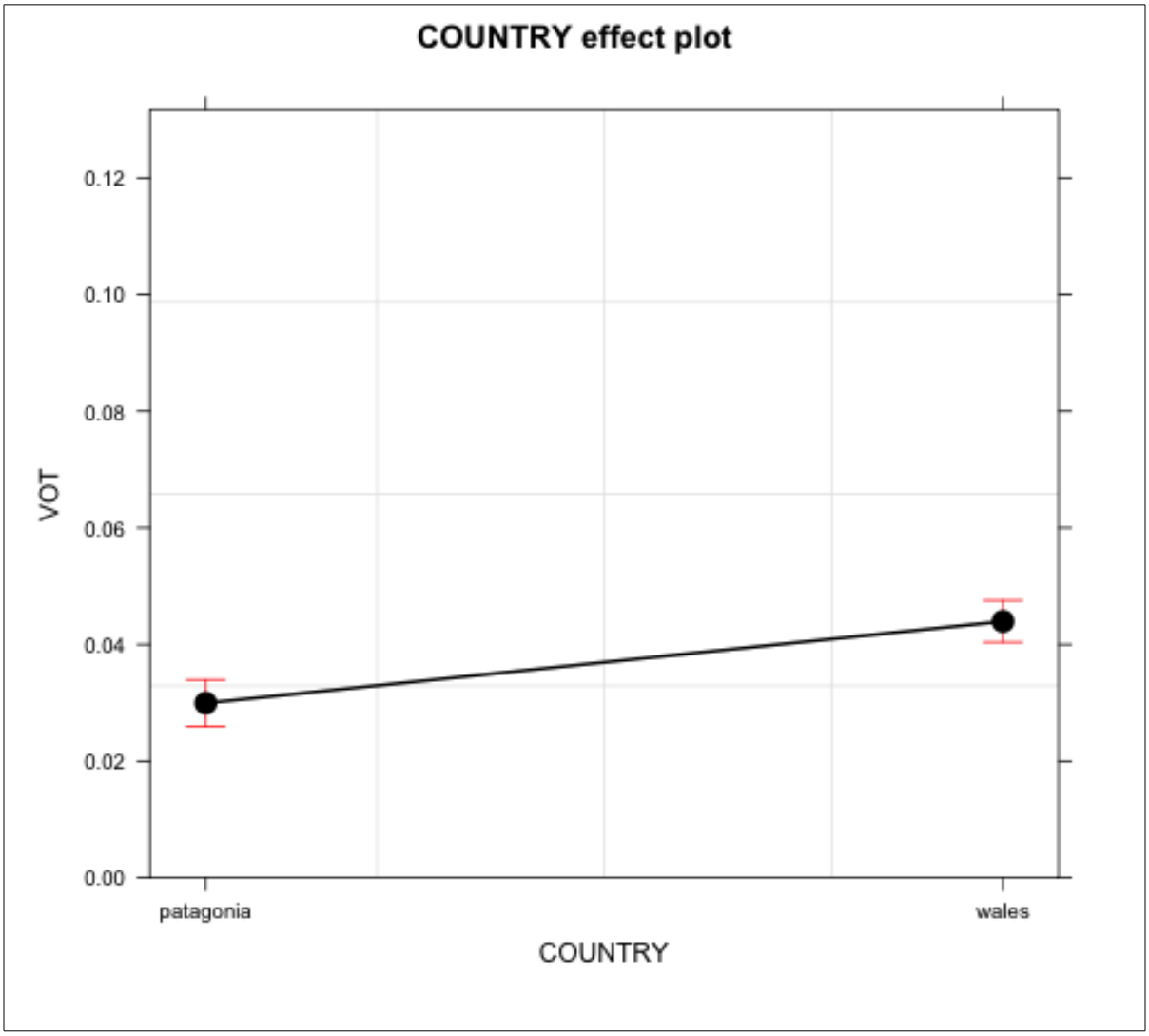
	Variance	*Standard deviation*	
SpeakerID (Intercept)	0.0000293	0.005413	***
Residual	0.0002678	0.016363	*

