The Structural Models of Lithuanian Plosive Consonants in the Different Positions of a Word

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Introduction

The traditional structure of plosive consonants consists of three stages in their production, involving a period of closure in the oral cavity (and of the velopharyngeal port), a burst or transient, which is generated by the sudden emission of intraoral pressure (upon constriction release), and aspiration phase in voiceless plosive consonants, which is created by noise turbulence at the glottis ([1], [2], [3], [4], [5] and many others).

This paper presents the results of a production experiment which examines the structural models and possible modifications of the acoustic events of Lithuanian plosive consonants in intervocalic, word-initial and word-final positions.

The results of this study are intended to be used for developing a set of rules for automatic recognition systems and for the future comparison of structural nature of consonants in different environments and their phonetic realizations in coarticulatory processes or consonantal clusters.

Material and Methods

24 sentences with consonants [p], [b], [t], [d], [k] and [g] in different positions of a word:

[p] in [ke²ˈpei·], Eng. *graveyard*, [²ˈpɑːdes], Eng. *a sole*, [ʋeke¹¹roːp], Eng. *towards evening;* [t] in [²ˈrɑːtes], Eng. *a wheel*, [²ˈtɑːkes], Eng. *a path*, [pe¹¹gɑ·ʊt], Eng. *to catch;* [k] in [²ˈbɑːkes], Eng. *a tank*, [²ˈkɑːboː], Eng. *hanging*, [pe¹¹gɑ·ʊk], Eng. *catch;* [b] in [²ˈstɑːboː], Eng. *the idol's*, [²ˈbɑːdoː], Eng. *hunger's;* [d] in [be²ˈdɑːʋo], Eng. *starved*, [²ˈdɑːroː], Eng. *does*, *makes;* [g] in [re¹¹gɑ·ʊto], Eng. *tasted*, [²ˈgɑ·ʋoː], Eng. *received;*

6 speakers (3 male and 3 female) x 3 read sentences;

432 tokens examined;

The segments extracted using the **automatic tools** created at VMU;

The models defined and classified manually based on the changes in the sound waveform and spectrograms (with **PRAAT**);

Labels: CL - a silent (or quasi-silent) interval, PW – a closure with a periodic (or quasi-periodic) waveform, PL – plosion (transient), FR – frication.
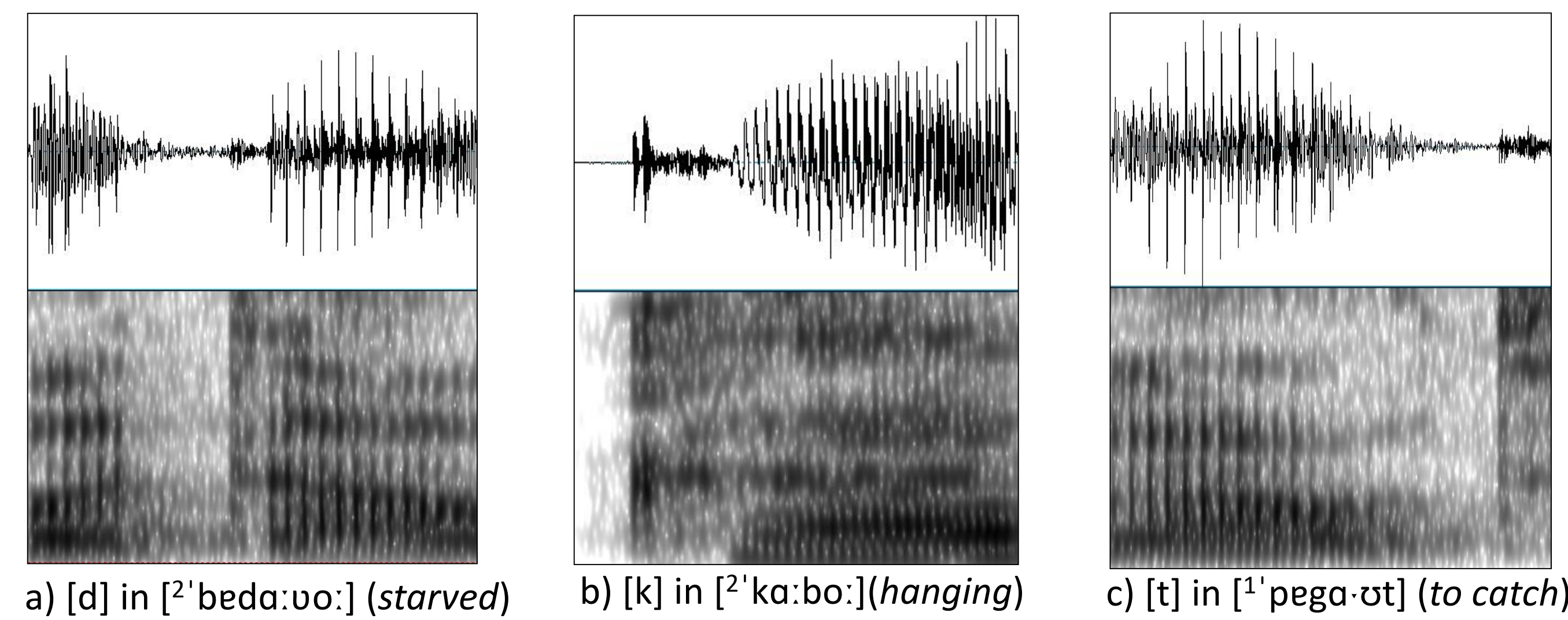
Results

