The voiceless consonantal stops /p/, /t/, and /k/ in code-switched and non-code-switched contexts. A study on Romanian and English

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The present study analyzes the variation that occurs in the realizations of the voiceless consonantal stops /p/, /t/, and /k/ by Romanian-English bilingual speakers, in both monolingual/non-switched and bilingual/code-switched language contexts. The central issue of our research is whether or not there exists cross-linguistic phonetic transfer of the suprasegmental feature [+aspiration], measurable through VOT values, when bilingual speakers of Romanian (as their L1) and English (as their L2) produce code-switched sentences, irrespective of the direction of the switch. The analysis of the VOT values of the speech productions, extracted using Praat (v. 6.3.09), shows that code-switching affects the productions of /p/, /t/, and /k/, with the [+aspiration] feature being transferred from English (L2) to Romanian (L1) in code-switched sentences, and that, in monolingual language contexts, we may also see a transfer of this feature occurring from one language to another.

Keywords: *code-switching, voiceless consonantal stops, phonetic transfer, cross-linguistic influence, VOT values*

1. Introduction

Sociophonetics can be described as a relatively new field of linguistic research, encompassing both the sociolinguistic aspect of studying language choices, patterns, and variation, as well as the phonetic element which focuses on sound production, duration, pitch and so on, doing so in a controlled environment. Thomas (2004, 189) states that sociophonetics represents a "melding" of sociolinguistics and phonetics, while Preston and Niedzielski (2010, 3) argue that, from a conceptual standpoint, sociophonetics can be viewed as a sub-branch of sociolinguistics, with a focus on the phonetic factors present in language variation.

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Given the constantly changing linguistic landscapes around the globe, coupled with factors such as migration and globalization, as well as the ever-growing need to extract and analyze linguistic data pertaining to how people belonging to certain groups utilize one or more languages, a sociophonetic study of Romanian-English code-switching is of significant relevance nowadays. The analysis of these data may aid in unravelling issues such as bilingual identity construction through language and identity performance at the level of sounds, and not just grammar. With this in mind, the study of phonetic features found in patterns of code-switching between a pair of under-represented languages (Romanian-English) aims to provide valuable insight into the matter of how code-switching is physically realized in speech, in instances of switching from Romanian to English and from English to Romanian. This data may also serve to inform existing debates among phoneticians and sociolinguists researching bilingualism on whether phonetic systems are separate or integrated (Bullock and Toribio 2009; Piccinnini 2016; Mitra and Dutta 2023), or whether there is phonetic transfer occurring at switch boundaries when a bilingual speaker code-switches, in this case from Romanian to English or vice-versa.

2. Literature review

The present paper provides a sociophonetic analysis which deals with the realizations of the voiceless stops /p/, /t/ and /k/ in both code-switched and non-code-switched contexts, in the speech of Romanian-English bilinguals. In this paper, the accepted definition of a bilingual individual is that given by Auer (1984, 1998), who asserts that a bilingual is a person who is capable of speaking two languages. As for the concept of "sociophonetics", it is, in broader terms, referred to as an interface between sociolinguistics and phonetics (Thomas 2004 and 2011; Brown and Miller 2013; Boberg 2023). Previous sociophonetic studies of voiceless stops in the aforementioned contexts include the work of Bullock and Toribio (2009), but with Spanish-English bilinguals instead of Romanian-English ones. Bullock and Toribio (2009) examine the "phonetic reflexes" of code-switching in the speech productions of Spanish-English bilingual speakers and demonstrate the fact that the bilinguals in question maintain distinct phonological categories for /p/, /t/ and /k/ in code-switched contexts. By asking the question of whether or not evidence of a cross-linguistic influence that is more subtle in nature would be revealed in the process of code-switching at the sentential level, the data in Bullock and Toribio (2009) show evidence for code-switching affecting phonetic production either bilaterally (where each language influences the other) or unilaterally (where only

one language is affected), with speakers demonstrating the ability to anticipate a switch, regardless of the direction (L1→L2 or L2→L1). As Bullock and Toribio (2009, 189) point out, the specific phonetic result of a code-switch which is obtained can be determined by linguistic-internal factors (for example, the inherent differences that exist between the L1 and the L2) and by linguistic-external factors (for example, elements such as proficiency, language practices, and perceptions of congruence).

A similar question is postulated by Olson (2012), who compares Spanish English code-switched productions with non-code-switched ones, with the goal of examining suprasegmental features (in this case, sound duration and pitch height) of code-switched tokens, as a result of his investigation pertaining to the phonetic production of Spanish-English code-switching. The research question asked by Olson (2012) is whether or not there is a distinction between code-switched and non-code switched tokens at the suprasegmental level, with results indicating the fact that there is a "consistent and significant increase" in the suprasegmental features of sound duration and pitch height when comparing code-switched tokens to non-code-switched ones. However, as Olson (2012, 453) states, the findings of his study "call for further research". He follows up on this with a paper that investigates the suprasegmental reflexes of code-switching, when accounting for both the factor of language context (or "language mode") and that of language dominance, with results suggesting a correspondence between the realizations of the suprasegmental variety affecting code switched tokens, and the concept of "contextually driven predictability" (Olson 2015, 1-2). The main research question asked by Olson (2015, 4) aims to uncover the effects of code-switching, language context and language dominance on the suprasegmental features of sound duration and pitch. The discovery Olson (2015, 13) makes is that "code-switched tokens are produced with greater pitch range and longer stressed vowel durations than their non-switched counterparts", with this difference being modulated by both language mode and language dominance. Piccinini (2016, 75) suggests that the element of language dominance is a more important factor than the order of language acquisition when it comes to the process of cross-language activation. Mitra and Dutta (2023) investigate if mixed language processing increases cross-language phonetic transfer in the speech of Bengali-English bilinguals. In this case, results show that "mixed language processing temporarily increases phonetic interaction between the languages" (Mitra and Dutta 2023, 12).

