BOUNDARY DISPUTES AND SOCIOPHONETIC VARIATION: SCHWA-EPENTHESIS IN DUTCH *r*C CLUSTERS

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ABSTRACT

Dutch schwa-epenthesis in liquid+consonant clusters has been the subject of a "boundary dispute", as to its phonetic or phonological status. There has been surprisingly little instrumental work on the phenomenon that could function as an arbiter in this dispute. This paper attempts to remedy this situation by bringing results from a corpus of sociophonetic variation data to bear on the issue, focussing on the duration of the epenthesised schwa and variability of /r/ in *r*C clusters.

The results show that both phonetic and phonological factors may be at play, and that there are intricate patterns of dialectal variation, highlighting the relevance of sociophonetic data on phonetics-phonology interface issues.

Keywords: phonetics-phonology interface, schwa, epenthesis, variation.

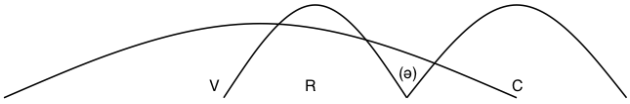
1. INTRODUCTION

In traditional phonological descriptions of Dutch, many dialects (including Standard Dutch) are said to have a process of schwa-insertion in C_1C_2 clusters, where C_1 is a liquid (/l,r/) and C_2 is either a nasal or a non-coronal obstruent (/m,n,p,b,k,f,v,x,ɣ/) [19, 20, 3]. The process applies to tautosyllabic (coda) clusters, and, under some additional restrictions, heterosyllabic (coda-onset) ones. The process is formalised in these descriptions as a phonological (i.e. categorical and discrete) rule that inserts a full "segment" [ə], creating an additional syllable. Examples are in (1).

(1)	*film*	/fɪlm/	[fɪ.ləm]	'film'
	harp	/hɑrp/	[hɑ.rəp]	'harp'
	verf	/vɛrf/	[vɛ.rəf]	'paint'
	verven	/vɛr.və/	[vɛ.rə.və]	'to paint'

The phonological nature of the process has been disputed by Hall [6, 7], who analyses it in an Articulatory Phonology (AP) framework as vowel *intrusion* instead, i.e. as a percept arising from gestural coordination. Specifically, the intrusive vowel is the result of the overlap of a vocalic gesture (that of the vowel before the CC cluster returning to a neutral position) and the two consonantal gestures involved in the cluster. Figure 2 (from [6]) provides a schematic representation of this.

Figure 1: Gestural score of vowel intrusion [6:43]. The tail end of the vocalic gesture that starts on the far left (V) intrudes between the gestures for the liquid (R) and the following consonant (C).



Hall's main claim in suggesting this phonetic, rather than phonological, view of the process is that the intrusive vowel does not create a new syllable. This is supported by multiple strands of evidence, such as speaker intuitions (when speakers are asked to segmentally "reverse" vowel-intrusive tokens such as *tulp* [tʏləp] 'tulip', they turn it into [plʏt], rather than [pəlʏt] [5]), the fact that total word duration is kept constant whether speakers produce the relevant items with or without schwa [5], and phonological patterning (intrusive schwa does not undergo post-schwa [n]-deletion, as opposed to lexical schwa: *toorn* [to.rən] 'rage' vs. *toren* [to.rə] 'tower').

Dutch schwa-epenthesis thus constitutes a case of "boundary dispute" [13], with a single process analysed as either fundamentally phonetic or phonological. As both accounts make a number of largely contradictory predictions, the dispute may be resolved by examining detailed data, preferably from a number of speakers. Neither the phonological accounts nor Hall do so, however; the former are unclear about their sources, while Hall relies on a single informant, from whom no data (from production or otherwise) are presented. This paper examines the claims made by both using a small sociophonetic corpus of Standard Dutch. The focus will be on the durational properties of the inserted schwa, and the relationship of schwa-epenthesis to the phonetic properties of the liquid (only /r/ in this case, for reasons detailed under 2. below). Previous studies that have considered variability in schwa-epenthesis have focused on the rate of application, rather than the phonetics of the process [11, 5, 8]. These have provided evidence against the claim (from [20]), that there is no intra-speaker variation

(i.e., that speakers either always apply schwa-insertion, or that they never do): they found rates of applications to vary within speaker correlated with the second consonant of the cluster and the rhythmic structure of the utterance context. The only previous study into the duration of epenthetic schwa found regional and social (gender) differences, but did not compare the duration of epenthetic schwa to that of canonical (lexical) schwa or other vowels [9].