a) [d] in [²ˈbedɑ·ʋoː] (*starved*)   b) [k] in [²ˈkɑ·boː](*hanging*)   c) [t] in [¹ˈpegɑ·ʊt] (*to catch*)

Figure 1. The structural model CL/PW+PL+FR in: a) VCV, b) #CV, c) VC#

a) [g] in [¹ˈregɑ·ʊtoː] (*tasted*)   b) [t] in [²ˈtɑːkes] (*a path*)   c) [p] in [ʋeker¹¹oːp] (*towards evening*)
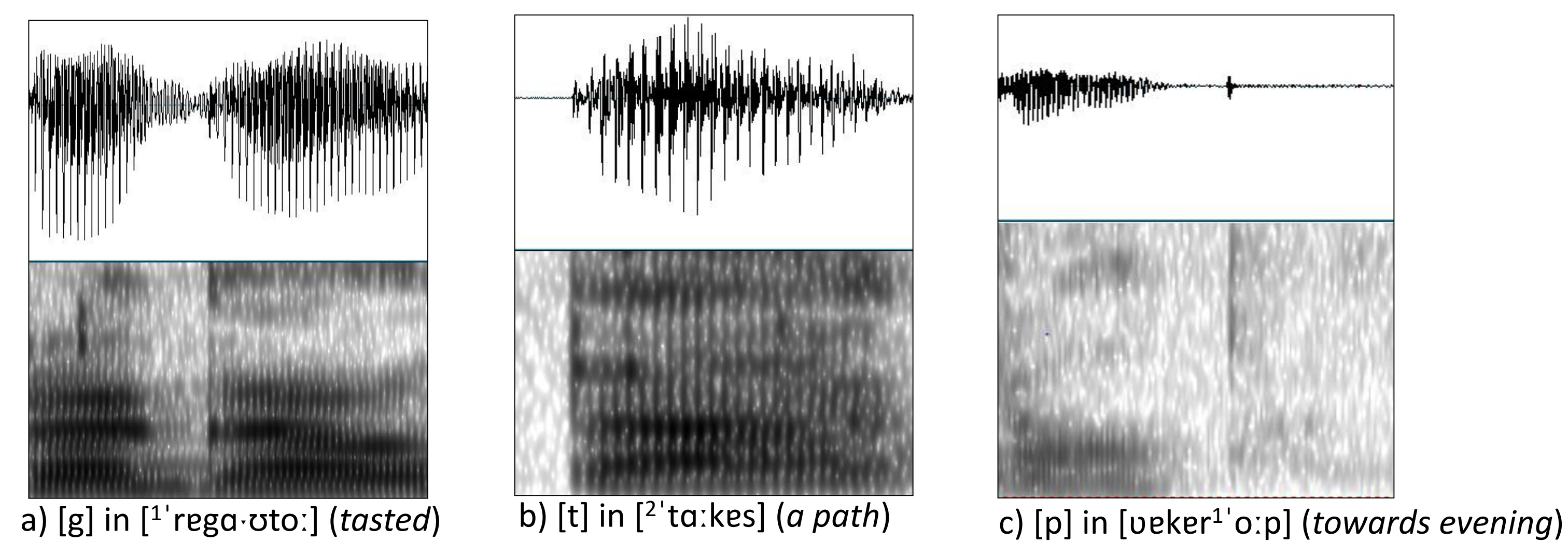
Figure 2. The structural model CL/PW+PL in: a) VCV, b) #CV, c) VC#