Language context (or language mode) is a concept further explored by Olson (2016) when addressing the role of code-switching and that of language context in the process of bilingual phonetic transfer. Olson (2016, 263) examines the effects that Spanish-English code-switching and language mode have on VOT productions and investigates not only the role played by "(near) simultaneous dual language

activation on phonetic production", but also the nature of the phonetic transfer. VOT (voice onset time) refers to the interval which takes place between the release of a consonant closure and the start of the voicing process (Ladefoged and Johnson 2015, 159). The research questions asked in this paper are (i) whether or not code-switching has an impact on segmental production (either through unidirectional or bidirectional transfer), as exhibited by VOT, and (ii) whether or not there exists a cumulative impact comprised of both the element of bilingual language mode, as well as that of code-switching on segmental production, again, as shown by VOT (Olson 2016, 268). The results show phonetic transfer "when comparing the non-code-switched tokens to the code-switched tokens, and particularly code-switched tokens in a monolingual context", with the phonetic interactions differing between English-dominant speakers, where unidirectional transfer is observed, and Spanish-dominant speakers, in which case bidirectional transfer is observed. This is also in accordance with the results of a similar study produced by Schwarts et al. (2015), where it was confirmed that VOT shows clear signs of cross-linguistic influence.

3. Research questions

Taking into consideration the aforementioned factors, we will now provide our own set of research questions, as well as an adequate hypothesis, which will serve as a point of assumption for the applicative part of the research to answer, and to either prove or disprove. Given the fact that this paper covers the suprasegmental feature of aspiration in the case pertaining to the productions of the voiceless stops /p/, /t/, and /k/ in the speech of Romanian-English bilinguals, as well as the fact that we will be analyzing both code-switched and non-code-switched tokens (extracted from a variety of language contexts), we bring forth the following research questions: (i) Is the suprasegmental feature [+aspiration] in the realizations of /p/, /t/, and /k/ carried from one language to the other when code-switching occurs, and if so, in what capacity?; (ii) Do the bilingual speakers transfer phonetic features pertaining to the realization of /p/, /t/, and /k/ from one language to the other in monolingual contexts as well?

        In order to answer the first research question, we must take into consideration, in different language contexts, the element of immediate cross-linguistic influence: whether or not our participants are able to anticipate and recover from a given code-switch, as well as identify, the type of effect, be it unilateral or bilateral, that code-switching has when it comes to the process of phonetic production. Cross-linguistic influence and language context are important factors in answering our second research question, as well. In this case, we check

the transfer of the previously mentioned phonetic features by providing monolingual language contexts to our speakers, meaning that there is no code switching. However, this may or may not stop the transfer of some phonetic features from L1 to L2, or from L2 to L1. Of course, it must be said that the recording and checking of the [± aspiration] feature through VOT measurements in the case of the sound productions will be carried out by utilizing the computer program *Praat* (v. 6.3.09).

With these research questions in mind, there is now a need for us to formulate an appropriate hypothesis for our research. Accounting for the fact that the study effected by Bullock and Toribio (2009), in which the bilingual participants spoke Spanish (a Romance language, similar to Romanian) and English, found significant evidence regarding the effect (bilateral or unilateral) of code-switching on phonetic production, our hypothesis is that code-switching affects the productions of the voiceless stops /p/, /t/, and /k/, with the [+aspiration] feature being transferred from English to Romanian in code-switched sentences, and that, in monolingual language contexts, we may also see a transfer of the [+aspiration] feature from one language to another. An interesting aspect to take into consideration in the process of proving or disproving this initial hypothesis is the factor regarding the language dominance scores of the participants, which will serve to determine their leanings towards either Romanian (the L1) or English (the L2), as elaborated in the following section of this paper.

4. The participants

A total of eight participants were recorded for this study. All of the participants self-identified as Romanian-English bilinguals. For the purposes of our research, a Romanian-English bilingual refers to an individual that can comfortably carry out conversations in both Romanian and English. Four of the participants are male and four are female. It is important to note the fact that all eight participants are native speakers of Romanian and use the standard variety of the language. This means that all of the participants in this research have Romanian as their L1 (with their age of acquisition in the case of Romanian being 0 for every one of the eight participants) and English as their L2. Because of this, we predict that, as a result of completing the BLP (Bilingual Language Profile) questionnaire, not only will the results indicate that the majority of the recorded bilingual speakers will be Romanian-dominant, but also that a majority of speakers will display higher proficiency scores for Romanian, as opposed to English. The ages of the male speakers vary from 21 to 51 years old, while the ages of the female speakers vary

from 17 to 52 years old. As for their place of residence, three of the participants live in the city of Constanța, Romania, two participants live in Norwich, U.K. and three participants live in Bucharest, Romania. In order to ensure their anonymity, the names attributed to each participant in this paper are fictitious.

The table presented below offers additional information extracted from our set of sociolinguistic interviews, regarding the age, gender, education level, place of birth, current place of residence, and level of exposure to English in the case of each participant.