Table 8: Fixed effects

	Coefficient estimate	*Standard error*	*DF*	*t-value*	*Pr(>|t|)*	
(Intercept)	0.031	0.002	36.64	15.36	< 2e-16	***
Country:Wales	0.014	0.003	30.63	5.16	1.4e-05	***
Sound:k_vs_p.t	0.007	0.002	264.51	3.56	0.0004	***
Sound:p_vs_t	-0.024	0.003	264.22	-9.08	< 2e-16	***
Age:Early_vs_Middle.Old	-0.004	0.003	29.07	-1.28	0.209	
Age:Middle_vs_Old	0.001	0.003	35.87	0.46	0.651	
Sound:k_vs_p.t x Age:Early_vs_Middle.Old	-0.013	0.004	263.8	-3.07	0.002	**
Sound:p_vs_t x Age:Early_vs_Middle.Old	0.006	0.005	264.01	1.18	0.239	
Sound:k_vs_p.t x Age:Middle_vs_Old	0.002	0.005	276.68	0.33	0.743	
Sound:p_vs_t x Age:Middle_vs_Old	0.002	0.007	267.87	0.37	0.708	

Most importantly, these results show that VOT for Welsh voiceless stops does vary by country in the direction predicted by Jones' (1984) observations: Patagonian speakers produce voiceless stops with significantly lower VOT values than speakers from Wales (p=2.16e-11). This result is shown in the graph below:

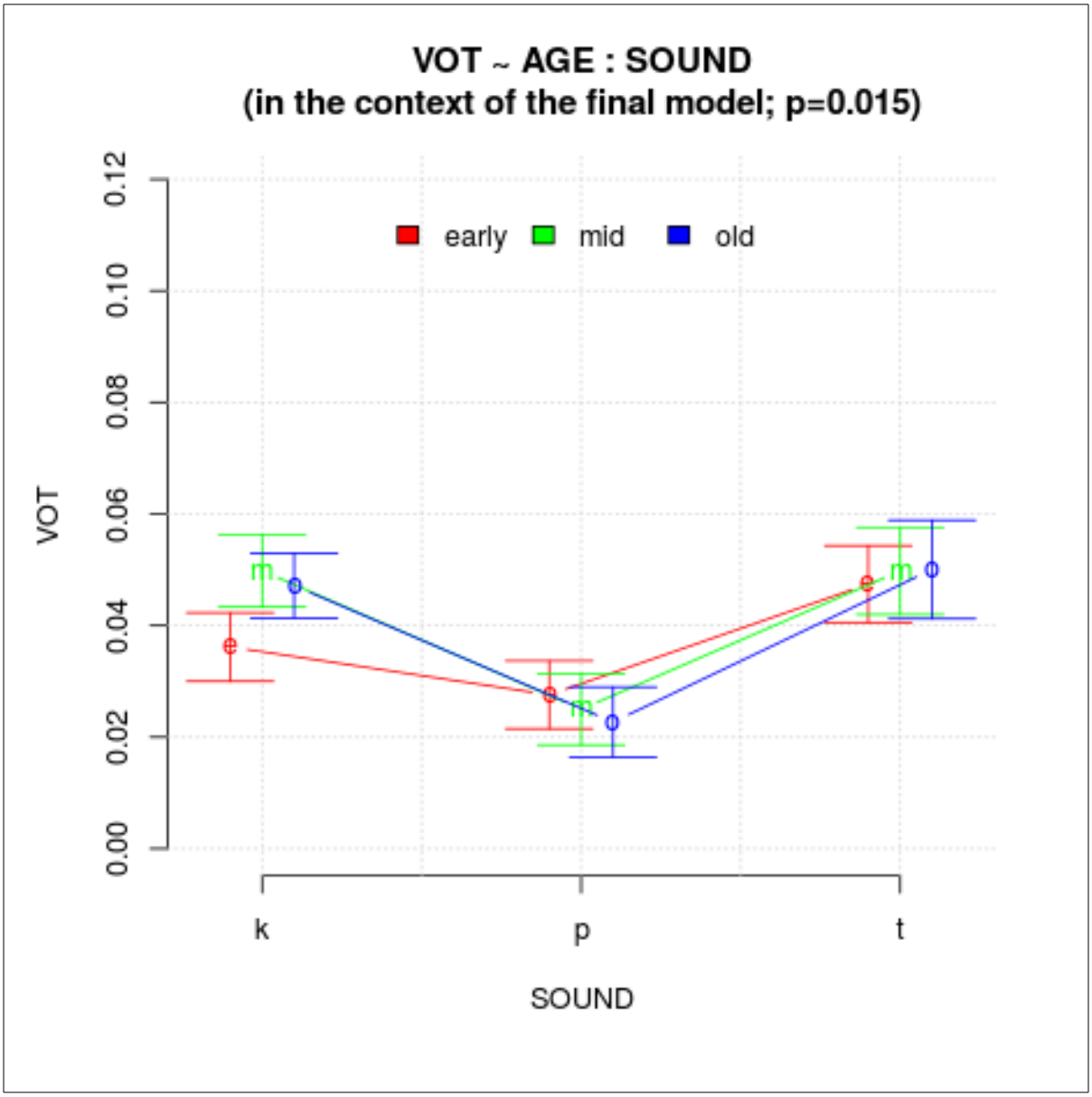
Figure 4: Effect of Country on VOT



The above graph depicts the mean VOT for Patagonian speakers (29ms) on the left side, and for speakers from Wales (44ms) on the right, showing that, on the whole, Patagonian speakers produce the voiceless stops /p t k/ with shorter VOT values than speakers from Wales.

The other significant predictor of VOT was the interaction between Sound and Age, shown in the graph below:

Figure 5: Effect of Sound and Age on VOT



This graph shows a difference between how speakers from both countries in the Early category (in the bottom left) produce the voiceless stops /p t k/ and how speakers in the Middle (bottom right) and Old (top left) categories produce these stops. For Early speakers, VOT values for /p/ are significantly lower than those for /t/, while /k/ patterns with /p/. For Middle and Old speakers, however, VOT values for /k/ and /t/ pattern together, and are both

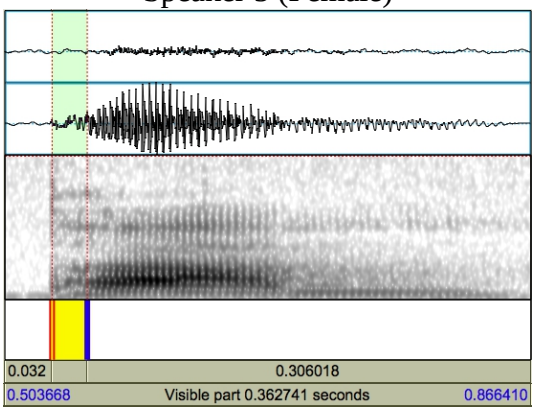
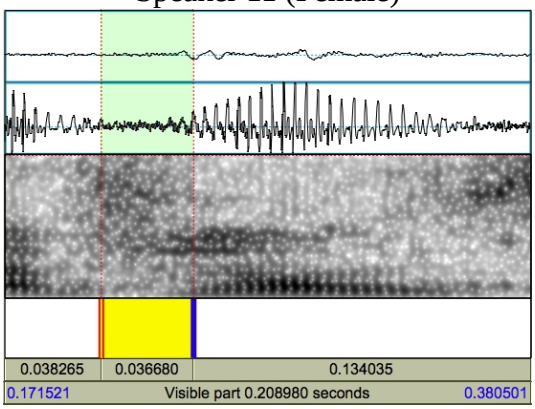
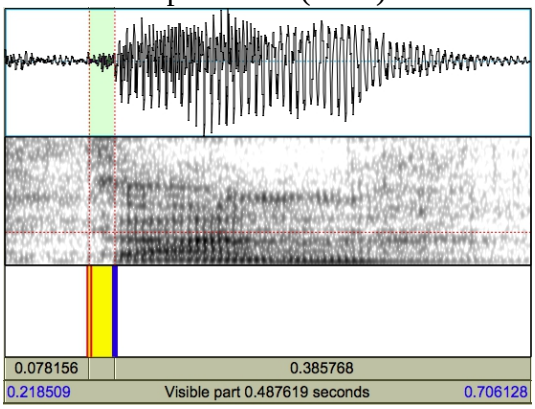
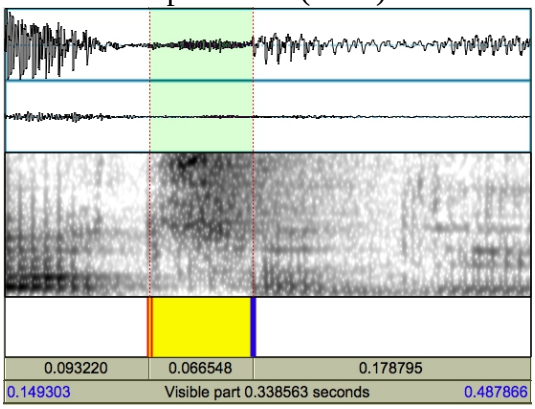
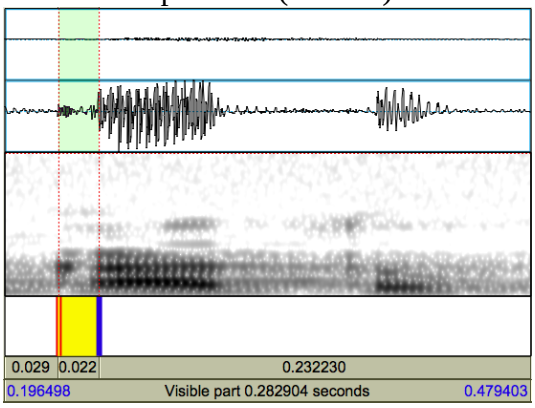
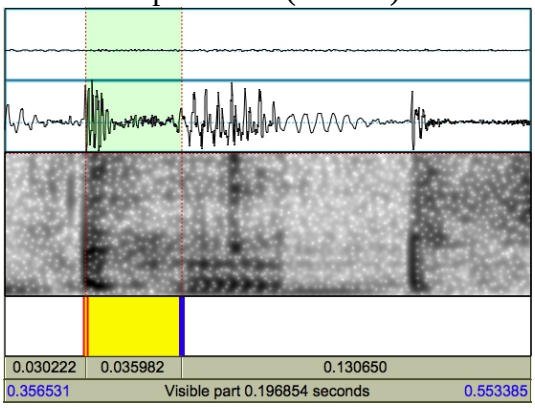
significantly different from those for /p/. In other words, this interaction shows that speakers of all age groups behave statistically identically in general; the only exception is /k/, where younger speakers have shorter VOT values, closer to those of /p/, than other speakers, whose values for /k/ pattern closer to /t/.

