An investigation of phonetic and phonological change and the influence of English on Modern Irish

Senior Thesis in Linguistics

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1 Introduction

The Irish language, with its remarkable revival and surrounding debates on language policy, has been of particular interest to linguists for decades. Today, approximately 3% of Irish people speak the Irish language on a daily basis (Government of Ireland 2006). The majority of these speakers live in traditional Irish-speaking communities outside of urban centers and speak the language at home, in schools, and around town. These speakers listen to Irish language radio, read Irish language news journals, and watch Irish language television programs. However, all of these Irish speakers also speak English, and there is much concern in and around these communities that English is influencing Irish, especially in younger generations. These concerns are reflected in news articles (Gleeson 2015, Healy 2015) and academia alike (Ó Béarra 2008). With the prevalence of English as the language of higher education, economic opportunity, and major urban centers in the country, it is not surprising that many are concerned about the role of English in these traditional communities. Given that all Irish speakers are also speakers of English, and given the complex attitudes towards the languages (McCloskey 2008), these traditional communities provide an interesting case study of language contact. In this study, I investigated whether and how Irish is changing in this context of overwhelming language contact by conducting a cross-generational study of traditional speakers. I focused specifically on the phonetic realization of the palatalization contrast, a key feature of Irish that is not present in English. While I did find some weakening of the palatalization contrast in coronal consonants, for the most part, this study shows that the palatalization contrast is not changing across generations. I also found a pattern of /u/ fronting in younger speakers that was not present in older speakers. It appears from this study that some changes are occurring across generations of Irish speakers, but essential patterns of Irish remain in tact.

1.2 The sociolinguistic context

Irish is the national and official first language of the Republic of Ireland, yet it is only spoken on a daily basis by approximately 3% of its citizens (Government of Ireland 2006). This curious fact reflects much about the nation's sociolinguistic context. Irish was once the dominant spoken language in Ireland, but years of subjugation and anti-Irish language practices under English rule drastically reduced the presence of Irish. After Ireland regained independence in 1922, the Irish language was slow to return. That century saw the initiation of a number of key pro-Irish movements and laws, becoming the beginning of the Irish language revival. This ongoing revival has largely been enthusiastically supported by the Republic's government as a primary means for providing a sense of unity and nationalism (I. Watson 2008). Irish became the language of the newly formed Republic, and over the years, it has become compulsory in schools and necessary for many civil service positions.

Despite this avid government support, the Irish language has not regained the footing it once had. Today, the majority of the nation speaks English in their day-to-day lives despite years of Irish language education. Irish is certainly a minority language and highly endangered. Irish speakers do still thrive, however, in certain areas of the country. These areas are known as Gaeltachts (Gaeltachtaí), or traditional Irish speaking areas. These Gaeltachts are concentrated in three major areas: the north, west, and south. Each region has its own major dialect (Ulster, Connacht, and Munster, respectively) with minor dialect variations within the region. These regions are shown below in Figure 1. The major dialects differ substantially, particularly in pronunciation. This study is concerned only with the Connacht dialect on the western coast. Specifically, this study looks at speakers of Connemara Irish, a subdialect which is primarily spoken in the Gaeltacht west of Galway.

Figure 1: map of the primary Gaeltachtaí/Irish speaking areas in Ireland (Bennett et al. 2014)

It's worth noting that the Gaeltachts are not the only arena for spoken Irish. In many urban centers in Ireland, families are increasingly speaking the language at home and sending their children to Irish-medium schools. There are thriving non-Gaeltacht Irish language communities around the country. I have chosen not to focus on the more urban Irish speaking areas due to their relative volatility; dialects are not firmly established in the urban speaking areas, but they are well established and well studied in the Gaeltacht. Urban dialects are certainly interesting and brimming with areas for research, but their youth and variability make a controlled cross-generational study quite difficult.

These Gaeltachts, as mentioned previously, are primarily Irish-speaking. Families in these areas communicate in Irish, children attend Irish-medium schools, religious gatherings are held in Irish, and commerce is often conducted in Irish. These areas were once almost exclusively Irish-speaking, but in the past few decades, English has made its way into the Gaeltacht. Tourism, economic development, and technology are just some of the supposed means of English

infiltration. In the modern Gaeltacht, speakers of Irish are fully bilingual in both Irish and English. In this scenario of close language contact between Irish and English, many researchers have wondered how the languages might be affecting each other. Work by Stenson (1993) and Ó Curnáin (2007), among others, has addressed this question. Stenson found an extension over time in the semantic territories of borrowing from English to Irish as well as increasing code-mixing or code-switching among younger speakers. Ó Curnáin observed, in his in-depth study of the Irish of Iorras Aithneach (in the Connacht dialect region), the borrowing of certain word orders into Irish. These findings are typical of most linguistic discussions of the interaction between Irish and English; the primary areas for interaction are in borrowings, code-switching, and syntactic structures. There has been no instrumental linguistic work on the interaction between these two languages in terms of sound systems, though, an interesting absence given the rich phonological and phonetic differences between the two languages. It is not uncommon to hear older speakers gripe about the language of the younger generation, especially in how they sound. Many complain of deviations from traditional forms and English influences (especially in the production of /r/), but few studies have investigated these claims. It is my hope that this study will be at least a step in the direction of answering the question of how these languages interact in phonological and phonetic terms.

It is impossible to avoid the topic of language attitudes in any discussion of the linguistic situation in Ireland. This study in particular must pay particular heed to this subject given the divisiveness of debates over the presence of English in the Gaeltacht and of Irish in the rest of the nation. Attitudes towards the Irish language in Ireland range from highly negative, believing the country ought to "bury the stinking corpse" of the language (Murchaidh 2008), to passionately enthusiastic, supporting the promotion of the language with the widest scope possible. The Gaeltacht is a particularly relevant region in this debate as its identity hinges on the internal presence and success of Irish. This necessity is countered by the rising importance of English in economic and social concerns. The Gaeltacht has been termed an "entity in crisis" by Ó Giollagáin and Mac Donnacha (2008), who express concerns that language shift will only continue to the detriment of the Gaeltacht if a social use is not provided for Irish. This view stems from the belief that Irish is seen by many younger speakers as a formal or institutional requirement. Aside from interactions with family, the language is primarily used in academic or institutional settings. Recent expansions of Irish language media could certainly be helping to minimize this issue, but it's unclear to what extent.

Tensions, of course, are not limited to the Gaeltacht. Across Ireland, language is a source of spirited (and often vitriolic) debate. Many believe that with the relatively small proportion of Irish speakers and the reasonably high value of English in a modern, Western society, Irish must be falling out of favor with the younger set. However, recent research has found that this shift in attitudes may not be true. In a study of attitudes towards compulsory Irish education, 52% of respondents between the ages of 18-24 believed that Irish ought to be compulsory in schools, while only 30% of participants aged 35-54 and 25% of respondents aged 55-64 shared this opinion (Murchaidh 2008). This percentage is both much higher than that of older speakers and indicative of a high valuation of the Irish language by the younger generation. In this situation of language conflict, studies must aim to also gauge the view of the language by the participants and to involve those views in the analysis.

1.3 The Irish language

Irish is a Celtic language, closely related to Scottish Gaelic and more distantly to languages like Breton and Welsh. The historical relationship between English and Irish is quite distant; both are descended from proto-Indo-European, but that is as close as they come. With this distant relationship comes a large array of differences between the two languages. These differences lie in all aspects of the languages; their syntactic structures, morphological compositions, and phonological systems differ dramatically. Irish has VSO word order where English has SVO, a complex grammatical case system where English has minimal expression of case, and phonological contrasts which are not present in English (Ó Baoill 2009).