Table 1. Participant backgrounds

Partici-pants	Age	Gender	Education level	Place of birth	Current place of residence	Level of exposure to English
Alissa	17 yrs old	Female	High-school education	Norwich, U. K.	Constanța, Romania	High
Cecilia	52 yrs old	Female	Tertiary education	Constanța, Romania	Norwich, U. K.	High
Daniel	24 yrs old	Male	Postgraduate education (MA)	Norwich, U. K.	Constanța, Romania	High
Eric	24 yrs old	Male	Undergraduate education (BA)	Constanța, Romania	Bucharest, Romania	Medium
Marcel	53 yrs old	Male	Doctorate (PhD)	Bucharest, Romania	Norwich, U. K.	High
Maria	26 yrs old	Female	Postgraduate education (MA)	Atlanta, U. S. A.	Bucharest, Romania	High
Samuel	21 yrs old	Male	Undergraduate education (BA)	Norwich, U. K.	Constanța, Romania	High
Sarah	26 yrs old	Female	Postgraduate education (MA)	Bucharest, Romania	Bucharest, Romania	High

Participants were each given a version of the BLP (Bilingual Language Profile) questionnaire (Birdsong, Gertken and Amengual 2012), which was adapted for Romanian as the L1 and English as the L2. This was done in order to extract the overall language-dominance scores of the participants, as well as the scores for language proficiency, in the case of both Romanian and English. The possible language dominance scores range from −218 (highly English-dominant) to +218 (highly Romanian-dominant), with a score of 0 indicating that the speaker displays a perfect linguistic balance between English and Romanian, being equally dominant in both languages. The overall language proficiency score ranges from 0 (not

proficient at all in the given language) to a total of 6 (highly proficient in the given language).

Table 2. Language-dominance and proficiency scores

The participants	Language-dominance score	Proficiency score	
		For Romanian	For English
Alissa	−27.09	5	6
Cecilia	+41.94	6	5
Daniel	+18.69	6	6
Eric	+93.63	6	4.50
Marcel	+103.52	6	6
Maria	+33.15	5.50	6
Samuel	+64.03	6	5.75
Sarah	+117.31	6	5.50

We may observe that Alissa is the only English-dominant participant, with a language-dominance score of −27.09, and a proficiency score of 5 for Romanian and 6 for English. Cecilia is Romanian-dominant, with a language-dominance score of +41.94, and a proficiency score of 6 for Romanian and 5 for English. Daniel is Romanian-dominant, and is the closest to 0 (the score of the "perfectly" balanced bilingual), with a language-dominance score of +18.69, and a proficiency score of 6 for Romanian and 6 for English. Eric is also Romanian-dominant, with a language-dominance score of +93.63, and a proficiency score of 6 for Romanian and 4.50 for English. Marcel is Romanian-dominant, with a language-dominance score of +103.52, and a proficiency score of 6 for Romanian and 6 for English. Maria is Romanian-dominant, with a language-dominance score of +33.15, and a proficiency score of 5.50 for Romanian and 6 for English. Samuel is Romanian-dominant, with a language-dominance score of +64.03, and a proficiency score of 6 for Romanian and 5.75 for English. Sarah is Romanian-dominant, with a language-dominance score of +117.31, and a proficiency score of 6 for Romanian and 5.50 for English.

To sum up, out of the total number of eight participants, one participant is English-dominant and seven are Romanian-dominant. The highest language-dominance value is +117.31 and the lowest value is −27.09. The highest recorded proficiency score is 6 for both Romanian and English. The lowest such score is 5.50 in the case of Romanian and 4.50 in the case of English. These numbers confirm our earlier prediction according to which most of the participants (in our case, seven out of a total of eight) will be classified as Romanian-dominant, with the mean language-dominance score being that of +55.64. When discussing proficiency scores, the mean value for Romanian is 5.81, and for English it is 5.59. This confirms

our second prediction, namely that of Romanian proficiency scores being overall higher than those of English. It is also worth mentioning that the 3 smallest language dominance scores (Alissa: −27.09; Daniel: +18.69; Maria: +33.15) all belong to participants who were born and partially raised in an English-speaking country (i.e. the U.K. and the U.S.A., respectively).

5. The study

The main goal of our current research is to observe whether or not the [+aspiration] feature is carried out from Romanian (L1) to English (L2), as well as from English (L2) to Romanian (L1) in the realizations of the voiceless stops /p/, /t/, and /k/. A secondary aim would be to note whether or not there is phonetic transfer of features pertaining to the realization of /p/, /t/, and /k/ from one language to the other in monolingual contexts as well, namely language contexts in which there is no code-switching. We believe that the language-dominance and proficiency scores obtained by our participants serve as indicators of their linguistic tendencies when employing code-switches from L1 to L2, as well as from L2 to L1.

The present study includes a total of 144 test sentences. Out of these, 48 are test sentences and 96 are filler sentences. The 48 test sentences are comprised of 12 monolingual sentences and 36 sentences with code-switching in them. Out of the 12 monolingual sentences, 6 of them are in Romanian (L1) and the other 6 are in English (L2). Out of the 36 code-switched sentences, 18 of them present code-switching from Romanian (L1) to English (L2) and the other 18 sentences present code-switching from English (L2) to Romanian (L1). The 96 filler sentences are comprised of 12 monolingual sentences in Romanian (L1), 12 monolingual sentences in English (L2), 36 code-switched sentences from Romanian to English (L1→L2), as well as 36 code switched sentences from English to Romanian (L2→L1). The test sentences act as the stimuli in our research, and they are each encoded with the target tokens /p/, /t/, and /k/. It must be said that we were careful to counterbalance the target tokens across all sentences, similar to what can be seen in the methodology laid out by Bullock (2009), as well as by Bullock and Toribio (2009, 196-197). Examples of the monolingual stimuli appear in (1):

(1)   a.   Monolingual Romanian:
             *Tata face **p**aste **c**u sos roșu.*
             'Father is making pasta with red sauce.'
       b.   Monolingual English:
             Testing the **c**adets is not a **p**unishment.