a) [k] in [²ˈbɑːkes] (*a tank*)   b) [k] in [²ˈkɑ·boː] (*hanging*)
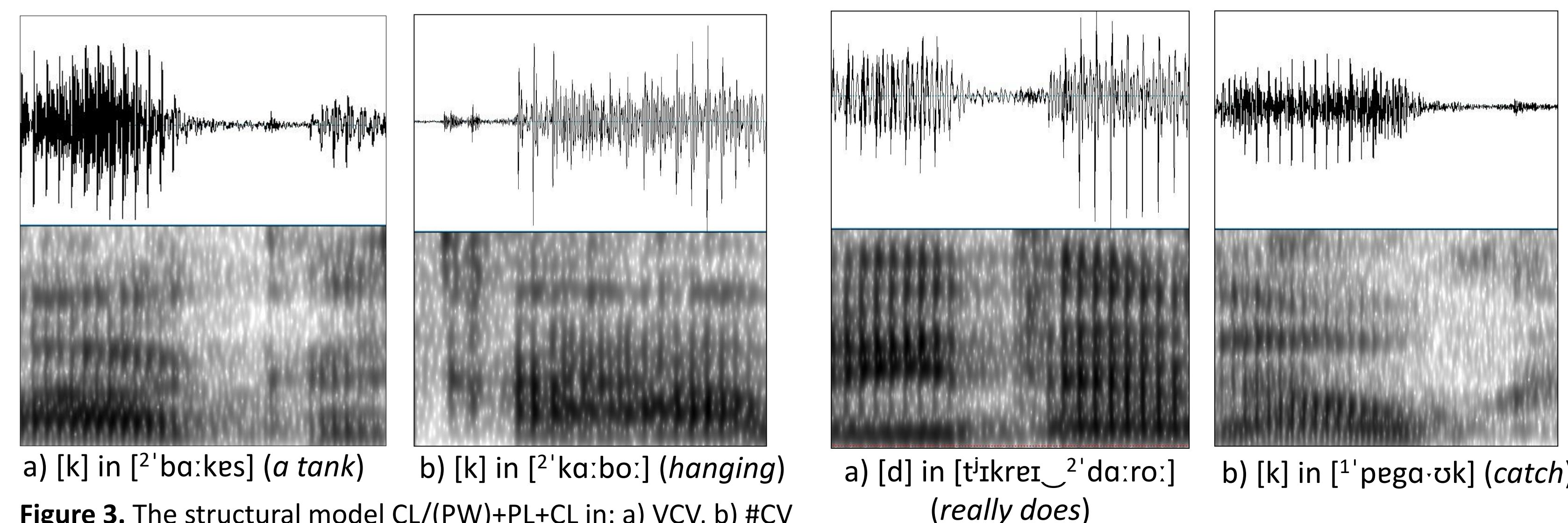
Figure 3. The structural model CL/(PW)+PL+CL in: a) VCV, b) #CV