1.3.1 The palatalization contrast in Irish

One of the most prominent phonological differences between Irish and English is the contrast in palatalization in the Irish consonant system. In this contrast, all consonants have both a palatalized (slender) and velarized (broad) form. Palatalization is defined as a superimposed palatal or /j/ like gesture wherein the tongue raises and moves forward. Velarization, on the other hand, involves the raising and backing of the tongue (Bennett et al. 2014). English, despite using palatalization and velarization in the phonetic realization of certain phonemes, does not use these secondary articulations contrastively. The Irish consonant inventory (shown below in Figure 2) is thus nearly double that of the English inventory.

Figure 2: Connemara Irish phonemic consonant inventory[1]

	Labial	**Coronal**	**Dorsal**	**Glottal**
Stop	p pʲ	t tj	k kj	
	b bʲ	d dj	g gj	
Fricative	f fʲ	s sj	x xj	h (hj)
	v vʲ			(ɣ) (ɣj)
Nasal	m mʲ	n nj	ŋ ŋj	
Liquid		l lj		
		r r		

These pairs of consonants are crucially contrastive in Irish. This palatalization contrast distinguishes between words and marks certain grammatical forms, as shown below in (3) and (4).

(3) *Minimal Pairs*

i. bí [bʲiː] vs. buí [bʸiː]
'to be' 'yellow'

(4) *Marking of the plural*

i. cat [kat] → cait [katʲ]
'cat.SG' 'cat.PL'

[1] According to Ní Chiosáin and Padgett (2012). This inventory differs notably from Ní Chasaide's 1995 description of Gaobh Dobhair in terms of the dorsal and glottal consonants.

1.4 Goals of the study

This study, as a part of a larger project to uncover phonetic and phonological change in Connemara Irish with respect to the influence of English, examines the realization of the palatalization contrast, a prominent feature of Irish that is not present in English. By conducting a cross-generational study of Irish speakers, I hope to gain some insights on what changes, if any, are occurring within this system of contrast.

2 Methods

To evaluate language change over time, this study adopts the apparent time hypothesis (Labov 1972), using age as a placeholder for time. I recorded mother-daughter pairs of speakers as they produced a set series of phrases designed to specifically target the realization of palatalization in certain positions, places of articulation, and vowel contexts.

2.1 Participants

There were 8 participants for this study, all native speakers of Connemara Irish residing in a Gaeltacht north of Galway. These participants were equally split across age groups; there were four older speakers, the mothers, and four younger speakers, the daughters. I chose to use parent/child pairs of the same gender to eliminate as much variability as possible; within a family, there is greater consistency in residential and language background than there would have been in a random grouping of younger and older volunteers. The mothers were between the ages of 45-56 while the daughters were between the ages of 18-20. I recruited speakers and carried out the data gathering with the help of Máire Ní Chiosáin, a professor at University College Dublin. I sought to find bilingual native speakers of Connemara Irish who both lived in the area for the majority of their lives and spoke Irish on a daily basis at home. I hoped for the entire family to fit this profile, though scarcity of volunteers forced us to be somewhat flexible with these prerequisites. All participants volunteered to participate knowing they would receive €25 as compensation for their time. I advised in advance that this would be a one-hour linguistic study of Irish including recordings and a survey.

Notable exceptions to the generalizations listed above include one aunt/niece pair and some variation in family and residential background. For the aunt/niece pair, the mother of the younger woman was not an Irish speaker. The aunt and niece lived rather close and reported spending much of their time together, though. In terms of family background, not all participants had parents that were both native Irish speakers from Connemara. Only one (the niece mentioned previously) had a parent who was not an Irish speaker. For two mother/daughter pairs, the husband/father was raised in a different dialect region. In one of those pairs, the family lived outside of the Gaeltacht for a good number of years. However, these speakers all reported full fluency in the local dialect and daily use of Irish.

2.2 Materials

The materials for this study were designed to address a number of hypotheses, though only two will be addressed in the current paper. As such, the materials given here are only a portion of those presented to participants. The hypotheses to be addressed here are given below. The first of these hypotheses addresses whether Irish is changing over time, particularly as a result of

extended contact with English. The second hypothesis builds off of previous research, especially Ní Chiosáin and Padgett (2012, 2014), which found certain places and positions to carry a stronger contrast in palatalization. If the palatalization contrast is in fact weakening over time, it would be expected to weaken most notably in places and positions where previously it had a markedly smaller contrast.

Hypotheses:

1) Younger speakers will produce a weaker palatalization contrast than older speakers
2) This difference will be especially pronounced for codas and for labials

To address these hypotheses, I sought relatively common monosyllabic Irish words of the structure (C)V(C), where either the onset or coda consonant was the target. I also controlled for place of articulation, manner, position, and vowel context. Acting on the findings of previous research that showed coronals to be more perceptually salient in the palatalization contrast than labials (Ní Chiosáin and Padgett 2014), the targets were divided into labials, coronals, and dorsals. This portion of the study only looks at voiced stops /b/, /d/, and /g/ and the voiceless fricative /s/ (realized as /ʃ/in palatalized contexts). Position (onset or coda) was also controlled for as the palatalization contrast is generally weaker in coda position than in onsets (Ní Chiosáin and Padgett 2012, 2014). There were two vowel contexts, /i/ and /u/. These were chosen because they are common high vowels in Irish that differ only in backness, with /i/ being far front and /u/ being far back. Because palatalization involves fronting the tongue and velarization involves backing, examining both environments allows for control over any possible advantage of vowel backness aligning with secondary articulation. For each combination of place of articulation, manner, position, and vowel context, I found a palatalized and velarized form (with the notable exception of palatalized coda /g/ following /i/, for which I could not find a corresponding word).

I aimed to keep secondary articulation (palatalization or velarization) of non-target consonants in a word controlled by only using velarized consonants, but in many cases this was not feasible, such as for *tríd* /tʲrʲiːdʲ/, which is palatalized in the non-target onset cluster and in the coda. Wherever possible, I avoided consonant clusters. I was unable to find a word to fit one of the categories, the palatalized dorsal stop in coda position following /i/, but all other relevant categories were filled. I focused only on the coronal fricative /s/ (realized as /ʃʲ/ when palatalized) in the fricative category for simplicity and ease of finding materials. The following Tables 1 and 2 on the following page give all materials used for this portion of the study in their orthographic and phonemic form. See the appendix for the full list of stimuli.