V. Discussion

These results confirm the hypothesis suggested by Jones' (1984) observations: Patagonian speakers produce Welsh voiceless stops with lower VOT than speakers from Wales. Interestingly, however, because there was no significant interaction between Country and Age, the age-graded difference in aspiration seen in Jones' study does not appear to be a significant factor here. In Jones' results, younger speakers produced Welsh /p t k/ with unaspirated “Spanish phones”, middle-aged speakers varied in whether they used unaspirated or aspirated /p t k/ based on their degree of affiliation with Welsh cultural institutions in Patagonia, and older speakers used aspirated /p t k/, as in Standard Welsh. Here, however, the effect of Country on VOT is independent of Age; Patagonian speakers, on the whole, produce Welsh voiceless stops with lower VOT values than their Welsh counterparts. Since the oldest speakers in the present study are peers of speakers in Jones' middle-aged category 30 years ago, this indicates that the less-aspirated voiceless stops seen in Jones' younger and middle-aged speakers represented the beginnings of a diachronic shift, rather than simply a synchronically age-graded pattern.

Examples of Patagonian and Welsh speakers of the same gender producing the same lexical items below illustrate this difference:

Figure 6: Examples of Patagonian and Welsh VOT measurements

	Patagonia	Wales
/p/ *pam* why	Speaker 5 (Female)  VOT = 11ms (Speaker /p/ avg = 17ms)	Speaker 11 (Female)  VOT = 37ms (Speaker /p/ avg = 32ms)
/t/ *tan* until	Speaker 24 (Male)  VOT = 24ms (Speaker /t/ avg = 25ms)	Speaker 33 (Male)  VOT = 62ms (Speaker /t/ avg = 65ms)
/k/ *cadw* keep	Speaker 3 (Female)  VOT = 22ms (Speaker /k/ avg = 22ms)	Speaker 10 (Female)  VOT = 41ms (Speaker /k/ avg = 46ms)

