SYSTEM I NORMA W PERSPEKTYWIE LINGWISTYCZNEJ POD RED. PIOTRA ZBRÓGA

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ARTICULATION OF AFFRICATES IN HOMORGANIC CLUSTERS IN ENGLISH

Key words: affricates, consonant gemination, acoustic analysis

It is argued that affricates in English never lose their release stage. This assumption requires testing since it has not yet been investigated empirically and there are other languages which are less permissive in the reduction of occlusive articulations, but allow unreleased articulation of affricates. In order to accomplish this task, a representative number of recordings involving the clusters /tʃ/ + /tʃ/, /dʒ/ + /dʒ/, /tʃ/ + /dʒ/ and /dʒ/ + /tʃ/ were downloaded from the "Phonetic Corpus of Audiobooks" and analysed acoustically. The results indicate that in some articulations the release of the first affricate may be realized less distinctly, but no cases of gemination were found. Consequently, the claims put forward in the relevant literate are confirmed.

1. Aims

English allows unreleased plosives in numerous contexts (Gimson & Cruttenden 2001). They are possible before a homorganic stop (e.g. *that time*), before a heterorganic stop (e.g. *football*) and word-finally (e.g. *a cat*). On the other hand, such a phonetic reduction is claimed to be impossible for affricates (Carley, Mees & Collins, 2018; Gimson & Cruttenden 2001; González & Roura

2016), but this assumption has not yet been evaluated empirically. There are reasons why such claims should be investigated using language data rather than accepting them only on the basis of a given author's intuition. Firstly, some publications put forward proposals using the prescriptive approach, which frequently disregards the actual language reality. Secondly, even in the descriptive tradition, deductive reasoning has been shown to be erroneous when confronted with real-life data (e.g. see the discussion on the articulation of the Polish rhotic in Stolarski 2013a, Stolarski 2013b and Stolarski 2015). Additionally, in the particular case of affricates, unreleased articulations are encountered in languages which are generally less permissive in the reduction of occlusive articulations than English. For instance, in Polish it is acceptable to geminate two homorganic or near homorganic affricates (Aleksander 1977; Thurgood & Demenko 2003) (see the discussion in Section 2).

In light of the above argumentation, the major aim of the present publication is to investigate the production of affricates in English in a context which could, potentially, involve unreleased articulations. Namely, a representative number of examples will be analysed in which pairs of affricates are pronounced in homorganic clusters. This investigation should provide a clear answer as to the possibility of the unreleased realization of such segments and validate or call into question claims found in the relevant literature.

2. Background

Affricates are typically defined as consonants "whose articulation involves a complete oral closure followed by a comparatively slow release with perceptible friction noise" (Trask 2006: 13). As a consequence, this articulation is frequently divided into two distinct stages. Wells (2010), for instance, describes them as complex consonants "consisting of a plosive that is immediately followed by a fricative" (15). This interpretation is, however, problematic when one considers languages which involve clear distinctions between affricates and plosive-fricative combinations. For example, in Polish the word *czy* (a particle used in interrogatives, pronounced [t͡ʃi]), is clearly distinguished from *trzy* ('three', pronounced [t̪ʃi]) (Wierzchowska 1971). Dłuska (1986) describes the history of this problem, which dates back to the works of Eduard Sievers, and mentions languages such as French and Italian in which similar contrasts may be found. Eventually, she proposes that the essence of affricate articulation is

the "sliding movement" of the tongue during the release stage which makes it different from regular plosive-fricative clusters (see also the acoustic differences mentioned below). Regardless of whether this explanation is correct or not, the additional term "affricated stop" used in Laver (1994) and Trask (2006) indicates the type of articulation under analysis more precisely than the popular, but often ambiguous, "affricate".