Table 1: *Orthographic and phonemic representations of materials with /i/.*

Place	Labial		Coronal		Dorsal	
Position	Onset	Coda	Onset	Coda	Onset	Coda
Palatalized Stop	*bí* [bʲi] 'to be'	*píb* [pʲiːbʲ] 'pipe'	*díon* [dʲiənˠ] 'protection, shelter'	*tríd* [tʲrʲiːdʲ] 'through'	*giall* [gʲiəl] 'jaw'	
Velarized Stop	*buí* [bˠiː] 'yellow'	*scríob* [ʃʲkʲrʲiːbˠ] 'scrape, scratch'	*daor* [dˠiːrˠ] 'slave'	*iad* [iədˠ] 'they'	*guí* [gˠiː] 'prayer'	*díog* [dʲiəgˠ] 'ditch'
Palatalized Fricative			*sí* [ʃʲiː] 'she'	*aois* [iːʃʲ] 'age'		
Velarized Fricative			*suí* [sˠiː] 'sitting position'	*taos* [tiˑsˠ] 'dough'		

Table 2: *Orthographic and phonemic representation of materials with /u/*

Place	Labial		Coronal		Dorsal	
Position	Onset	Coda	Onset	Coda	Onset	Coda
Palatalized Stop	*b'fhiú* [bʲuː] 'it would be worth'	*lúib* [lˠuːbʲ] 'bend, loop (genetive)'	*diúl* [dʲuːlˠ] 'suck'	*dúid* [dˠuːdʲ] 'stump'	*giús* [gʲuːsˠ] 'fir, pine'	*cúig* [kˠuːgʲ] 'five'
Velarized Stop	*bua* [bˠuə] 'victory'	*lúb* [lˠuːbˠ] 'bend, loop'	*dua* [dˠuə] 'labor'	*úd* [uːdˠ] 'yonder'	*gúna* [gˠuːnˠə] 'gown'	*grúg* [gˠrˠuːgˠ] 'anger'
Palatalized Fricative			*siúd* [ʃʲuːdˠ] 'that'	*duais* [dˠuːʃʲ] 'gift'		
Velarized Fricative			*sú* [suː] 'juice'	*túis* [tˠuːs] 'beginning'		

2.3 Procedure

This study was conducted through in-person, self-paced recordings. A slideshow was used for the presentation of materials and Praat (Boersma and Weenick 2007) was used for all phonetic analyses.

2.3.1 Recording Sessions

The recording sessions took place in the participants' homes during a weekend in February of 2015. Recordings were made using a Shure WH20XLR dynamic cardioid microphone hooked up to a Focusrite Scarlett Solo USB audio interface with a microphone preamplifier and connected to my 2011 MacBook Pro. Sessions were recorded directly into Praat in mono at a sampling rate of 44.1 kHz. I requested that the recording session occur in a quiet area of the house, usually in a kitchen or living room. I first gave participants a brief overview of the recording task and then recorded a brief test file to check the volume levels and background noise. Each participant was shown the waveform and spectrogram of this test file and given a brief explanation of how the values culled from these visuals would be used for phonetic analysis. Participants were informed that there were roughly 240 Irish slides and 100 English slides, each consisting of one phrase, and that they could take a break whenever needed. Then, participants began a self-paced slideshow, which was divided into two portions: Irish and English. Each portion had its own set of directions in the language of focus. The directions explained how to navigate through the slideshow and asked participants to read each sentence aloud as naturally as possible, without additional emphasis or pauses. Each recording took approximately 30-45 minutes, and speakers expressed no concerns aside from fatigue. Following this recording session, speakers took a short 5-minute survey (the Bilingual Language Profile, not analyzed in this paper).

Within the slideshow, each item from the materials list was presented in the carrier phrase "Ní hí Máire atá ag rá ___ ach Séan" or "It wasn't Mary that said ___, but Sean". This sentence was chosen because it surrounds the item with vowels and shifts stress away from the target to avoid hyperarticulation. The names were randomized from a list of 10 names and the blank was filled by the item from the materials. Each item from the materials appeared 5 times, randomized within separate blocks so that the same item didn't occur multiple times in sequence.

2.3.2 Collecting the data

To measure palatalization and velarization, I gathered formant values around the midpoint of the vowel and during formant transitions. I was particularly concerned with F2 as this was found to be a prominent cue for the palatalization contrast in Ní Chiosáin and Pagett (2012). I collected these measurements by running scripts through Praat. Before analysis, I downsampled the files to 22.5 kHz. To collect values at formant transitions, CF1 (consonantal formant one) and CF2 were measured at 25 ms following the onset of periodicity for initial/onset targets and 25 ms preceding the end of periodicity for final/coda targets. To gather formant values for vowel midpoints, average VF1 (vowel formant one) and VF2 were taken from a 20 ms window around the midpoint of the vowel.

3 Results

In some cases, Praat's automatic formant tracking algorithm was not accurate in predicting formants. This was especially common for a velarized consonant preceding /u/, so approximately 0.3% of data points were manually corrected. To correct erroneous formants, I generally selected overlapping regions of roughly the same duration which had better defined formant structure. After correcting the data, I conducted statistical analyses to examine the palatalization contrast within age groups, between age groups, and across both position and place.

3.1 The palatalization contrast within groups

The first comparison was in the consonantal second formant within age groups and across secondary articulation. This comparison indicates whether the palatalized and velarized consonantal second formant, CF2, differ significantly within both the older group and younger group. The mean for each age and secondary articulation pairing is given in Table 3, and box plots of CF2 by secondary articulation and age are given in Figure 3 on the following page. It does appear both in Table 3 and Figure 3 that the palatalized and velarized consonants differ substantially in CF2.

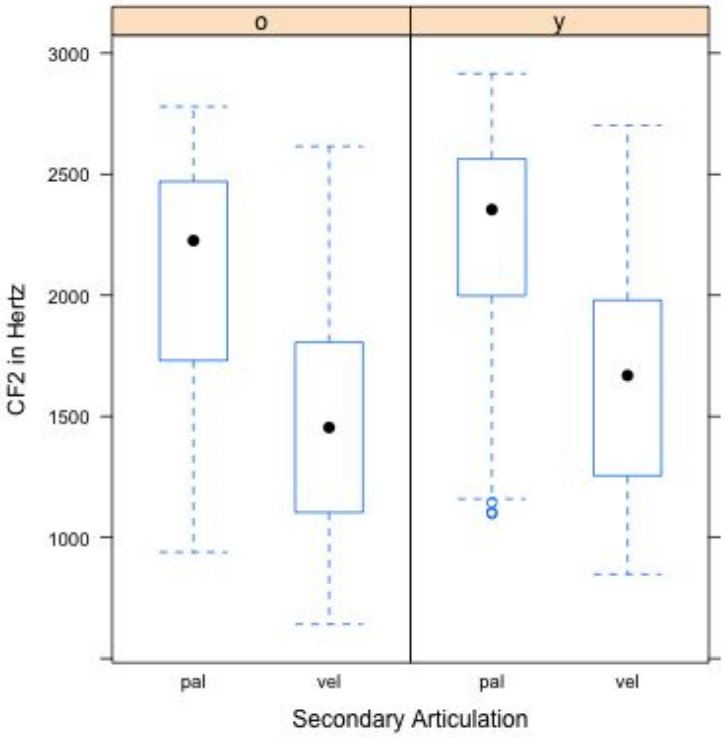
Running a two sample t-test of CF2 by secondary articulation for each age group substantiates this observation. For the younger group's productions, the p-value was nearly zero (<0.001), indicating that these two samples come from significantly different distributions. The P-value, T-value, degrees of freedom, and group means are given in Table 3. These results indicate that the palatalization contrast is maintained in younger speakers because there is a significant difference in CF2 values for palatalized and velarized consonants. The same result holds for the older speaker group.

Table 3: *means by secondary articulation (in Hertz) for each age group and the results of the one-way analysis of variance (F-value, degrees of freedom, and p-value)*

Age group	Palatalized mean	Velarized mean	t	Degrees of freedom	P-value[2]
Older	2070	1507	13.918	591.110	<0.001
Younger	2241	1679	15.700	604.300	<0.001

[2] In this paper, I will use the general groupings for P-values as follows: non-significant/n.s. (>0.05), <0.05, <0.01, and <0.001.