a) [d] in [tˡɪkrɛɪ_²ˈdɑːroː] (*really does*)   b) [k] in [¹ˈpegɑ·ʊk] (*catch*)
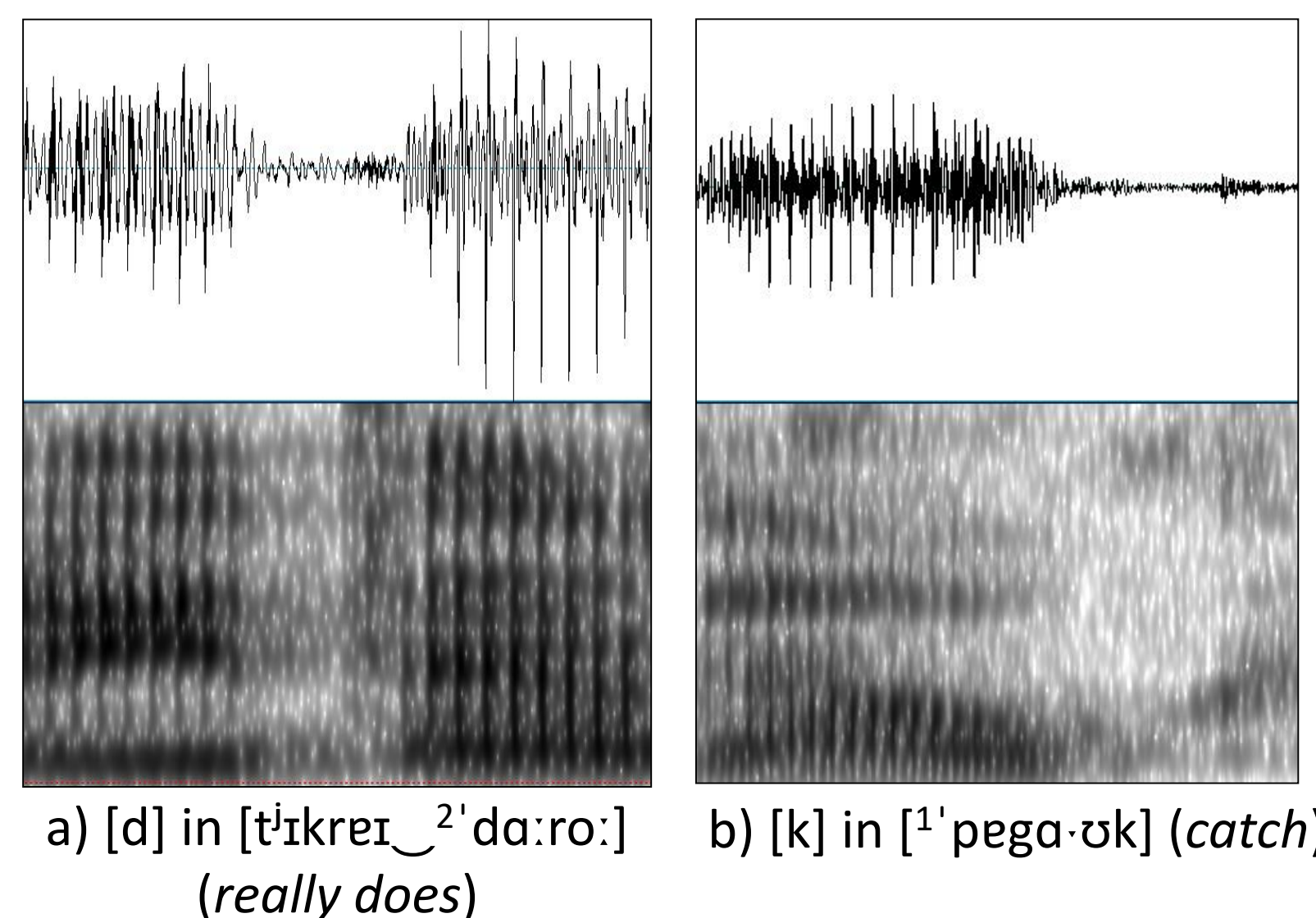
Figure 4. The structural model CL/PW+FR in: a) VCV, b) VC#

[k] in [²ˈbɑːkes] (*a tank*)