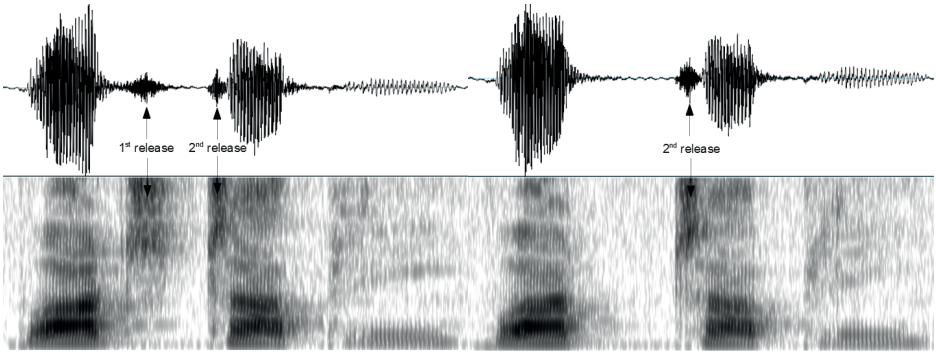
It is worth mentioning that many authors explicitly indicate that the closure and the release must be made at the same place of articulation (Ladefoged & Maddieson 1996; Reetz & Jongman 2011; Roach 2010; Wells 2010). From the cross-linguistic perspective, this is usually the palato-alveolar region (as in the two phonemes /tʃ/ and /dʒ/ in English), but affricates may also be articulated at any place where stops can be formed (Ladefoged & Maddieson 1996; Laver 1994; Maddieson 1984).

Descriptions of affricates frequently involve discussions on their phonemic status in a given language. In English, usually only /tʃ/ and /dʒ/, represented as "č" and "ǰ" in the American tradition (Becker & Bieswanger 2010; Fromkin, Rodman & Hyams 2003; Laver 1994), are ascribed to this category, although other potential candidates exist (e.g. /tr/, /dr/, /ts/, /dz/, /tθ/, /dð/). In order to substantiate this choice, Gimson & Cruttenden (2001) and Roach (2010) consider the distributional characteristics of all homorganic stop-fricative sequences and indicate that /tʃ/ is found in all possible positions, that is word-initially, word-finally and word-medially (both in "close-knit" and "disjunct" sequences), while /dʒ/ can be found in all but word-medial "disjunct" combinations. The distribution of other candidates is more restricted. Another important argument is the possibility of commutation of homorganic stop-fricative sequences with other consonants. Again, /tʃ/ and /dʒ/ may be commutated with other segments to a higher degree than the other articulations under discussion. Additionally, analysis of speech errors and native speaker's reaction also suggest the preference to treat /tʃ/ and /dʒ/ as single phonemes and the rest of the candidates as sequences of phonemes.

From the acoustic point of view, affricates involve features of both stops and fricatives (Gimson & Cruttenden 2001; Stevens 2000). However, what makes them different from other plosive-fricative sequences is the so-called "rise-time", defined as "the interval from the onset of the consonant until the maximum amplitude of the friction noise" (Reetz & Jongman 2011: 199). This rise-time is significantly shorter for affricates than for fricatives, which makes

the former articulation distinct from other sibilants (Johnson 2003; Reetz & Jongman 2011).

Gimson & Cruttenden (2001) suggest that the English /tʃ/ and /dʒ/ may be reinforced before vowels with the glottal stop, as in *teaching* pronounced as [tiːʔtʃɪŋ]. Moreover, the [t] element may be replaced by [ʔ], as in *couch* articulated as [kaʊʔʃ]. Another type of phonetic reduction happens in the clusters /ntʃ/ and /ndʒ/, in which some speakers omit the "stop element" in the word-final positions. Nevertheless, as mentioned in Section 1, it has been claimed that /tʃ/ and /dʒ/ never lose their fricative release stage (Carley et al. 2018; Gimson & Cruttenden 2001; González & Roura 2016). This is, however, possible in other languages that happen to be less permissive in the reduction of occlusive articulation. A good example is Polish, in which two homorganic or near homorganic affricates may be geminated. Graph 1 depicts a spectrogram and the corresponding oscillogram of a careful articulation of *płacz czapli* [pw̥at͡ʃ t͡ʃap̥li] ('heron's cry') by the author. Both the first and the second affricate are released. Graph 2, however, presents a more casual articulation involving gemination, in which only the release of the second [t͡ʃ] is observable.