Figure 3: *CF2 in Hertz by secondary articulation and age. Corresponding means in Table 3.*



3.2 Comparing the contrast between groups

The next step is to compare CF2 values between age groups to determine whether there is a significant difference in the realization of the palatalization contrast. To do this, I ran a two-way ANOVA of CF2 by secondary articulation and age. The results of this two-way ANOVA are given in Table 4. Means of palatalized and velarized CF2 by group are given in Table 3 in section 3.1. The P-value of this analysis was 0.991, well over the <0.05 requirement for significance. This high P-value indicates that there is no significant interaction between age and secondary articulation in terms of CF2. This test supports the conclusion that there is no difference in the realization of the palatalization contrast across age groups, at least insofar as it affects CF2.

Table 4: *results of a two-way ANOVA of CF2 by age and secondary articulation.*

Interaction	F-value	Degrees of freedom	P-value
Age and secondary articulation	0.000	1	n.s. (>0.05)

3.3 The palatalization contrast across position

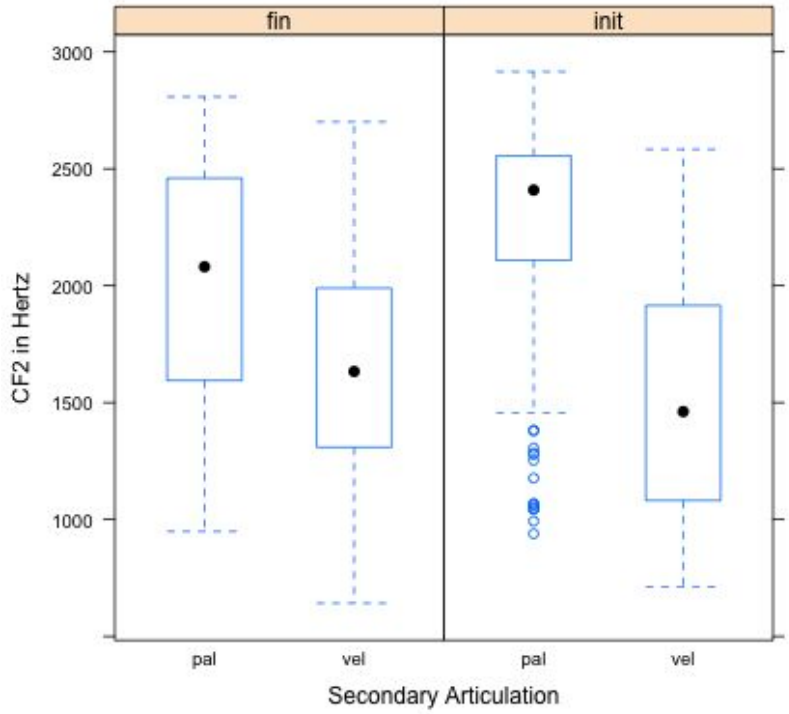
The next analysis will compare CF2 values across position (initial and final) to see if there is a difference in the realization of the palatalization contrast. I ran a two-way ANOVA of CF2 by position and secondary articulation to see whether there was a significant interaction effect between secondary articulation and position. The output of this analysis was a P-value of <0.001,

indicating that there is a significant interaction between secondary articulation and position in determining CF2. This result as well as the visual data in Figure 5 indicate that the palatalization contrast is stronger in initial position than it is in final position.

Table 5: *results of a two-way ANOVA of CF2 by secondary articulation, position, and age group*

Interaction	Age group	F-value	Degrees of freedom	P-value
Secondary articulation and position	both	75.678	1	<0.001
Secondary articulation and position	older	38.182	1	<0.001
Secondary articulation and position	younger	41.058	1	<0.001

Figure 5: *boxplots of CF2 by secondary articulation and position. Corresponding means are given in Table 6.*



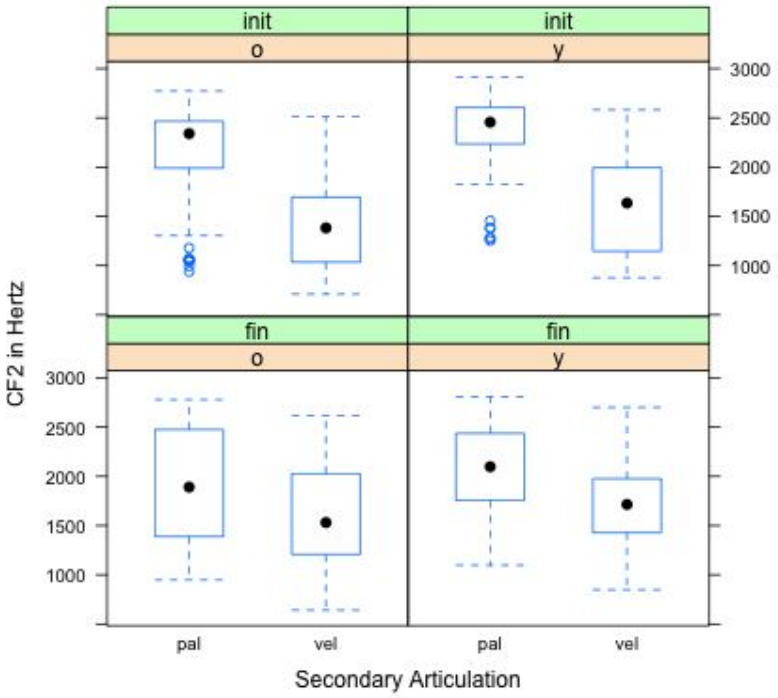
I also conducted a two-way ANOVA on CF2 by position and secondary articulation for each age group to determine whether both groups showed the same interaction. These results are also shown in Table 5. In both cases, the P-value was well below the significance threshold of <0.05, indicating that there is a significant interaction effect of position and secondary articulation on CF2. Both age groups had a stronger contrast in initial position than in final position, as shown in Figure 6. Additionally, the variability of the data appears to be narrower for initial consonants than for final. To quantify this, I calculated the standard deviation of CF2 by

secondary articulation and position. The results are given in Table 6, along with age group-specific means that correspond to Figure 6. It does appear that variability is much narrower in initial position compared to final position for palatalized consonants, but the variability is roughly equivalent for velarized consonants. It's worth noting, though, that these standard deviations are relatively large across all positions and secondary articulations. While some of this variability is certainly due to the combination of both vowels and age groups into the calculations, it does appear to be that speakers as a whole produced these consonants with a great degree of variability. The source of this variability is yet unclear.

Table 6: *mean (overall and by age) and standard deviation of CF2 by secondary articulation and position*

Position	Secondary Articulation	Mean (overall)	Standard Deviation (overall)	Mean (older group)	Mean (younger group)
Initial	Palatalized	2291.737	376.290	2194.394	2391.577
Final	Palatalized	1997.923	511.079	1919.414	2073.043
Initial	Velarized	1510.458	470.103	1404.477	1615.089
Final	Velarized	1680.205	486.239	1614.611	1742.063

Figure 6: *CF2 by secondary articulation, position, and age. Corresponding means in Table 6.*



3.4 The palatalization contrast across place of articulation

In order to determine whether the palatalization contrast is stronger in particular places of articulation, I first ran a two-way ANOVA of CF2 by secondary articulation and place of articulation. The resulting P-value for this analysis, shown in Table 7, was <0.001, allowing me to reject the null hypothesis and confirm that there is an interaction between secondary articulation and place. Because place of articulation is a factor with three levels and the box plot by place of articulation and secondary articulation (Figure 7 with corresponding means in Table 8) doesn't reveal the exact interaction, I ran a pairwise analysis using a post-hoc Tukey Honest Significant Difference (Tukey HSD) test. The results of this analysis are shown in Table 9. When this test is run over all of the data (regardless of position of the consonant), the outcome is a significant difference between all pairs with coronals showing the weakest contrast in CF2 based on secondary articulation, labials showing the most, and dorsals somewhere in the middle.