A specific claim that follows from the phonological view is that inserted schwa, forming a part of the phonological plan, should not be very different phonetically from any other schwa in the language, whereas if schwa is intrusive and does not form the nucleus of a syllable, it would presumably be shorter and of a more gradient and variable nature than a canonical schwa. Secondly, while both Booij [3] and Hall [6] mention in passing that Dutch /r/ displays considerable variability, neither consider this to be of influence on the process. In fact, recent studies have shown Dutch /r/ to exhibit a very large amount of inter- and intra-speaker variation, reporting up to 20 variants in Standard Dutch alone [21, 18, 17]. While a formal phonological rule would not be predicted to be influenced by the realisation of /r/, under a gestural account the exact articulatory properties of the liquid are likely to be relevant. The focus here will be on the major variation in place of articulation (alveolar vs. uvular), which for most Dutch speakers is categorical [17].

2. DATA BACKGROUND AND METHOD

2.1. Corpus and choice of items

The data for this study come from the HEMA corpus, containing speech data from over 400 speakers of urban-accented Standard Dutch from 10 cities in the Netherlands and Flanders (for details see [17]). The focus will be on *r*C clusters, as the corpus used in this study was originally collected for the purpose of studying Dutch *r*-variation, and contains no relevant items with /l/. It contains four *r*C items that have potential schwa-epenthesis: *harp* /hɑrp/ 'harp', *kerk* /kɛrk/ 'church', *berg* /bɛrɣ/ 'mountain', *arm* /ɑrm/ 'arm'. These were read as part of a longer word list. This also included two items with canonical schwa, *beraad* /bə.rad/ 'counsel', where the schwa is part of a historical prefix with non-transparent meaning, and *sturen* /sty.rə/ 'steering wheels', in which the schwa corresponds to the plural morpheme. These two items were included to be able to compare the duration of epenthetic to that of canonical schwa. Finally, two items on the word list with full short vowels, *rok* /rɔk/ 'skirt' and *kruk* /krʏk/ 'stool', were included to be able to compare the durations of epenthetic and canonical schwa to other short vowels. The total number of items examined per speaker is therefore 8.

2.2. Speakers

Since the rate of application of schwa-epenthesis differs strongly among individual speakers and urban accents in the corpus, a subcorpus was created including data from 85 speakers, selected on the basis of a number of criteria. First, speakers were included only if they realised a majority of their *r*C items *with* schwa. All speakers came from one of four cities: 25 from Bruges (Flanders) and 26 from Nijmegen (Netherlands), the most homogeneous cities in terms of /r/ realisations, with almost exclusively alveolar /r/ variants in Bruges (including for all tokens from our speakers), and exclusively uvular /r/ variants found in Nijmegen. To be able to separate broad dialectal from /r/-realisational variation, speakers from Rotterdam and Utrecht (both NL), where /r/ is more variable, were also included: 11 of the 17 Rotterdam speakers have alveolar /r/ in all relevant items, while 6 have exclusively uvular /r/; the situation in Utrecht is the reverse. These and other speaker details are in Table 1.

Table 1: Speakers in the schwa-insertion corpus.

			female		*male*	
			young	*older*	*young*	*older*
Bruges	alv *r*	25	5	9	7	4
	uv *r*		-	-	-	-
Nijmegen	alv *r*		-	-	-	-
	uv *r*	26	7	8	5	6
Rotterdam	alv *r*	11	3	3	1	4
	uv *r*	6	1	3	1	1
Utrecht	alv *r*	6	0	1	2	3
	uv *r*	11	4	5	1	1

2.3. Procedure

All data in the larger corpus were coded independently by two native speaker transcribers based on auditory and spectrographic analysis, after which they established a consensus transcription, with the primary aim of establishing the /r/ variant used by the speaker. The transcription includes the information of whether an epenthetic schwa was present in the 340 (85x4) relevant epenthetic schwa tokens, which was the case for all but 11 tokens. These 329 *r*C tokens were supplemented with 167 tokens of items containing canonical schwa, and 163 tokens of items containing full short vowels /ʏ/ or /ɔ/ (the potential numbers were 170 in both cases (85x2), but 3 and 7 tokens of these, respectively, were discarded during the original analysis of the

larger corpus, or missing from the data collection procedure). The corpus for the present study therefore consists of 659 tokens.

Duration measurements were performed on epenthetic and canonical schwa and the full short vowels in the relevant tokens; segmentation was performed manually by the author based on visual inspection of waveform and spectrogram.