Spectrographs for the sentences in 1a and 1b are represented in Figure 1 and Figure 2 below:
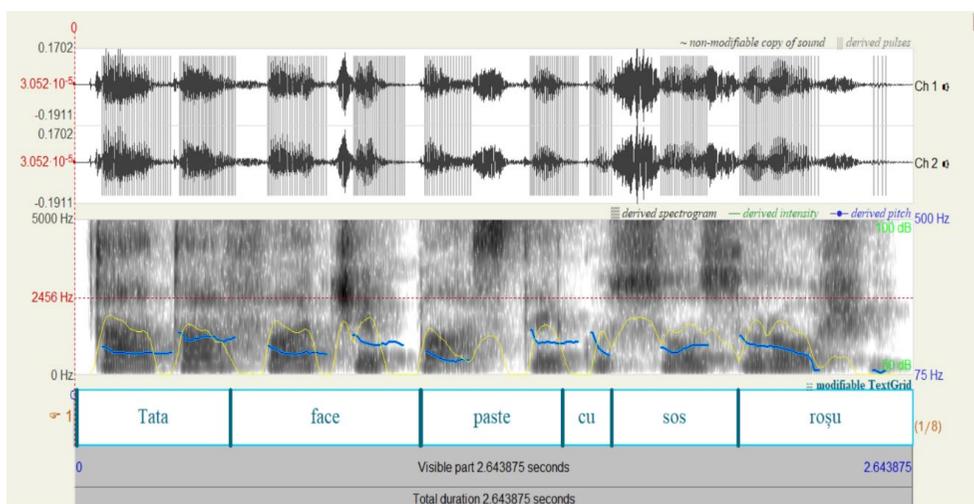

Figure 1. Spectrograph of sentence 1a (as uttered by Marcel; dated April, 2024)

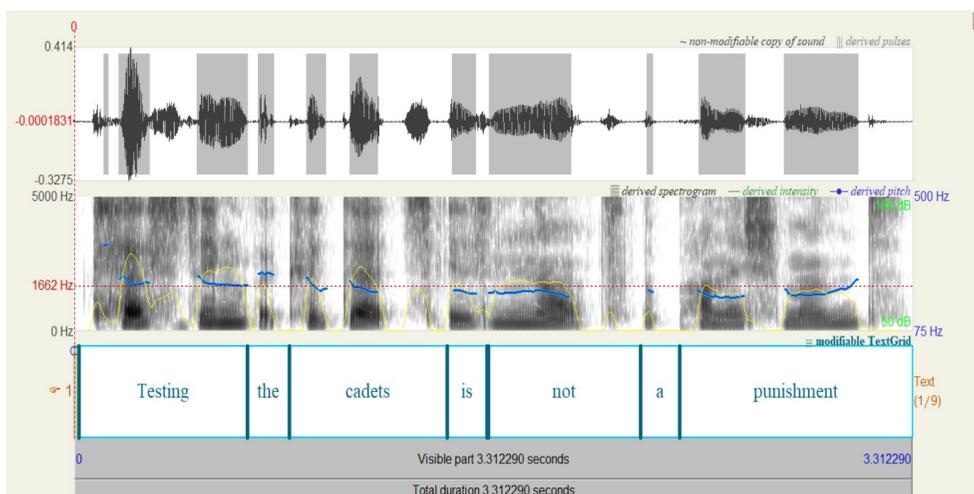**Figure 2.** Spectrograph of sentence 1b (as uttered by Alissa; dated April, 2024)

Each of the 36 bilingual sentences contain the three voiceless stop tokens /p/, /t/, and /k/, in three different contexts or "sites", as Bullock and Toribio (2009) would name these elements. The contexts/sites are the following: before the code-switch, directly at the switch site, and after the code-switch has taken place. The
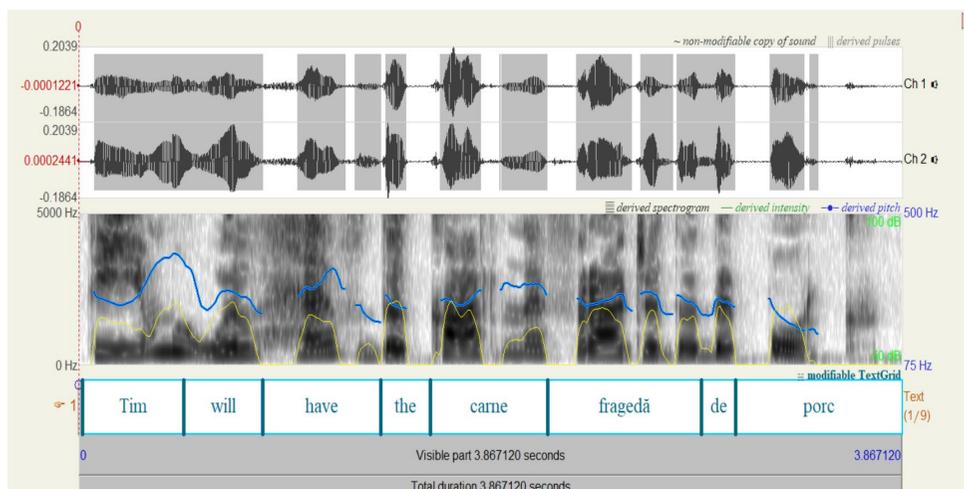
occurence of the pre-switch and post-switch positions varies from one to nine syllables away from the switch site itself. Examples of the bilingual stimuli can be observed in (2):

(2)   a.   Code-switching from Romanian to English:
             ***T**ortul a fost făcut după o rețetă **k**ept secret by **P**am.*
             ↑ pre-switch   ↑ switch   ↑ post-switch
             'The cake was made after a recipie kept secret by Pam.'
        b.   Code-switching from English to Romanian:
             Tim will have the ***c**arne fragedă de **p**orc.*
             ↑ pre-switch   ↑ switch   ↑ post-switch
             'Tim will have the tender pork meat.'