Table 7: *results of two-way ANOVA of CF2 by secondary articulation and place*

Interaction	F-value	Degrees of freedom	P-value
Secondary articulation and place	29.92	2	<0.001
Secondary articulation, place, and position	44.405	2	<0.001
Secondary articulation, place and age	6.279	2	<0.01
Secondary articulation, place, age, and position	0.723	2	n.s.

Table 8: *Mean CF2 by place of articulation and secondary articulation, corresponding to Figure 7*

Place of articulation	Secondary articulation	Mean
Labial	Palatalized	2057.238
Labial	Velarized	1268.429
Coronal	Palatalized	2200.348
Coronal	Velarized	1831.576
Dorsal	Palatalized	2162.57
Dorsal	Velarized	1434.656

Figure 7: *CF2 by secondary articulation and place of articulation*

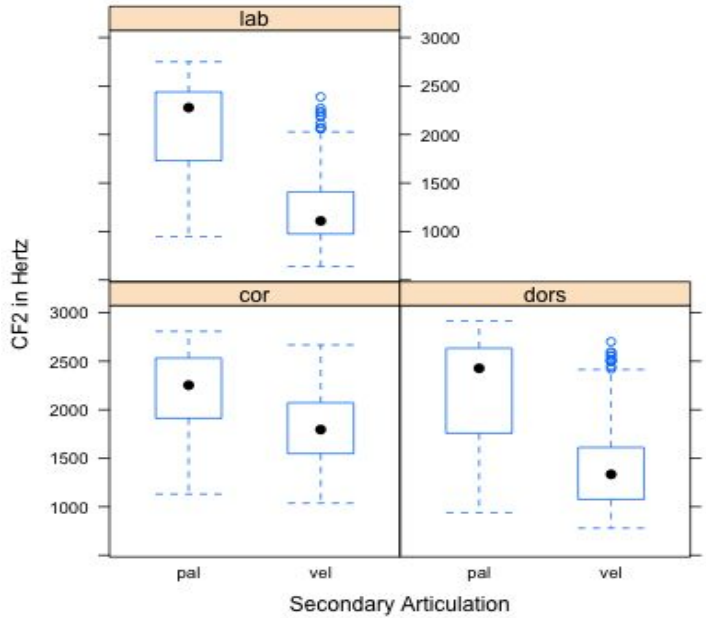


Table 9: *Pairwise Tukey HSD comparisons by place and position*

Pairing	Age group	Position	P-value
dors-cor	both	both	<0.001
lab-cor	both	both	<0.001
lab-dors	both	both	<0.01
dors-cor	both	initial	<0.001
lab-cor	both	initial	<0.001
lab-dors	both	initial	<0.05
dors-cor	both	final	<0.01
lab-cor	both	final	<0.001
lab-dors	both	final	n.s.

Table 10: *Pairwise Tukey HSD comparisons by age and place*

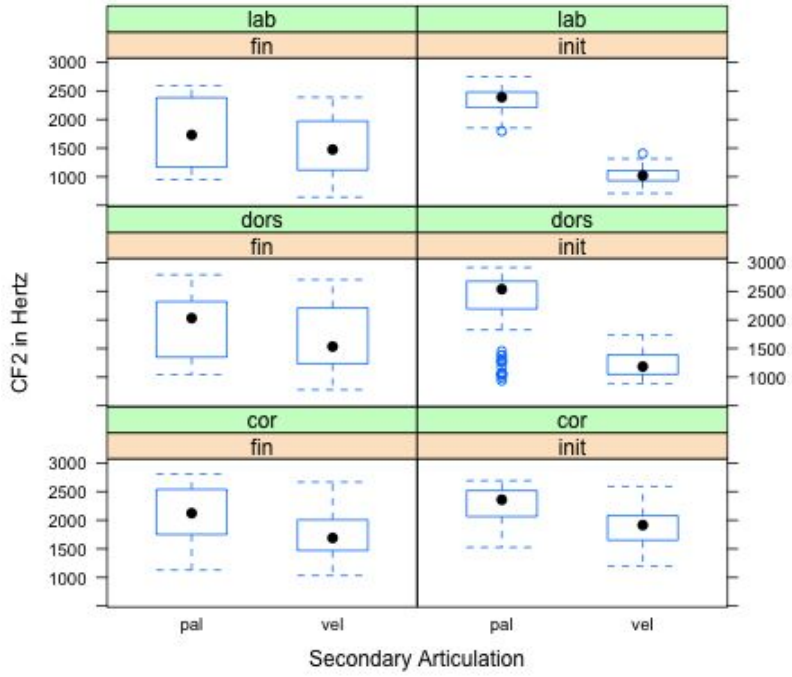
Pairing	Age group	Position	P-value
dors-cor	older	both	<0.001
lab-cor	older	both	<0.001
lab-dors	older	both	n.s.
dors-cor	younger	both	<0.001
lab-cor	younger	both	<0.001
lab-dors	younger	both	<0.001

Interestingly, breaking the data down by position, which was shown to interact with secondary articulation in the previous section (see Table 7 for ANOVA results and Table 9 for pairwise comparison), gives slightly different results. A boxplot of this breakdown is shown in Figure 8, and accompanying means and standard deviations are given in Table 13. Consonants in

initial position, which had a stronger effect of contrast in CF2 compared to final position, still showed a significant difference for all pairs. Final consonants, though, only showed a significant difference between the coronal-labial pairing and the coronal-dorsal pairing. The labial-dorsal pairing, however, had a P-value greater than 0.05, supporting the null hypothesis that these samples could derive from the same distribution. So, initial consonants appear to have a hierarchy of contrast with labial consonants showing the greatest palatalization contrast, followed by dorsal consonants, and with coronal consonants last. In final position, coronals were the least contrastive with respect to palatalization, with both labial and dorsal consonants having a stronger contrast in CF2 based on secondary articulation. This difference could be a floor effect of the reduced contrast in final position as the difference that was present in initial position decreases in a weak position. Another potential explanation is the increased variability in final position, which makes finding significant differences less likely. Both of these explanations could be true.

Checking for interactions of secondary articulation with place of articulation and age also yielded a low P-value less than 0.01, indicating an interaction between these factors. To determine what the exact interaction was, I ran post-hoc Tukey HSD tests on each pairing within age groups (Table 10), and I found that the younger group had highly significant P-values for all pairings while the older group did not. Specifically, the older group had a P-value greater than 0.05 for the labial-dorsal pairing, indicating an insignificant difference in those samples. Ultimately, this implies that younger speakers do have the hierarchy of coronal < dorsal < labial in realization of the palatalization contrast on CF2, while older speakers only have a coronal < dorsal, labial hierarchy.