For reference, Table 7 provides the mean VOT values for each dialect from the present study, along with those of their respective contact languages:

Table 9: Average VOT (ms) in Spanish, Welsh, and English

Language (Source)	/p/	/t/	/k/
Spanish (Argentina) (Borozone de Manrique 1980)	10	15	25
Welsh (Patagonia) (Present study)	17	40	36
Welsh (Wales) (Present study)	31	55	49
English (Lisker & Abramson 1964)	58	70	80

In this context, the two varieties of Welsh fit into a continuum of VOT values that points towards phonetic influence from contact: Patagonian Welsh patterns closer to Argentinian Spanish, and the Welsh spoken in Wales patterns closer to English. While the Spanish and English VOT values above are not necessarily representative of the specific bilingual speech patterns of the Patagonian and Welsh speakers in this sample, the results still align well with other research on the effects of language contact on VOT. The pattern seen above is consistent with Fowler et al.'s (2008) results, for instance, which show that bilingual French-English speakers in Montréal produced French voiceless stops with longer VOT values than monolingual French speakers, and English voiceless stops with shorter VOT than monolingual English speakers, each as a result of cross-language phonetic influence. The fact that Patagonian speakers produce unaspirated Welsh stops with lower VOT values than speakers from Wales indicates an analogous effect of “phonetic pull” from each of the respective contact languages.

Further, any lowering in VOT values of unaspirated stops is significant in Welsh, because, as discussed above, Standard Welsh contrasts initial /p t k/ and /b d g/ on the basis of aspiration, rather than voicing – both sets of stops are phonetically realized as voiceless,

with the difference in VOT providing the main perceptual cue for the distinction (Ball 1984:15). This means that the shorter VOT in Patagonian Welsh could potentially point towards a phonological transfer in bilingual speakers, since it actually represents a move away from maximum perceptibility in monolingual (Welsh) terms. If Patagonian Welsh /b d g/ values have begun to shift towards or even into negative values as a form of differentiation from lowered /p t k/, this could mean that the contrast between [voiceless aspirated] /p t k/ and [voiceless unaspirated] /b d g/ seen in Standard Welsh could move towards a contrast between [voiceless unaspirated] /p t k/ and [voiced] /b d g/, in terms of Cho & Ladefoged's (1999) phonological dimensions of VOT. Future research should therefore investigate Patagonian Welsh speakers' productions of /b d g/ in terms of VOT measurements, to see if a lowering effect analogous to the one seen in the voiceless series /p t k/ has taken place as a result of contact with Spanish.

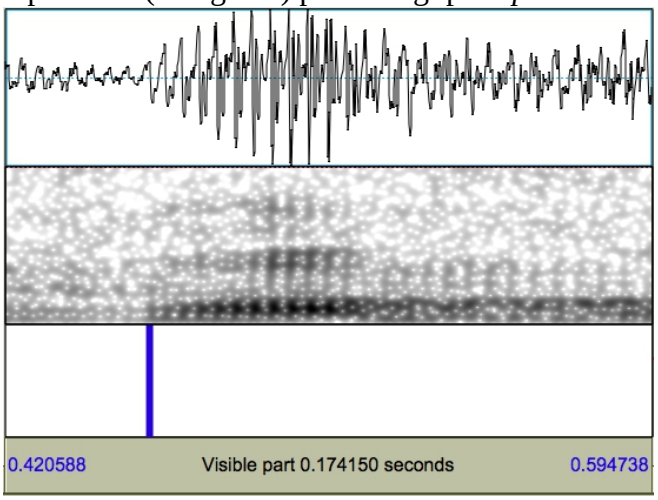
The other significant predictor of VOT in the data, the interaction between Sound and Age, shows an age-graded pattern in terms of overall VOT across all speakers – both Patagonian and Welsh – seen in Figure 5 above. This effect shows that for speakers under 30, /p/ and /t/ differ significantly in terms of VOT, and while /k/ patterns more closely with /p/ (as expected from the literature), it does not differ significantly from /p/ or /t/. For speakers over 30, however – both 'Mid' (30-59) and 'Old' (60+) in the categories here – another pattern develops: /k/ and /t/ pattern together, and differ significantly from /p/ in terms of VOT. This indicates that older Welsh speakers in both Patagonia and Wales produce /k/ with higher VOT values than younger speakers, and that this pattern may be acquired later in language development. It is unclear what might motivate this distinction, and previous research on the effects of age on VOT have shown that adult and childhood VOT patterns largely align

(Whiteside & Irving 1998; Whiteside et al. 2004); future research could explore this phenomenon further using finer-grained data from younger speakers to see if it is present throughout the 0-30 category, or localized to a smaller timeframe.