        Spectrographs for the sentences in 2a and 2b are given in Figure 3 and Figure 4 below:

Figure 3. Spectrograph of sentence 2a (as uttered by Daniel; dated April, 2024)

Figure 4. Spectrograph of sentence 2b (as uttered by Corina; dated April, 2024)

As noted by Bullock and Toribio (2009, 196), not only does the process of coding the data for the switch site allow for measurements to be made in the sense of the effect pertaining to the direction of a code-switch (whether it is a code-switch from Romanian to English, or from English to Romanian), but it also permits the carrying out of an analysis with the purpose of determining whether or not the bilingual speakers taking part in our research have the capability of anticipating and recovering from a code-switch, phonetically speaking. Olson (2016, 280) follows up on these claims, stating that "both code-switching and bilingual language context have been shown to serve as potential catalysts for interlanguage interaction", due to the fact that they constitute "situations in which both of a bilingual's languages must be accessed in a compressed timeframe".

It must also be stated that, besides language context, the factors of language-dominance and language proficiency in both Romanian and English are also expected to play an important role in determining eventual anticipations and recoveries from code-switching or lack thereof on the part of the speaker. This is due to the correlation between the proficiency of a speaker in a given language and their patterns of switching which reflect their particular language choices, as seen in Bullock and Toribio (2009), as well as in Olson (2016). With this being said, the next section focuses on the procedure itself, thus describing the carrying out of the study in order to obtain and successfully interpret the data provided by our eight Romanian-English bilingual speakers participating in this research.

Given the fact that, in the present study, our main objectives consist of (a) being able to determine the capacity in which the phonetic transfer of the

[+aspiration] feature from one language to another in a code-switching context occurs, in the realizations of /p/, /t/, and /k/ by Romanian-English bilinguals, as well as (b) observing if this specific type of transfer also takes place in monolingual contexts, it is safe to say that, in order to attempt to satisfy these objectives, we will have to deal with a substantial number of analyzable productions from which to collect our data. When considering the exact number, this amounts to a total of 2304 sound productions (the result of 8 participants x 48 test sentences/stimuli x 3 phonetic realizations/target tokens per test sentence x 2 repetitions) that are of interest to us. Out of the initial 2304 productions, 2296 of them were analyzable. This means that 8 tokens were eliminated for various errors, ranging from background elements and/or items of jewelry on the participant in question producing noise which coincided with the phonetic production of one or more of the target tokens, to pauses in speech at the switch site in excess of 500 ms. Though infrequent, eliminations of this type are normal when dealing with a high number of sound productions; the appearances of similar unanalyzable productions have been encountered in previous sociophonetic research regarding bilingual speech and code-switching (as seen in Olson 2012, 2013, 2015, 2016, 2019, 2020; Mitra and Dutta 2023; Warren 2023).

The bilingual speakers were first given a sociolinguistic interview to determine the background information regarding age, gender, education level, place of birth, current place of residence, exposure to L2, social networks, all of which have been presented earlier in this paper. Each participant was then administered a version of the BLP (Bilingual Language Profile) questionnaire (in our case, adapted for Romanian and English), in order to obtain their previously mentioned language-dominance and language proficiency scores. Comparable to the time frame conditions employed by Bullock and Toribio (2009, 197), the part of our study pertaining to the recording of the phonetic realizations of /p/, /t/, and /k/ was completed over 2 days, separated by one week. The first day of recording the sound productions of the participants focused on the monolingual aspect of our research, meaning that the speakers were asked to read the monolingual Romanian sentences out loud, and, after a 30-minute break, the procedure was repeated, but for the English monolingual sentences this time. After a week, we recorded the bilingual sentences uttered by our speakers. First, the participants were instructed to read out loud the sentences which contained code-switching from Romanian to English and, after a 30-minute break, they were asked to do the same for the sentences that contained code-switching from English to Romanian. In all of the aforementioned cases, the participants were told to utter the sentences in question as though they were speaking to a very good friend of theirs that speaks both Romanian and English. The test sentences, which constitute the stimuli

in the case of this experiment, were presented to the bilingual speakers in randomized blocks (for monolingual Romanian, monolingual English, sentences involving code-switching from Romanian to English, as well as for sentences involving code-switching from English to Romanian), by using the software program *E-Prime* (v. 3.0). The participants were recorded in a quiet environment, on a HP 15s-eq2000nq laptop with a built-in AMD 48000 Hz microphone. The productions of the voiceless stops /p/, /t/, and /k/ were analysed for the [+aspiration] feature by measurement of VOT values through the usage of the computer program *Praat* (v. 6.3.09), which is specially designed for the process of acoustic analysis. Version 6.3.09 is the newest version of *Praat* at the time of writing this paper.

