ASSIMILATION OF IRISH VELARISED & PALATALISED STOPS

Ailbhe Ní Chasaide and Liam Fitzpatrick
Centre for Language and Communication Studies, Trinity College, Dublin, Ireland

ABSTRACT

Assimilatory patterns for [t̪ˠ tʲ c k] in Irish were examined for one speaker in $VC_1\#C_2V$, using EPG and limited EMA data. All assimilations were anticipatory. Palatalised and palatal stops were much more prone to assimilation than velarised and velar stops. To this extent, coronals do not all assimilate more readily than dorsals. Many effects may be explained in terms of mechanical and dynamic lingual constraints. Segments involving contiguous articulators assimilate more readily, and follow a different assimilation route than the non-contiguous. Fewer assimilations occur when the tongue gesture required for the cluster follows the "preferred" anti-clockwise trajectory.

INTRODUCTION

The four way opposition of lingual stops in Irish involves differences in secondary articulation (palatalisation and velarisation) as well as differences in the primary place of articulation. As such, they offer a rich testing ground for theories of assimilation. As part of a broader study, we report here on the assimilations that occur when these stops form clusters across a word boundary.

METHODS

The assimilation patterns for every combination of the four lingual stops of Irish /t t' k' k/ = [t̪ˠ tʲ c k] across a word boundary were examined for one female speaker of Connemara Irish in '$VC_1\#'C_2V$ utterances where V = /a/. This yielded four homorganic clusters as well as twelve non-homorganic clusters. Each stop was also elicited in #CV and VC# contexts. Five randomised repetitions of all utterances were recorded using the Reading EPG system and audio. The EMA illustrations below are drawn from a separate recording which included EMA, EPG and audio (same materials, same speaker, 10 repetitions). The four lingual EMA coils were positioned: (1) at 0.5 cm behind the tip; (2), (3) and (4) respectively at about EPG row 5, row 7 and 0.3 cm behind the EPG palate (during a swallow).

As all assimilations were anticipatory, the description of the unassimilated stops below is based on the VC# context. However, to decide on the extent to which a given non-homorganic cluster (for example, /t#k'/) had assimilated, the temporally more comparable homoranic clusters (/t#t/ and /k'#k'/) were used as a basis for comparison. We focused on the dynamic patterning in the interval from 40 ms before closure of C_1 to 25 ms after. A "unique" contact template was calculated for each EPG frame over this interval, describing that part of the contact pattern which was found in any repetition of /t#t/, but never in any repetition of /k'#k'/. Similarly, we established on a frame-by-frame basis the "unique" pattern for /k'#k'/ never present in /t#t/. This interval for the non-homorganic /t#k'/ was then compared to the "unique" templates. The degree of assimilation corresponded to the extent to which it approached the "unique" contact pattern of C_2 and differed from that of C_1. This process was carried out for every combination of C_1 and C_2.

RESULTS

The unassimilated stops

Figure 1 presents EPG contact patterns for the unassimilated stops in VC# as well as the approximate tongue contours, at the timepoints of consonant closure and maximum EPG contact. The tongue contour outlines show where midsagittal contact occurs, as well as approximate tongue height in the regions corresponding to the EPG rows 5-8.

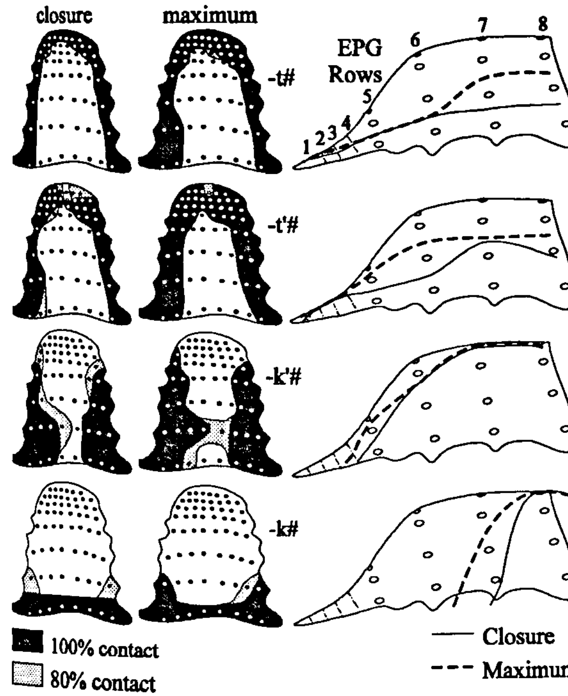

Figure 1. Averaged EPG contact patterns and approximate tongue contours for stops in VC#.