Graph 1: "/tʃ/ + /tʃ/" with a full release of the first affricate in the words "płacz czapli" (heron's cry) articulated by the author

Graph 2: Geminated "/tʃ/ + /tʃ/" in the words "płacz czapli" (heron's cry) articulated by the author. Only the release of the second affricate is observable

3. Methods

In order to accomplish the aims outlined in Section 1, recordings of participants pronouncing an affricate in the word final position followed by an

affricate articulated in the next word had to be found and analysed. In theory, such samples could be collected directly by recording a representative number of native speakers of English reading such pairs words. Possible problems with this methodology involve potential high cost and, more importantly, the need to ensure that the participants are unaware of what is being investigated.

With the recent advances in corpus linguistics, an alternative solution is available which eliminates these obstacles. Specifically, the appropriate recordings were found in the "Phonetic Corpus of Audiobooks" (PCA). At the time of writing this paper, the corpus was still in the development stage and available for testing at "pca.clarin-pl.eu/". It involves audiobooks obtained from "librivox.org", which is a non-profit library of free audiobooks that was initiated in 2005 by Hugh McGuire. The recordings are aligned with corresponding text versions of the novels obtained from "gutenberg.org". Currently, alignment is at the sentence level. This means that after searching for a given word or phrase, whole sentences involving this word or phrase may be downloaded as mp3 files. The user needs to extract the appropriate fragments by himself/herself from such excerpts, possibly using a speech analysis software such as Praat (Boersma & Weenink 2014). Nevertheless, gathering audio materials for analysis in this way is considerably faster and significantly easier than recording a representative group of informants reading pairs of words. Furthermore, the excerpts obtained from the corpus are read by readers who are "unaware" of what is being investigated, so the articulation of affricates may be assessed objectively.

The corpus uses only those audiobooks which were read by groups of readers, rather than an individual person. This results in a sample representing different genders and dialects. In total, the corpus involves as many as 647 readers: 420 of whom are female and 226 of whom are male. The dialect distinction applied in the corpus provides only broad categories such as "Great Britain" and "North America". The former group encompasses all dialects spoken in the UK, although most of the readers are speakers of Received Pronunciation. Likewise, the latter category includes various accents found in North America, including Canadian English, but most of the readers use General American. Such a distinction is useful for the present analysis, in which the two dialects should be examined separately.

PCA involves 104 audiobooks, which constitutes over 1,104 hours of reading. Still, the size of the corpus is perhaps better expressed in terms of word

tokens, as this unit is frequently used when comparing language corpora. PCA contains 10,407,032 word tokens. It is smaller than the largest text corpora available on the Internet, such as the "British National Corpus" (about 100 million word tokens) or the "Corpus of Contemporary American English" (over 500 million word tokens), but at the time of writing this paper it is probably the largest corpus offering audio recordings in English.

In order to find pairs of words in which the first one ends in an affricate and the second one begins with an affricate, English spelling patterns were used. According to Gimson & Cruttenden (2001), /tʃ/ is spelled "ch" both in the word-initial position and word-final position. /dʒ/, on the other hand, may be written in various ways. Word-finally it is spelled "ge", but in the word-initial position there are two possibilities: either "j" or (sometimes) "g". At the current stage of development, PCA allows four distinct wildcards ("*" for "one or more characters, "?" for "one character", "=v" for "a vowel letter" and "=c" for "a consonant letter"). For the purposes of the present study, the wildcards were used in the following way:

1. to find /tʃ/ + /tʃ/ – "*ch ch*"
2. to find /dʒ/ + /dʒ/ – "*ge j*" and "*ge g=v*"
3. to find /tʃ/ + /dʒ/ – "*ch j*" and "*ch g=v*"
4. to find /dʒ/ + /tʃ/ – "*ge + ch*"

4. Results and conclusion

Table 1 and Table 2 summarize the tokens count and types count for all the appropriate combinations of affricates found in texts read by British readers and American readers, respectively. The overall number of tokens for both groups amounts to 768, but the majority of the examples (604) were read by American readers. This disproportion results from the fact that PCA is not balanced in terms of dialect categories. Over 70% of the readers are classified as American, in contrast to about 16% of the readers who are British.