It is important to affirm the fact that the sociolinguistic interviews carried out with each of the participants, the questionnaires that were administered, as well as the recordings of their sound productions have all been executed in accordance with the ethical guidelines and practices for collecting language data. Concerning the usage and subsequent analysis of these language data during the course of the present paper, it must be stated that informed consent was obtained in this regard from all of the bilingual speakers taking part in this study.

6. Findings

In this section of the paper, we present the results obtained from the analysis of the recordings. Specifically, we show the mean VOT values when accounting for the factors of language, the code-switched or non-code-switched context/site, as well the participant uttering the sound production in question. These values have been grouped into four tables (Table 3, Table 4, Table 5, Table 6), in accordance with the voiceless stops that are analyzed in each instance. In Table 3, we have extracted the mean VOT values in the case of the realizations of /p/. In Table 4 and Table 5, the same procedure has been carried out for the realizations of /t/ and /k/, respectively. Finally, Table 6 contains the overall VOT values in the case of all three voiceless stops. In all of the aforementioned tables, the VOT values are measured in seconds and have been rounded off to three decimal places. These measurements will aid in our understanding of how and when the [+aspiration] feature is transferred in Romanian-English bilingual speech.

The following abbreviations are used in the tables 3 through 6:
(i) Monoling. Rom. = a monolingual Romanian context (all of the words in the sentence are uttered in Romanian);
(ii) Pre-switch Rom. = the word containing the target token in question is uttered in Romanian, before the code-switch from Romanian to English;

(iii) Switch site Rom. = the word containing the target token in question is uttered in Romanian, and marks the beginning of the code-switch from English to Romanian;

(iv) Post-switch Rom. = the word containing the target token in question is uttered in Romanian, after the code-switch from English to Romanian;

(v) Monoling. Eng. = a monolingual English context (all of the words in the sentence are uttered in English);

(vi) Pre-switch Eng. = the word containing the target token in question is uttered in English, before the code-switch from English to Romanian;

(vii) Switch site Eng. = the word containing the target token in question is uttered in English, and marks the beginning of the code-switch from Romanian to English;

(viii) Post-switch Eng. = the word containing the target token in question is uttered in English, after the code-switch from Romanian to English.

Table 3. Mean VOT values by language, site, and participant in the realization of /p/

Partici-pants	Monoling. Rom.	Pre-switch Rom.	Switch site Rom.	Post-switch Rom.	Monoling. Eng.	Pre-switch Eng.	Switch site Eng.	Post-switch Eng.
Alissa	0.053	0.034	0.056	0.031	0.072	0.070	0.056	0.082
Cecilia	0.028	0.030	0.041	0.024	0.032	0.029	0.032	0.061
Daniel	0.026	0.025	0.038	0.025	0.049	0.045	0.047	0.046
Eric	0.027	0.035	0.037	0.028	0.038	0.035	0.031	0.051
Marcel	0.034	0.037	0.040	0.050	0.057	0.048	0.033	0.034
Maria	0.028	0.027	0.024	0.044	0.040	0.041	0.032	0.038
Samuel	0.029	0.032	0.022	0.053	0.058	0.037	0.038	0.032
Sarah	0.027	0.031	0.039	0.031	0.037	0.040	0.023	0.045

Table 4. Mean VOT values by language, site, and participant in the realization of /t/

Partici-pants	Monoling. Rom.	Pre-switch Rom.	Switch site Rom.	Post-switch Rom.	Monoling. Eng.	Pre-switch Eng.	Switch site Eng.	Post-switch Eng.
Alissa	0.056	0.051	0.044	0.041	0.072	0.075	0.068	0.081
Cecilia	0.022	0.029	0.028	0.027	0.054	0.040	0.059	0.047
Daniel	0.025	0.026	0.039	0.025	0.053	0.050	0.060	0.064
Eric	0.024	0.025	0.037	0.038	0.056	0.045	0.044	0.047
Marcel	0.031	0.032	0.033	0.044	0.058	0.053	0.054	0.031
Maria	0.024	0.034	0.047	0.059	0.052	0.042	0.030	0.025
Samuel	0.024	0.025	0.042	0.048	0.058	0.044	0.032	0.034
Sarah	0.025	0.033	0.025	0.027	0.052	0.047	0.049	0.057

Table 5. Mean VOT values by language, site, and participant in the realization of /k/

Partici-pants	Monoling. Rom.	Pre-switch Rom.	Switch site Rom.	Post-switch Rom.	Monoling. Eng.	Pre-switch Eng.	Switch site Eng.	Post-switch Eng.
Alissa	0.047	0.058	0.068	0.047	0.064	0.067	0.070	0.089
Cecilia	0.060	0.050	0.056	0.040	0.069	0.074	0.080	0.073
Daniel	0.051	0.038	0.048	0.036	0.052	0.057	0.063	0.065
Eric	0.048	0.049	0.037	0.031	0.078	0.069	0.060	0.066
Marcel	0.054	0.047	0.053	0.045	0.071	0.078	0.076	0.081
Maria	0.043	0.049	0.057	0.050	0.058	0.059	0.069	0.080
Samuel	0.052	0.048	0.046	0.044	0.074	0.076	0.059	0.070
Sarah	0.045	0.056	0.069	0.059	0.065	0.072	0.068	0.081

Table 6. Overall VOT values by language, site, and participant in the realization of /p/, /t/, and /k/