Figure 8: *CF2 by secondary articulation, place of articulation, and position*



Breaking down this analysis even further by secondary articulation, place of articulation, age, and position does not yield a significant interaction, as shown in Table 7. This non-significance suggests that age groups are equally robust in the two age groups across different places of articulation and positions. However, running a Tukey HSD comparison within each age group by position and place of articulation yields somewhat interesting results (Table 11) as there is a difference in the realization of the palatalization contrast across all places and positions for the older speakers, but not for the younger speakers. This contradicts the findings of Table 10. The younger speaker group only showed a significant difference in realizations of the contrast in labial-coronal and coronal-dorsal pairings in both initial and final position. The labial-dorsal pairing was not significant in either position.

Table 11: *Pairwise Tukey HSD comparison by age, place, and position*

Pairing	Age group	Position	P-value		Pairing	Age group	Position	P-value
dors-cor	older	initial	<0.001		dors-cor	younger	initial	<0.001
lab-cor	older	initial	<0.001		lab-cor	younger	initial	<0.001
lab-dors	older	initial	<0.05		lab-dors	younger	initial	n.s.
dors-cor	older	final	<0.05		dors-cor	younger	final	<0.01
lab-cor	older	final	<0.001		lab-cor	younger	final	<0.01
lab-dors	older	final	<0.05		lab-dors	younger	final	n.s.

Comparing CF2 by age and secondary articulation within each place of articulation also yields interesting results. Table 7 shows that the interaction between age, secondary articulation, and place of articulation is significant, but in Figure 9, the only contrast that appears to differ substantially between age groups is in coronals (refer to the means in Table 12 for more detail). To test whether this is true, I ran two-way ANOVAs of CF2 by secondary articulation and age within each place of articulation. The results are shown in Table 13 on the following page. Here, coronals do indeed have the only significant P-value, revealing that the palatalization contrast as measured by CF2 is in fact weaker for coronals in the younger speaker group than in the older speaker group.

Figure 9: *CF2 by secondary articulation, place of articulation, and age group*

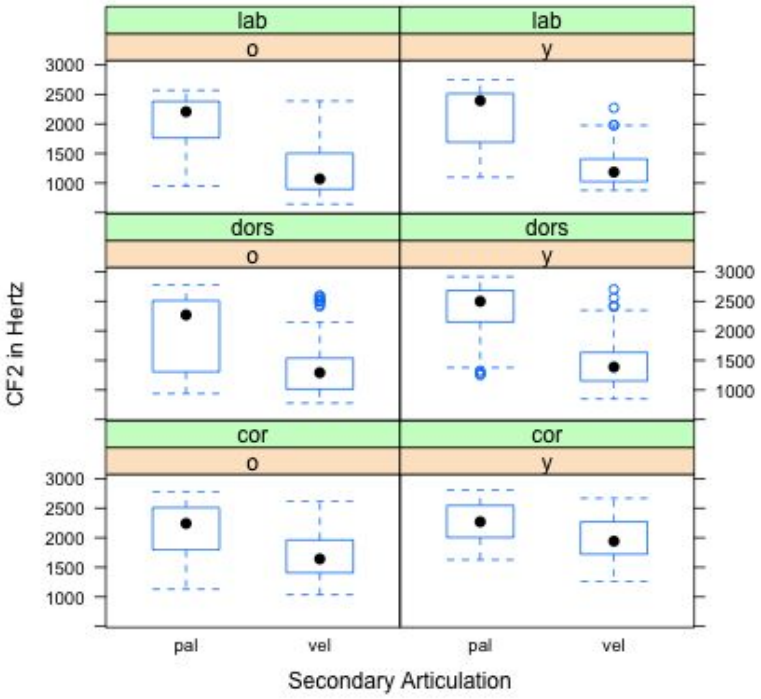


Table 12: *Mean CF2 by age, place, and secondary articulation:*

Place of articulation	Secondary articulation	Mean (Older group)	Mean (Younger group)
Labial	Palatalized	1981.800	2131.684
Labial	Velarized	1246.57	1289.203
Coronal	Palatalized	2142.137	2257.137
Coronal	Velarized	1690.191	1972.962
Dorsal	Palatalized	1993.258	2340.492
Dorsal	Velarized	1380.833	1483.709

Table 13: *results of two-way ANOVAs of CF2 by secondary articulation and age within each place of articulation*

Place of Articulation	F-value	Degrees of freedom	P-value
Coronal	8.333	1	<0.01
Labial	1.002	1	n.s.
Dorsal	3.713	1	n.s.

Looking at the variability of CF2 values for each secondary articulation, position, and place of articulation combination also yields interesting results. In the previous section, I showed that the variability of data was larger in final position for palatalized consonants, but not for velarized consonants (Table 6). Looking at the variation in CF2 from a more detailed perspective in Figure 8, it appears that the variability is much narrower for initial labials and dorsals (both palatalized and velarized). Coronal CF2 values appear to be roughly equally variable regardless of position. In Table 14, standard deviations for each grouping show support for this reading of Figure 8. In general, the final consonants have a much larger standard deviation than the initial consonants. This difference is especially pronounced in labials, where the standard deviation of final labials is nearly double that of initial consonants. This holds for velarized dorsals as well (interestingly, not for palatalized dorsals). For coronals, the standard deviation in final position is only about one and a half times as much as for initial position. Again, it's notable that the standard deviation is fairly high, even though it has been broken down into more distinct categories than before. I am not sure what the source of this large degree of variability is aside from potential inconsistency in production of palatalized and velarized consonants.

Table 14: *Standard deviation and mean of CF2 by secondary articulation, position, and place of articulation*

Position	Place of articulation	Secondary articulation	Mean	Standard deviation
Initial	Labial	Palatalized	2331.587	224.919
Initial	Labial	Velarized	1028.304	147.652
Initial	Coronal	Palatalized	2276.713	283.593
Initial	Coronal	Velarized	1888.389	322.943
Initial	Dorsal	Palatalized	2284.519	590.673
Initial	Dorsal	Velarized	1230.921	231.846
Final	Labial	Palatalized	1786.500	586.121
Final	Labial	Velarized	1521.36	449.000
Final	Coronal	Palatalized	2122.026	430.361
Final	Coronal	Velarized	1774.764	437.580
Final	Dorsal	Palatalized	1915.625	512.458
Final	Dorsal	Velarized	1641.107	571.242

3.5 Comparing vowel productions

One coincidental finding of this project was a difference in the production of /u/ between speaker groups. This difference is shown in Table 15 and Figure 10, where younger speakers appear to have a higher VF2 for /u/. A two-way ANOVA of VF2 by age and vowel (Table 15)

shows that the P-value is significant for the interaction between age and vowel. Post-hoc comparisons within vowels using Tukey HSD tests revealed that the difference in VF2 by age group was significant only for /u/. These pairwise results are shown in Table 16.

This difference is apparent even in the CF2 data (that is, in the formant transitions between consonant and vowel). For productions in the context of /u/, CF2 is roughly 300 Hertz higher for younger speakers than for older speakers. This difference is visible in Figure 11. To test whether this difference is significant, I ran post-hoc comparisons using Tukey HSD tests of CF2 by age within each vowel context. Again, a significant difference was found only in the context of /u/, while /i/ was found to be non-significantly different between age groups. In this portion of the analysis, VF1 was not collected as it is not affected by palatalization (the main focus of this paper). However, in the future, VF1 ought to be collected and compared between speaker groups.