3. RESULTS

The results of the duration measurements are in Table 2. These show the means ($\bar{x}$) and standard deviations (*s*) for the three types of vowel. The Rotterdam and Utrecht data are pooled, as there are no significant differences between these cities for any of the vowel types (see the statistical model below).

Table 2: Duration of epenthetic schwa, canonical schwa, and short vowels in selected urban accents of Dutch (ms). *n*=659. No. of speakers: 85.

	Bruges (n=190)		*Nijmegen (n=203)*		*Rott/Utr (n=266)*	
Vowel type	$\bar{x}$	*s*	$\bar{x}$	*s*	$\bar{x}$	*s*
epenthetic ə	38	13	84	31	78	25
canonical ə	83	16	91	27	96	26
full short V	97	22	120	33	110	23

In line with what is generally reported about schwa (in Dutch and other languages), it is shorter than other short vowels [10]. In addition, epenthetic schwa is shorter than canonical schwa across the board. By far the most striking result, however, is the difference between canonical schwa and epenthetic schwa in Bruges, and how different the Bruges speakers are from those of the other accents in this respect. Epenthetic schwa in Bruges has less than half the mean duration of canonical schwa. In Nijmegen, on the other hand, epenthetic schwa is not much shorter than canonical schwa. Finally, the results from Rotterdam and Utrecht resemble those from Nijmegen more than they do Bruges, but the difference in duration between the two types of schwa is larger.

In order to interpret these results, a linear mixed-effects model was fitted to the data, with vowel duration as the response variable. The analysis was performed using the lme4 package [2], in R version 3.0.2 [14]. Speaker and item were included as random effects, while the fixed effects included were urban accent (city), vowel type, and sex and age of the speaker. In addition, significant interactions between these main effects were tested for using the log-lik test [1]. Only significant interactions were retained in the final model. Based on this procedure, the model that provided the best fit of the data included an interaction between city and vowel type, and sex and age as main effects. An overview of the results is in Table 3. Significant differences were tested for; *p*-values were obtained using Satterthwaite's approximation [12].

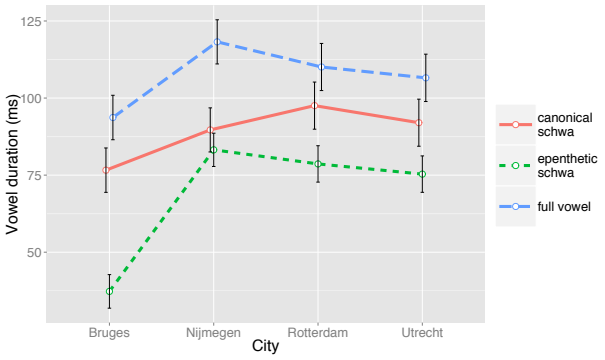
Table 3: Summary of a linear mixed-effects regression predicting vowel duration in schwa-epenthesis and control contexts in four urban accents of Dutch. The intercept corresponds to a canonical schwa for an older female speaker from Bruges. Number of obs = 659.

Random effects	*Variance*	*StdDev*	*N*	
speaker	183.32	13.54	85	
item	74.58	8.64	8	
Residual	341.23	18.47		
Fixed effects	*Estimate*	*StdError*	*t*	*p*
(intercept)	83.890	7.50	11.19	<.001
city: Nijmegen	13.055	5.31	2.46	.015
city: Rotterdam	20.933	5.96	3.52	.001
city: Utrecht	15.396	5.95	2.59	.010
v: epenthetic	-39.326	8.17	-4.82	.003
v: full	17.079	9.43	1.81	.117
age: young	0.637	3.32	0.19	.849
sex: male	-15.211	3.32	-4.58	<.001
city:Nijm*v:ep	32.865	4.56	4.56	<.001
city:Rot*v:ep	20.416	5.09	5.09	<.001
city:Utr*v:ep	22.648	5.11	4.43	<.001
city:Nijm*v:full	11.482	5.29	2.17	.030
city:Rot*v:full	-4.549	5.87	-0.77	.439
city:Utr*v:full	-2.530	5.93	-0.43	.670

The model shows that for the Bruges speakers, full vowels and canonical schwa are not significantly different, but epenthetic schwa is. Relevelling the model so that the intercept corresponds to the other urban accents shows that for the Nijmegen speakers, epenthetic schwa is not significantly different from canonical schwa (*p*=.456), whereas full vowels are (*p*=.022). For the Rotterdam and Utrecht speakers (between whom there are no significant differences for any of the vowel types), epenthetic schwa is also not different from canonical schwa, though its *p*-value borders on significance (*p*=.059), but it is significantly different from full vowels (*p*=.007), while canonical schwa is not (*p*=.238).