Partici-pants	Monoling. Rom.	Pre-switch Rom.	Switch site Rom.	Post-switch Rom.	Monoling. Eng.	Pre-switch Eng.	Switch site Eng.	Post-switch Eng.
Alissa	0.052	0.047	0.056	0.039	0.069	0.070	0.064	0.084
Cecilia	0.036	0.036	0.041	0.030	0.051	0.047	0.057	0.060
Daniel	0.034	0.029	0.041	0.028	0.051	0.050	0.047	0.058
Eric	0.033	0.036	0.037	0.032	0.057	0.049	0.045	0.054
Marcel	0.039	0.038	0.042	0.046	0.062	0.059	0.054	0.048
Maria	0.031	0.036	0.042	0.051	0.050	0.047	0.043	0.047
Samuel	0.035	0.035	0.036	0.048	0.063	0.052	0.043	0.045
Sarah	0.032	0.040	0.044	0.039	0.051	0.053	0.046	0.061

7. Discussion

From the tables presented earlier, it can be seen that the mean VOT values not only differ from speaker to speaker, but also from sound to sound (be it the realization of /p/, /t/, or /k/). We may also note that female speakers exhibit greater aspiration lengths than males, and that speakers that were born and raised in Romania (Cecilia, Eric, Marcel, Sarah) had lower aspiration lengths than those born and raised in English-speaking countries (Alissa, Daniel, Maria, Samuel).

When examining the data pertaining to the overall VOT values by language, site, and participant in the realization of the voiceless stops /p/, /t/, and /k/, we

may observe that, in almost every instance, (i) in the case of code-switching from Romanian to English, the values in the pre-switch context are lower than the ones identified at the switch site to English, which, in turn, are lower than the values extracted from post-switch contexts, and that (ii) in the case of code-switching from English to Romanian, the values in the pre-switch context are higher than those at the switch site from English to Romanian, which are, in turn, higher than the values found at the post-switch site. From (i) and (ii), we see that, despite the VOT values being higher than normal almost everywhere, the bilingual speakers still display the general pattern of anticipating and recovering from a code-switch, regardless of it being an instance of code-switching from Romanian to English or the other way round, although, in some cases, we are also able to notice small influences of the L1 or L2 when looking at the values found at the switch site and the direction of the switch.

Nevertheless, there are exceptions to this general observation that have been identified in the process of analyzing the present data. The most noteworthy exception is bilingual speaker Alissa, who not only produced realizations of /p/, /t/, and /k/ with higher lengths of aspiration when compared to the other participants, but also yielded considerably higher values at the switch site, regardless of the direction of the code-switch. The tendencies shown in such a case act as an indicator towards the fact that, in the case of Alissa, her L2 (English) has a greater, more obvious influence on her phonetic productions than the L1 (Romanian). This statement is further supported when taking into consideration the fact that Alissa is the only English-dominant participant, with a language-dominance score of −27.09, and a proficiency score of 5 for Romanian and 6 for English. Thus, we can observe how the factors of language-dominance and language proficiency not only affect the transfer of phonetic features when a bilingual speaker employs code-switching, but also the speaker's ability to fully anticipate and recover from a code-switch. By contrast, bilingual speaker Daniel, who is the closest to 0 (and thus being a "perfect bilingual") out of all eight participants, with a language-dominance score of +18.69 and a language proficiency score of 6 for Romanian and 6 for English, was able to fully anticipate and recover from the code-switching process, regardless of the direction of the switch. The other 6 participants, with language-dominance scores ranging from +33.15 to +117.31, saw varying degrees of influence from English present in their L1 (Romanian) productions. However, these degrees of influence were considerably lower than in the case of Alissa, which is an expected outcome, given the fact that she is the only English-dominant participant in this study. These findings confirm the other half of our research hypothesis, and give an affirmative answer to our first research question, by proving that there is indeed phonetic transfer pertaining to the [+aspiration] feature, as well as aspiration

length in the realizations of /p/, /t/, and /k/ that is carried out from one language to the other, through cross-linguistic influence. The capacity in which this transfer takes place varies from language context to language context, as well as from speaker to speaker. It is, however, safe to say that the factors of language context, language-dominance, and language proficiency are all vital components in this process.

Mitra and Dutta (2023, 11) state that studies on what they call "language-switching" have "often reported phonetic transfer from L2 to L1, and no parallel transfer from L1 to L2". However, this claim is disconfirmed by the case of Alissa. Our findings align with those reported by Bullock and Toribio (2009, 200), who conclude that bilinguals show that they are capable of anticipating a switch, and of phonetic preservation from a given switch, with these shifts, in consequence, being divergent or convergent, as well as asymmetric in direction, thus affecting one language only. According to Bullock and Toribio (2009, 204), the process of code-switching leads to significant phonetic reflexes in the production of bilingual speakers, yet the direction of influence that exists between the L1 and the L2 spoken by the bilinguals in question is not predetermined or uniform. Olson (2013) writes that "discursive properties may partially drive the production of code-switches", both in the case of scripted and spontaneous instances of code-switching. Building on this idea, Olson (2015) demonstrates that the factors of code-switching, language contexts, and language-dominance all affect the production of code-switched tokens, by investigating the suprasegmental reflexes of code-switching, accounting for language context and language-dominance, to ultimately suggest that "the suprasegmental realizations of code-switched tokens correspond to a degree of contextually driven predictability". Again, we observe that these previous findings are in agreement with our own results on this matter.

7. Concluding remarks

As a result of our measuring of the aspiration lengths though VOT values of the sound productions of /p/, /t/, and /k/, and subsequent presentation of this data, presented while also accounting for the factors of language, switch site, as well as the individual speaker producing the sound in question, we noted the existence of phonetic transfer pertaining to the [+aspiration] feature and the length of aspiration as well, occurring in the realizations of /p/, /t/, and /k/.