According to the data presented in Tables 1 and 2, the combinations /tʃ/ + /tʃ/ and /tʃ/ + /dʒ/ are more popular than /dʒ/ + /dʒ/ and /dʒ/ + /tʃ/. Still, all the patterns are represented by a number of examples which makes it possible to draw meaningful conclusions.

An overwhelming majority of the examples found in the corpus are articulated with a clear release of the first affricate. This observation refers to all

Table 1: Number of tokens and types found for British English

phoneme combination	**/tʃ/ + /tʃ/**	**/dʒ/ + /dʒ/**	**/tʃ/ + /dʒ/**	**/dʒ/ + /tʃ/**
1st search combination	*ch ch*	*ge j*	*ch j*	*ge + ch*
tokens count	63	12	38	30
types count	49	12	26	25
2nd search combination		*ge g=v*	*ch g=v*	
tokens count		6	15	
types count		5	14	
Summary				
all tokens	63	18	53	30
all types	49	17	40	25

Table 2: Number of tokens and types found for American English

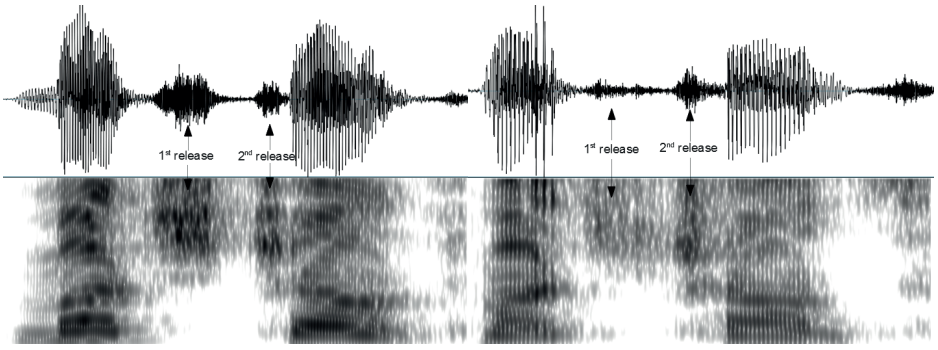
phoneme combination	**/tʃ/ + /tʃ/**	**/dʒ/ + /dʒ/**	**/tʃ/ + /dʒ/**	**/dʒ/ + /tʃ/**
1st search combination	*ch ch*	*ge j*	*ch j*	*ge + ch*
tokens count	204	32	187	77
types count	102	30	87	51
2nd search combination		*ge g=v*	*ch g=v*	
tokens count		48	56	
types count		11	32	
Summary				
all tokens	204	80	243	77
all types	102	41	119	51

the affricate combinations under analysis. An example of such an articulation is presented in Graph 3, which depicts the production of the sequence *much chance* by a female British reader. The release stage of the first /tʃ/ is marked by a distinct acoustic activity visible both in the oscillogram and spectrogram (indicated by the arrows inside the graph). As in the case of the previously mentioned Polish example (see Graph 1), the plosion of the first affricate is visibly longer than the corresponding release for the second /tʃ/.