Table 15: *results of 2-way ANOVAs of VF2, CF2 by age and vowel*

Interaction	F-Value	Degrees of Freedom	P-value
VF2 by age and vowel	301.7	1	<0.001
CF2 by age and vowel	19.32	1	<0.001

Figure 10: *VF2 by age group and vowel. Corresponding means in Table 16.*

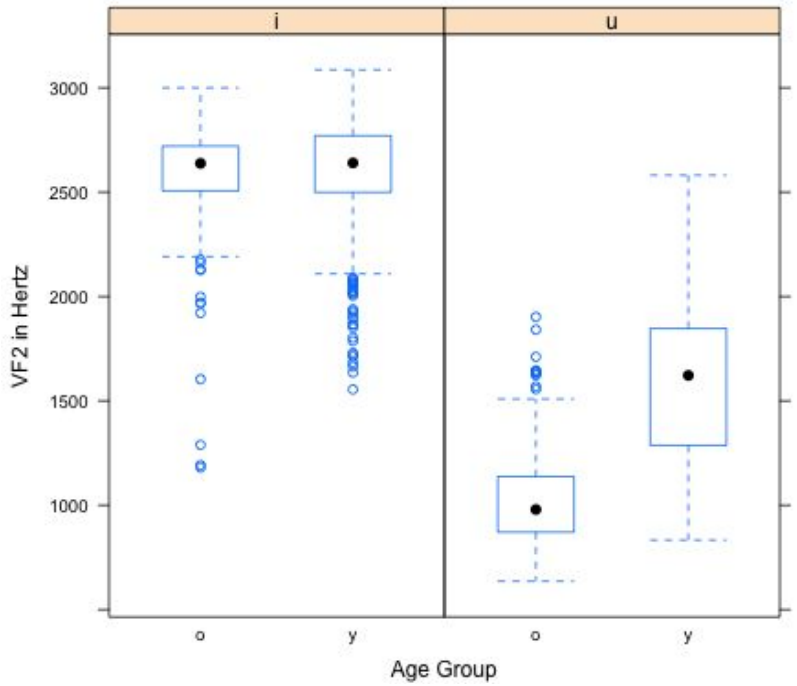
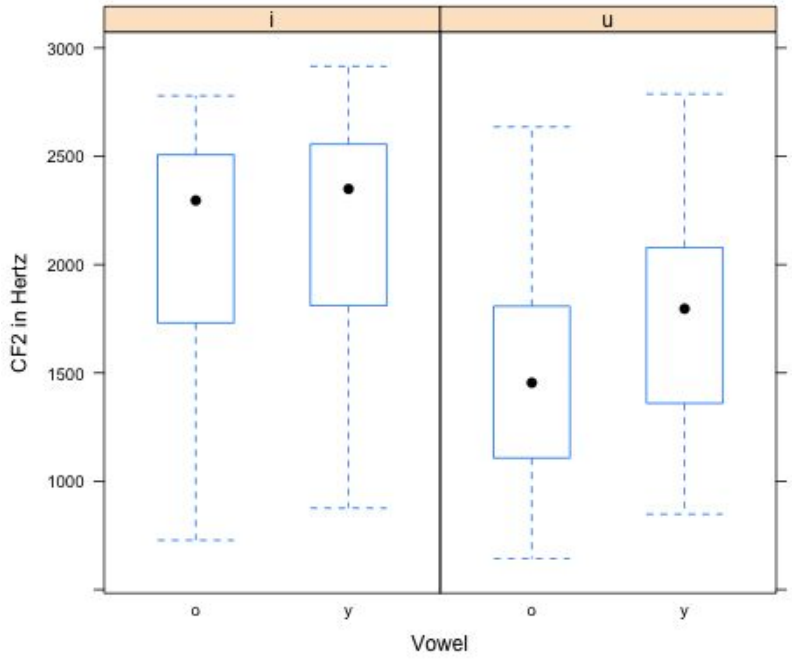


Table 16: *Means by age group and vowel; output of one-way ANOVA of CF2 by age within each vowel context.*

VF2/CF2	Vowel	Mean (older)	Mean (younger)	P-value
VF2	/u/	1027	1597	<0.001
VF2	/i/	2586	2585	n.s.
CF2	/u/	1487	1763	<0.001
CF2	/i/	2112	2144	n.s.

Figure 11: *CF2 by age group and vowel. Corresponding means in Table 16.*



4 Discussion

This study supports the conclusion that the palatalization contrast is generally maintained within each age group, differing only in certain contexts between generations (specifically those discussed in section 4.3). The findings of this study echo those of previous studies, as well, particularly in comparisons of the palatalization contrast across position. Place of articulation results were more complex, potentially contradicting previous studies in finding coronal consonants to be the weakest for this contrast and labial consonants the strongest. Finally, the younger group had a significant pattern of fronting of /u/. Overall, there is little clear evidence of reduction in the palatalization contrast, and the only potential evidence of English influence is in fronting of /u/.

4.1 The palatalization contrast over time

My examination of CF2 in response to secondary articulation both within and across age groups suggests that the palatalization contrast is equally strong in younger and older speakers. These results indicate that the palatalization contrast is not diminishing over time as a result of extended contact with English (except perhaps in select environments, to be discussed in the following sections). It is important to note, though, that I have only used one measurement of secondary articulation, CF2 or transitional formants, to reach this conclusion, and a more assured conclusion requires investigation of other cues to palatalization such as release duration, intensity, and center of gravity (Ní Chiosáin and Padgett 2012). Another important consideration is the very limited number of speakers used in this study. More reliable results would require a larger pool of participants.

4.2 The palatalization contrast across position

This study found that the palatalization contrast in terms of CF2 was stronger in initial position than in final position both overall and within age groups. This finding aligns with previous studies (Ní Chiosáin and Padgett 2012, 2014). Initial consonants showed a stronger contrast in palatalization across place of articulation. For final consonants, the contrast was not significant across place of articulation and there tended to be more variability in CF2. My hypothesis that weakening of the palatalization contrast would be particularly prevalent in final position was not supported by this study. There is no significant evidence of difference between older and younger speakers in relation to the palatalization contrast across position, and as such, no evidence for language change in this respect.

4.3 The palatalization contrast across place of articulation

Analysis of the palatalization contrast across place of articulation proved to be the most complex. It's clear for both age groups that place of articulation affects the degree of contrast in palatalization. For both groups, coronals bear the weakest contrast in CF2 based on secondary articulation. This is an interesting finding given the results of Ní Chiosáin and Padgett (2014), where coronals were the most perceptually distinct in terms of the palatalization contrast. This could potentially be due to the pattern of affrication of palatalized coronals in Irish. If the palatalization contrast in coronals is in fact shifting to a contrast of stop-affricate rather than palatalized stop-velarized stop, then the CF2 measurements taken in this study are not very indicative of the degree of contrast. Interestingly, the findings of this study do line up with an earlier study (Ní Chiosáin and Padgett 2012), where coronals were found to be less perceptually distinct than labials. Further analysis of the palatalized coronals in my findings is needed to determine whether the contrast has simply been shifted to affrication-stop or if it is indeed the weakest contrast. A perceptual study would also be enlightening in this matter as it could verify whether this contrast is actually weak perceptually. Regardless, these findings do not support my hypothesis that weakening of the palatalization contrast would be most prevalent in labial consonants.

It appears that there is some difference between age groups in the realization of the palatalization contrast for certain places of articulation. While overall results indicated that labial consonants bore the strongest contrast, followed by dorsals, then coronals, examination of each

age group yielded different results. Younger speakers were found to have no distinction in the degree of realization of the palatalization contrast between labials and dorsals. In older speakers, the labial>dorsal>coronal hierarchy was supported. It does appear from these findings that Irish might be shifting in terms of the degree of palatalization on certain places of articulation, but the fact remains that the contrast is maintained across place in both age groups.