Therefore, to answer RQ1, the data clearly demonstrates that this transfer is carried out from one language to the other and thus confirms the fact that there is cross-linguistic influence occurring in phonetic transfers in the code-switching. The

extent to which the transfer takes place can be linked to the sociolinguistic factors of language dominance and language proficiency, as we have seen that participants with scores that indicate their dominance and proficiency in one language over the other have a tendency of replicating the aspiration lengths from their dominant language into the productions in the other language.

This leads us to RQ2, to which we can provide a positive answer when accounting for the fact that all of the participants clearly show influences of L2 (English) in monolingual sentences uttered in L1 (Romanian), to varying degrees (again, depending on factors of language dominance, proficiency, exposure, etc.). Thus, our research hypothesis is confirmed, with previous studies in this area of sociophonetics obtaining comparable results and drawing similar conclusions to those presented in this paper.

Directions of further research may include (but are not limited to): (i) the acoustic analysis of suprasegmental features pertaining to the realization of /p/, /t/, and /k/, such as sound duration, intensity, pitch, in the speech of Romanian-English bilinguals; (ii) the analysis of other consonantal sounds (such as approximants, fricatives, nasals, affricates, liquids, and glides) from a sociophonetic perspective pertaining to Romanian-English code-switching; (iii) a look into language perception and language attitudes between certain groups/communities of bilinguals speakers of both Romanian and English that have Romanian as their L1 towards the usage of different English (L2) accents in a variety of language contexts/situations.

References

Auer, Peter. 1984. *Bilingual Conversation*. Amsterdam/Philadelphia: John Benjamins.

Auer, Peter (ed.). 1998. *Code-Switching in Conversation: Language, Interaction and Identity*. London: Routledge.

Birdsong, David, Libby M. Gertken, and Mark Amengual. 2012. *Bilingual language profile: An easy-to-use instrument to assess bilingualism*. COERLL, University of Texas at Austin. Retrieved from https://sites.la.utexas.edu/ bilingual/.

Boberg, Charles. 2023. "Sociophonetics and sound change." In *The Routledge Handbook of Sociophonetics*, ed. by Christopher Strelluf, 285–306. London: Routledge.

Boersma, Peter and David Weenink. 2023. *Praat: doing phonetics by computer*. Version 6.3.09. [computer program]. Retrieved from http://www.praat.org/.

Brown, Keith and Jim Miller. 2013. *The Cambridge Dictionary of Linguistics*. Cambridge: Cambridge University Press.

Bullock, Barbara E. 2009. "Phonetic reflexes of code-switching." In *The Cambridge Handbook of Linguistic Code-Switching*, ed. by Barbara E. Bullock and Almeida J. Toribio, 163–181. Cambridge: Cambridge University Press.

Bullock, Barbara E. and Almeida J. Toribio. 2009. "Themes in the study of code-switching". In *The Cambridge Handbook of Linguistic Code-Switching*, ed. by Barbara E. Bullock, Almeida J. Toribio, 1–17. Cambridge: Cambridge University Press.

Ladefoged, Peter and Keith Johnson. 2015. *A Course in Phonetics* (7th ed.). Boston: Cengage Learning.

Mitra, Auromita and Indranil Dutta. 2023. "Mixed language processing increases cross-language phonetic transfer in Bengali-English bilinguals." *Bilingualism: Language and Cognition* 26(5): 1–14.

Olson, Daniel J. 2012. "The phonetics of insertional code-switching: Suprasegmental analysis and a case for hyper-articulation". *Linguistic Approaches to Bilingualism* 2(4): 439–457.

Olson, Daniel J. 2013. "Bilingual language switching and selection at the phonetic level: Asymmetrical transfer in VOT production." *Journal of Phonetics* 41: 407–420.

Olson, Daniel J. 2015. "The impact of code-switching, language context, and language dominance on suprasegmental phonetics: Evidence for the role of predictability." *International Journal of Bilingualism* 20(4): 1–20.

Olson, Daniel. 2016. "The role of code-switching and language context in bilingual phonetic transfer." *Journal of the International Phonetic Association* 1(3): 1–23.

Olson, Daniel. 2019. "Phonological processes across word and language boundaries: Evidence from code-switching." *Journal of Phonetics* 77: 1–16.

Olson, Daniel J. 2020. "Short-Term Sources of Cross-Linguistic Phonetic Influence: Examining the Role of Linguistic Environment." *Languages* 5 (4): 43–64.

Piccinini, Elizabeth. 2016. *Cross-language Activation and the Phonetics of Code-switching*. PhD thesis, defended at the University of California, San Diego.

Schwartz, Geoffrey, Anna Balas, and Arkadiusz Rojczyk. 2015. "Phonological factors affecting L1 phonetic realization of proficient Polish users of English." *Research in Language* 13(2): 181–198.

Thomas, Erik R. 2004. "Instrumental phonetics." In *The Handbook of Language Variation and Change* (1st ed.), ed. by Jack K. Chambers, Peter Trudgill and Natalie Schilling-Estes, 168–200. Maiden: Blackwell Publishing.

Thomas, Erik R. 2011. *Sociophonetics: An Introduction*. London: Palgrave Macmillan.

Warren, Paul. 2023. "Sociophonetics and sound change." In *The Routledge Handbook of Sociophonetics*, ed. by Christopher Strelluf, 326–341. London: Routledge.