Aside from these significant predictors, the data also show a few potential points of interests in terms of phonetic features of Patagonian Welsh. The first is that all tokens in the data (n=8) which displayed 0 VOT – that is, where the voicing on the following vowel begins at the same time as the stop release – came from Patagonian speakers. An example of 0 VOT in a Patagonian Welsh voiceless stop is shown below:

Figure 6: Sample measurement of 0 VOT in Patagonian Welsh

Speaker 7 (Patagonia) producing /p/ in *pan* 'when'



VOT = 0

This phenomenon, and its localization to Patagonian Welsh, is consistent with the general finding that Patagonian speakers produce voiceless stops with lower VOT than speakers from Wales. In terms of language contact, it is also consistent with accounts of Spanish as having voiceless stops with 'unaspirated' or 'near-zero' (a category which includes zero) VOT (Lisker & Abramson 1964; Cho & Ladefoged 1999; Dmitrieva et al. 2015). Similarly, the fact that no

speakers from Wales produced any stops with 0 VOT means that this could be a distinctive, contact-induced feature of Patagonian Welsh.

VI. Conclusions

This results of this study show that Welsh-Spanish bilingual Patagonian Welsh speakers produce the voiceless stops /p/, /t/, and /k/ with lower VOT values than Welsh-English bilingual speakers from Wales. These results confirm and quantify the observation in Jones (1984) that younger speakers of Patagonian Welsh have developed less aspirated voiceless stops through increased contact with Spanish. The effect seen in the present study applies to Patagonian Welsh speakers of all ages, indicating that a diachronic shift has taken place, resulting in lower VOT values on voiceless stops as a unique phonetic feature of Patagonian Welsh.

Importantly, this contact-induced phonetic change may have phonological implications. Standard Welsh, like English but unlike Spanish, traditionally contrasts the stop series /p t k/ and /b d g/ on the basis of aspiration rather than voicing (Lisker & Abramson 1964; Cho & Ladefoged 1999; Ball 1984:15), and a lowering of VOT in the voiceless series thus results in a shift away from maximum perceptibility. Further research should therefore examine the VOT values of the stop series /b d g/ in Patagonian Welsh, to see whether these stops have undergone a similar shift – or even begun to move into negative VOT values and a true voicing distinction – as a result of the contact-induced change in /p t k/.

Of course, the effects of language contact go both ways (Thomason & Kaufman 1988), and another step would be to investigate any effects Patagonian Welsh may have had on Spanish in the Welsh-speaking communities of Chubut. In particular, following the

example of Fowler et al. (2008) mentioned above, analyzing the VOT of the Spanish and English /p t k/ stop series in bilingual speakers in Patagonia and Wales could shed light on any substrate influence from Welsh in those languages, as well as provide more locally meaningful data for cross-language VOT comparisons in these bilingual communities.

Finally, with the sociolinguistic situation in Chubut changing constantly, it will be important to continue systematically studying the effects of language contact in Patagonian Welsh in order to get a fuller sense of the dialect as it is spoken in Patagonia today. A recent rise in Wales-Patagonia exchange programs, both in person and virtually via Skype setups in schools (Birt 2005), the 2008 introduction of the Menter Patagonia program, where young people from Wales are brought over to Patagonia to act as community teachers and language advisors each year, and a huge influx of Welsh-speaking visitors for the colony's recent sesquicentennial celebrations in 2015 all point towards the increasing importance of another contact language for Patagonian Welsh: Welsh from Wales. Whether that contact leads to dialect leveling – potentially including a reversal of the VOT shift seen here – or further divergence remains to be seen, and the results are likely to be determined by the sociocultural realities of language contact in Patagonia as much as structural factors.

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