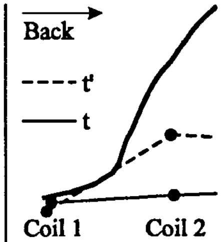

Figure 2. Average positions of EMA coils (1) and (2) for /t/ and /t'/ at closure.

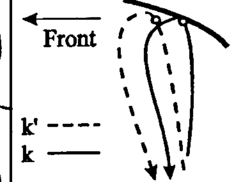

Figure 3. Trajectory of EMA coil (4) for /k'/ and /k/. The small circle marks the coil position at the time of closure.

For coronal stops /t/ and /t'/, despite considerable overlap in the area of contact at the maximum time point, the dynamics at onset and offset suggest two rather different articulations. The initial and final point of contact for /t/ is in the dental region (row 1). For /t'/ the contact pattern at closure and release suggests a more posterior, laminar articulation with lowered tongue-tip (see discussion of similar patterns in [1]). The different relative positions of tip and blade for the two stops at closure can be visualised in Figure 2.

As concerns secondary articulation, the greater fronting of the tongue body for /t'/ is evident from the tongue contours of Figure 1.

For the dorsal stops, /k/ and /k'/, one cannot easily differentiate primary and secondary aspects of the articulation. The main stricture for /k'/ is formed with a raised tongue front and a more anterior point of contact than for /k/. There was some variability in the precise location of the occlusion for /k'/, and this gives the impression in Figure 1 of incomplete closure in row 7 of the EPG palate. For /k/, much of the contact is likely to be behind the artificial palate.

Assimilating Environments

On the whole, these data did not reveal large numbers of assimilations. Under what we term assimilation (we deal mainly here with the primary aspects of the articulation), we observed rather different kinds of phenomena. Results in Table 1, are presented in terms of different types of assimilation and some of these are illustrated in Figure 4, which shows four repetitions of the -t'#k- cluster. For each repetition, EPG contact on the two rows best representing the primary articulatory gestures for /t'/ and /k/ are plotted over the interval of both stops. This was always row 8 for /k/, and varied as between rows 2 and 3 for /t'/. Closure and release of both stops are shown.

None: no/little evidence of assimilation (repetition 1 in Figure 4)

Len: a partial assimilation where an appropriate gesture for the first consonant of the cluster is retained, but the stricture never becomes a stop. **Len1** = fricative-like strictures held for a relatively long interval (e.g. repetition 2, Figure 4); **Len2** = such strictures when of very short duration and/or of a lesser degree of narrowing (e.g. repetition 3, Figure 4).

Blend: partial assimilations where the first part of the (potential) cluster has features of C_1 and C_2, but doesn't necessarily include all the features of either.

Full: no/little EPG evidence of C_1 features (repetition 4 in Figure 4).

In terms of resistance to assimilation (based on the numbers in the None column), we get the following hierarchy: k > t > k' > t'. The palatalised stops emerge as the "weakest". Note that a rather analoguous phenomenon has been discussed for Russian, where palatalisation is tending to disappear in segments which precede velarised consonants in word-internal clusters [2].

For each of the stops, the likelihood of assimilation appears to be greatest when it abuts a stop whose primary articulation involves a contiguous, mechanically linked part of the tongue (e.g. tip and blade). Thus, abutting coronals or abutting dorsals are more prone to assimilation than clusters which involve a combination of coronal and dorsal.

When C_1 and C_2 involve contiguous articulators, the assimilation route seems to involve a blending of the C_1 and C_2 gestures in the first part of the cluster. When the consonants involve non-contiguous articulators, the route assimilations takes would seem to involve a gradual lenition (reduction in the amplitude of the gesture) of C_1. Generally, the C_1 gesture in the more assimilated cases has a shorter duration and tends to overlap more with the C_2 gesture. These findings are broadly compatible with predictions of articulatory phonology [3].