In some examples analysed, however, a degree of reduction in the release of the first affricate was observed. This phenomenon is depicted in Graph 4, which shows a different realization of *such chance* by the same female British reader. This time, the first /tʃ/ is articulated less distinctly, and its release stage is less pronounced. This reduction could be quantified by measuring, for example, the value of sound intensity. While the average intensity for the duration of the release stage of the second affricate amounts to 59.87 dB, the same measurement performed for the first /tʃ/ yields only 48.07 dB. Such phonetic reduction is rather infrequent and happens mostly in articulations involving an increased rate of speech. In the two examples under discussion, the one in Graph 3 lasts 0.617 seconds and the one in Graph 4 0.507 seconds. Additionally, this phonetic reduction happens to different degrees and results from the general articulation economy principle.

Nevertheless, it must be stressed that not a single example was found in which the first affricate in a pair was articulated without an audible release. In all the cases, a burst of acoustic energy was also observable in spectrograms and corresponding oscillograms. The two neighbouring affricates were always produced separately, even when, in some cases, the first one happened to be reduced.

Overall, the assumptions found in the literature mentioned in Sections 1 and 2 have been confirmed both for British English and American English. Indeed, even though the range of possible effort-saving phonetic processes in English is relatively wide, unreleased affricates are not even encountered in contexts that in other languages allow for gemination. Finally, the varying degrees of reduction found in some examples do not contradict this conclusion since they exemplify phonetic undershoot resulting mostly from extralinguistic factors.



Graph 3: "/tʃ/ + /tʃ/" with a full release of the first affricate by a female British reader articulating the words "such chance"

Graph 4: "/tʃ/ + /tʃ/" with a reduced release of the first affricate by a female British reader articulating the words "such chance"

References

Aleksander Z., 1977, *Problemy wymowy polskiej w ujęciu słownika*, [in:] Słownik wymowy polskiej, (eds.) M. Karaś & M. Madejowa, Kraków.

Becker A. & Bieswanger M., 2010, *Introduction to English linguistics*, Tubingen.

Boersma P. & Weenink D., 2014, *Praat, a system for doing phonetics by computer (version 5.4.01)* [computer software], Amsterdam.

Carley P., Mees I. M. & Collins B., 2018, *English phonetics and pronunciation practice*, London & New York.

Dłuska M., 1986, *Fonetyka polska: Artykulacja głosek polskich*, Warszawa–Kraków.

Fromkin V., Rodman R. & Hyams N., 2003, *An introduction to language*, Boston.

Gimson A. C. & Cruttenden A., 2001, *Gimson's pronunciation of English*, Oxford.

González M. de los Á. G. & Roura T. S., 2016, *English pronunciation for speakers of spanish: From theory to practice*, Boston–Berlin.

Johnson K, 2003, *Acoustic and auditory phonetics*, Oxford.

Ladefoged P. & Maddieson I., 1996, *The sounds of the world's languages*, Oxford.

Laver J., 1994, *Principles of phonetics,* Cambridge–New York.

Maddieson I., 1984, *Patterns of sounds,* Cambridge.

Reetz H. & Jongman A., 2011, *Phonetics: Transcription, production, acoustics, and perception*, Chichester.

Roach P., 2010, *English Phonetics and Phonology*, Cambridge.

Stevens K. N., 2000, *Acoustic phonetics*, Cambridge–London.

Stolarski Ł., 2013a, *Articulation of the Polish /r/ in the intervocalic position*, [in:] Language, thought and education: across systems, (eds.) M. Kuczyński & L. Szymański, Zielona Góra.

Stolarski Ł., 2013b, *Tap as the basic allophone of the Polish rhotic*, "Linguistica Silesiana", 34, p. 35–56.

Stolarski Ł., 2015, *Further Analysis of the Articulation of /r/ in Polish – the Postconsonantal Position*, "SKY Journal of Linguistics", 28, p. 349–379.

Thurgood E. & Demenko G., 2003, *Phonetic realizations of Polish geminate affricates*, "Proceedings of the 15th International Congress of Phonetic Sciences", p. 1895–1898.

Trask R. L., 2006, *A dictionary of phonetics and phonology*, London & New York.

Wells J. C., 2010, *Longman pronunciation dictionary*, Harlow.

Wierzchowska B., 1971, *Wymowa polska*, Warszawa.