Another interesting dimension of the place of articulation analysis was in relation to position. I found that in initial position, the labial>dorsal>coronal hierarchy held, while in final position, coronals were found to be weakest with no ranking between labial and dorsal consonants. It's possible that the difference between contrasts in labials and dorsals is slight enough that when it's placed in a weak position (such as a coda), it becomes insignificant.

4.4 Vowel shift

One unexpected finding of this study was higher overall VF2 and CF2 values for and in the environment of /u/ by the younger speakers. Higher F2 values in vowels indicate fronting, so it appears that younger speakers of Irish are fronting /u/. While there was no significant difference between the VF2 values for /i/ between younger and older speaker groups, the difference between age groups for /u/ was significant. It's unclear from this study whether this shift towards a fronter /u/ could be a result of contact with English. In order to determine whether the fronting is an effect of contact with English, VF2 measurements would need to be taken from the same participants speaking English and from nearby monolingual English speakers. If the monolingual English speakers and the bilingual speakers both have high VF2 for /u/, then it would appear that fronting of /u/ in younger Irish speakers is a result of contact with English. If monolingual speakers of English were found to also have the fronted /u/, it would be highly unlikely that the fronting moved from Irish to English. Recordings have already been made of these same participants in English, but no recordings have been obtained of monolingual English speakers in the area as a part of this project. Prior work, though, notably Hickey (2002), found fronting of /u/ in northern dialects of Hiberno English, but does not mention the fronting in the western region. It also possible that glottalization or uptalk could be influencing these results, particularly if younger speakers tend to engage in these patterns more.

5 Conclusion

I conducted a cross-generational study of Irish speakers from the Connacht dialect in hopes of finding whether the phonetics or even phonology of Irish is changing over time, especially from the influence of extended contact with English. By collecting CF2 and VF2 in the environment of consonants that were controlled for position, place of articulation, vowel context, age of speaker, and secondary articulation, I hoped to determine whether the palatalization contrast differed across age groups (i.e. whether the contrast is changing over time). I found that overall, it does not seem that the contrast is reducing or increasing over time, except perhaps in coronals. Positional weakness of this contrast in final position was found across speaker groups, but the contrast was not weaker for younger speakers than older speakers as hypothesized. Somewhat contrary to previous findings and certainly contrary to my hypothesis that labials would show weakening between generations, both dorsal and labial consonants were found to be strongest in this contrast, while coronal consonants were the weakest. This finding aligns with some previous

work (Ní Chiosáin and Padgett 2012) and contradicts others (Ní Chiosáin and Padgett 2014). The realization of the palatalization contrast was weaker in coronals for younger speakers compared to older speakers, potentially revealing a shift to a stop-affricate rather than velarized-palatalized contrast. Overall, this study contrasts with previous findings of English influence such as in Ó Curnáin (2007) and Stenson (1993) as well as with complaints of change like those in Ó Beárra (2008). This study suggests that Irish, at least in terms of the phonetic realization of the palatalization contrast, has not in fact undergone change over time except in relatively minor ways. The only substantial changes over time that I've found are the fronting of /u/ and reduction in the palatalization contrast in coronals, but it is yet unclear whether these changes are the results of English influence.

This study is part of an ongoing project to examine potential sound changes in Irish especially due to the influence of extended English contact. The next steps in this project include quantification of potential affrication of palatalized coronals, analysis of the production of /r/ across speaker groups and between Irish and English, and comparison of the aspiration contrast across generations and between Irish and English. These investigations will give a broader perspective on whether Irish is changing over time, particularly from English influence.

Appendix
Full list of materials:

1. *Irish materials with /i/:*

Place	Labial		Coronal		Dorsal	
Position	Onset	Coda	Onset	Coda	Onset	Coda
Palatalized Stop	*bí* [bʲi]	*píb* [pʲi:b]ʲ	*díon* [dʲiənˠ]	*tríd* [tʲrʲi:dʲ]	*giall* [gʲiəl]	-
Velarized Stop	*buí* [bˠi:]	*scríob* [ʃʲkʲrʲi:bˠ]	*daor* [dˠi:rˠ]	*iad* [iədˠ]	*guí* [gˠi:]	*díog* [dʲiəgˠ]
Palatalized Fricative			*sí* [ʃʲi:]	*aois* [i:ʃʲ]		
Velarized Fricative			*suí* [sˠi:]	*taos* [tiːsˠ]		
Palatalized Retroflex			*trí* [tʲrʲi:]	*aoir* [i:rʲ]		
Velarized Retroflex			*rí* [ri:]	*daor* [dˠi:rˠ]		
Palatalized Lateral			*lí* [lʲi:]	*saoil* [sˠi:lʲ]		
Velarized Lateral			*lao* [lˠi:]	*saol* [sˠi:lˠ]		

2. *Irish materials with /u/:*

Place	Labial		Coronal		Dorsal	
Position	Onset	Coda	Onset	Coda	Onset	Coda
Palatalized Stop	*b'fhiú* [bʲuː]	*lúib* [lʸuːbʲ]	*diúl* [dʲuːlʸ]	*dúid* [dʸuːdʲ]	*giús* [gʲuːsʸ]	*cúig* [kʸuːgʲ]
Velarized Stop	*bua* [bʸuə]	*lúb* [lʸuːbʸ]	*dua* [dʸuə]	*úd* [uːdʸ]	*gúna* [gʸuːnʸə]	*grúg* [gʸrʸuːgʸ]
Palatalized Fricative			*siúd* [ʃʲuːdʸ]	*duais* [dʸuːʃʲ]		
Velarized Fricative			*sú* [suː]	*tús* [tʸuːs]		
Palatalized Retroflex			*triús* [trʲuːsʸ]	*uair* [uːrʲ]		
Velarized Retroflex			*rua* [rʸuə]	*túr* [tʸuːrʸ]		
Palatalized Lateral			*liú* [lʲuː]	*dúil* [dʸuːlʲ]		
Velarized Lateral			*luath* [lʸuə]	*úll* [uːlʸ]		

3. *English Materials*

	Coronal - [i]		Coronal - [u]	
	Onset	Coda	Onset	Coda
Stop P				
Stop V				
Fricative P	*she* [ʃi:]	*leash* [li:ʃ]	*shooed* [ʃu:d]	*douche* [du:ʃ]
Fricative V	*see* [si:]	*lease* [li:s]	*soup* [su:p]	*deuce* [du:s]
Retroflex P				
Retroflex V	*read* [ri:d]	*dear* [di:r]	*roo* [ru:]	*tour* [tu:r]
Lateral P				
Lateral V	*lee* [li:]	*keel* [ki:l]	*loo* [lu:]	*cool* [ku:l]

4. *VOT targeting materials (both Irish and English)*

	English Voiced	English Voiceless	Irish Voiced	Irish Voiceless
Labial	*pall* [pɑ:lʸ]	*ball* [bɑ:lʸ]	*pá* [pʸɑ:]	*bá* [bʸɑ:]
Coronal	*tall* [tɑ:lʸ]	*dawn* [dɑ:n]	*tá* [tʸɑ:]	*dá* [dʸɑ:]
Dorsal	call [kɑ:lʸ]	*gall* [gɑ:lʸ]	*cá* [kʸɑ:]	*gá* [gʸɑ:]

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