Table 1. Number and type of assimilations found for all clusters.

	None	Len1	Len2	Blend	Full
-t#t'-	2			3	
-t#k'-	5				
-t#k-	5				
-t'#t-		1		1	3
-t'#k'-	2		3		
-t'#k-	1	1	2		1
-k'#t-	4	1			
-k'#t'-	3	2			
-k'#k-	1			2	2
-k#t-	5				
-k#t'-	5				
-k#k'-	5				

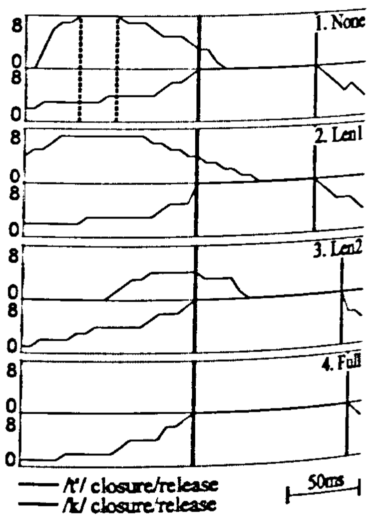

Figure 4. For 4 repetitions of -t'#k- are shown EPG activation (0-8 electrodes) in those rows representing the region of C_1 and C_2 primary articulation, aligned to C_2 closure.

It is also worth noting that the two coronal stops are extremely different in terms of their propensity to assimilation. Whereas /t'/ bears out the frequently observed high propensity to assimilation, /t/ emerges as very resistant, assimilating much less than the palatal /k'/.

It is striking that when either coronals or dorsals abut, the order of occurrence appears to matter greatly. Note that no assimilations were found for -k#k'-, whereas for -k'#k- there were 4 assimilations (in the 5 repetitions).

This asymmetrical behaviour that results from the juxtaposition of two dorsals might possibly be explained in terms of tongue dynamics. As can be seen in Figure 3, the preferred tongue body gesture appears to follow an anti-clockwise elliptical gesture (see discussion of this in [4]).

We suggest that this basic gesture may need little modification to produce -k#k'-: it might simply be a matter of allowing the tongue forward movement to be more extensive. However, the articulation of -k'#k- may require movement that runs counter to the preferred tongue body gesture. One should note that even in the (potentially) assimilating environments of -k'#k- we found no examples of a clockwise gesture.

This may explain why palatalised stops generally assimilate more readily before velarised stops than vice-versa. It would also explain the clearly similar phenomena discussed for Russian by Barry [2].

Finally, this same principle may also explain the somewhat greater propensity to assimilation in /t'#k'/ than in /k'#t'/.

CONCLUSIONS

The different propensities to assimilation of the consonants may well have their origin in mechanical and dynamic properties of the tongue. The tendency to assimilation is heightened where C_1 employs a contiguous articulator to that of C_2. When assimilated, C_1 here "blends" features of C_1 and C_2. Where C_1 and C_2 involve non-contiguous articulators, C_1 assimilated through a gradual weakening of the gesture.

Palatalised consonants are much more prone to assimilation than are the velarised. It is hypothesised that this asymmetry arises because tongue-body gestures in an anti-clockwise direction are preferred to clockwise gestures. So, for example, a sequence of velar + palatal may represent an easy target, less likely to assimilate, than the sequence palatal + velar.

ACKNOWLEDGEMENTS

This work was supported by Esprit-BRA, Working Group, ACCOR II.

REFERENCES

[1] Pandelli, H. (1993), "The articulation of lingual consonants", *Unpublished Ph.D. thesis*. Cambridge University

[2] Barry, M. (1992), "Palatalisation, assimilation and gestural weakening in connected speech", *Speech Communication*, 11, pp. 393-400

[3] Browman, C. and Goldstein, L. (1989), "Articulatory gestures as phonological units", *Phonology*, 6, pp. 201-231.

[4] Mooshammer, C., Hoole, P., and Künhert, B. (1995), "On loops", *Journal of Phonetics*, 23, in press.