Figure 5. The structural model CL/PW in VCV position
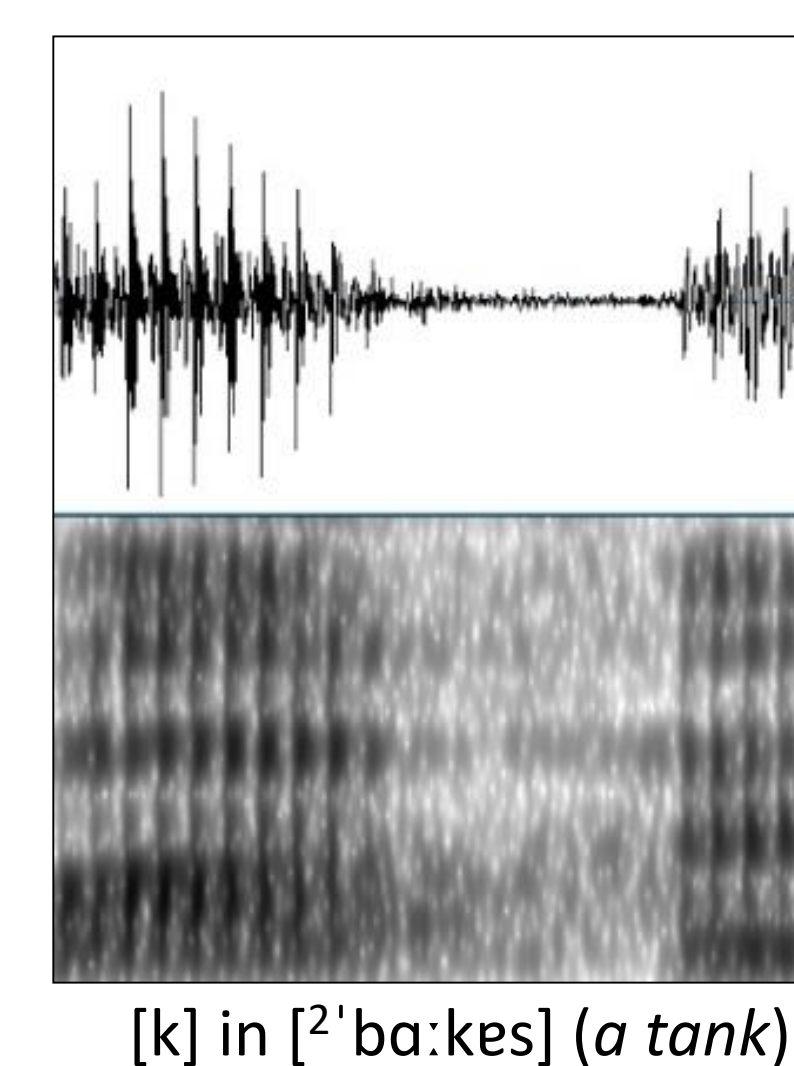
Table 1. The structural models of Lithuanian plosive consonants and their distribution (%)

Structural model	VCV						#CV						VC#		
	k	t	p	g	d	b	k	t	p	g	d	b	k	t	p
CL/PW+PL+FR	10	45	20	15	30		30	50	10	15	20		60	90	20
CL/PW+PL	25	30	50	55	50	60	10	30	50	80	80	80	20		65
CL/(PW)+PL+CL	50	15	15		5		60	20	40						
CL/PW+FR	5	10	5		5						5		20	10	15
CL/PW	10			10	30	10	40					20			

The plosive consonants can be composed of from one to three phases, or from two to three phases in the case of voiceless consonants in the word final position.

The experimental results have revealed 5 structural models: **CL/PW+(PL)+(FR/CL)**.

The most typical model in the **initial and intervocalic** positions consists of two phases: a closure and a burst release (CL/PW+PL, 50%). In **word- and phrase-final** position the most common pattern is CL+PL+FR (57%).

Considering all models **regardless the position** of the consonant in the word or the **absence or presence of voicing**, the most frequent model of plosive consonants is the binomial pattern, i.e. a closure released with a burst (46%).

In all positions, CL+PL+FR is the most frequent pattern for **voiceless** consonants (37%) and PW+PL – for **voiced** consonants (68%).

The distribution of the frequency of the structural models is irregular also in regard to **the place of articulation** of the plosive consonants:

- the dental consonants [t] and [d] tend to be most frequently fricated (CL/PW+PL+FR);

- the burst accompanying segment is common to the velar plosive [k] but here the plosion is followed by strongly attenuated frication acoustically similar to the phase of a complete closure (CL+PL+CL); the following noise is atypical in the production of the voiced velar [g];

- most fronted articulated bilabials [p] and [b] are usually pronounced without or with a very weak frication noise (CL/PW+PL). The voiced bilabial [b] may have no plosion at all (PW).

Conclusions

The metaphorical denotation of these consonants does not always reflect their phonetic realization, and the plosive consonants are not required to have a constant number of acoustic events as it is usually expected in Lithuanian linguistics.

The next stage of this study is to investigate the structural models of plosive consonants in **consonant clusters**.

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