The picture that emerges from the data is illustrated by Figure 1, which plots the interaction between city (or urban accent) and vowel type. In Bruges, epenthetic schwa is much shorter than canonical schwa, which patterns with full short vowels. In Nijmegen, epenthetic schwa is non-distinct from canonical schwa. Rotterdam and Utrecht pattern more like Nijmegen, although there is a tendency towards a three-way split with overlapping edges.

Figure 1: Plot showing the interaction between city accent and vowel type.



4. DISCUSSION

What these data suggest for the status of epenthetic schwa as either phonetic or phonological is that it may well differ between accents of Dutch. While the "half-segment" in Bruges may be an artefact of gestural coordination, the identification of epenthetic with canonical schwa in Nijmegen suggests that there it is more likely to be an actual phonological element. However, a number of issues arising from this interpretation need to be dealt with.

Firstly, there is the question if the difference between Bruges and Nijmegen cannot be wholly reduced to the difference in /r/ variants in these cities (alveolar and uvular, respectively). Perhaps the longer epenthetic schwa in Nijmegen is only the result of dorsal gestures being inherently slower than coronal ones. However, the Rotterdam and Utrecht results show that this is not the case. These two cities have both alveolar and uvular /r/ speakers, in differing proportions, and they show no significant differences. In fact, tot test for the effect of place of articulation of /r/, a separate linear mixed-effects model was fitted to the data from these two cities only. Comparison between models with and without /r/ place as a fixed effect showed no significant improvement in model fit (loglik test, $\chi^2(1)=0.223$, $p=.637$), suggesting that place of articulation is not the deciding factor.

The results from Rotterdam and Utrecht provide some food for thought by themselves, however. While they seem to mostly pattern with Nijmegen, suggesting that schwa-epenthesis in these other two Dutch cities is also of the "phonological" type, the phonetics of the three categories of vowels are clearly different, with canonical schwa being neither different from epenthetic schwa nor full short vowels. In other words, bringing schwa (epenthetic or otherwise) into the domain of phonetics or phonology does not in itself explain the differences between accents, and apparently the duration of schwa is one of the myriad ways in which accents of Dutch can differ. (A related point may be that speaker sex is a predictor of schwa duration (see Table 3), with shorter (canonical and epenthetic) schwas found with male speakers, although this may be due to differences in speech rate between men and women in the corpus.)

A final issue is that of /r/ allophony. While the duration results suggest that the "phonetic" analysis of vowel intrusion is warranted for the Bruges data (but not the other cities), Hall's [6] claim that the intrusive element does not constitute a syllable nucleus suggests that /r/ in *r*C clusters is in a coda, and that the /r/ variants used in this context should pattern with word-final /r/ and unequivocal coda clusters, i.e. those of /r/ + a coronal obstruent. In fact, across the larger corpus from which the subcorpus was selected, there is a strong correspondence between the /r/ variants used in the schwa-epenthesis *r*C context and intervocalic onsets, but not canonical codas, in all the accents examined [17]. In Bruges, voiced alveolar taps form the large majority in both intervocalic onsets (78%) and the schwa-epenthesis context (82%). Voiced alveolar taps are considerably less frequent in codas (26%), and the typical coda variants (voiceless trills, taps and fricatives) that make up 55% of coda variants are entirely absent from the schwa-epenthesis context. In terms of /r/ allophony, at least, even the very short epenthetic schwas in Bruges behave like syllable nuclei in conditioning onset variants of /r/. (A similar result has been reported for the clear/dark /l/ allophony in *l*C clusters in Dutch [22]).

5. CONCLUSION

It is hard to interpret the results from this study in a framework where a phenomenon has to be either phonetic or phonological. While the /r/ allophony results discussed above suggest that even the Bruges data need a phonological treatment, this would need to be supplemented by an account of how the phonology is able to distinguish between canonical and inserted schwas (and why it does so). What detailed sociophonetic data make clear in cases of "boundary disputes" is that it is exactly these cases that operate in what is traditionally thought of as the interface between phonetics and phonology, which should perhaps be conceptualised as an area of *overlap* [15, 16, 4], without sacrificing the idea that there are two distinct domains. Certain phenomena display characteristics of both domains, and recognising and attempting to separate out these features would appear more fruitful than arguing that all of them should fit into either one.

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