

# **Influence of L1 on VOT production in Spanish: English and Ukrainian Comparison**

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## **1 Introduction**

The following study sets out to examine the Voice Onset Time (VOT) production of Spanish voiceless stops /p t k/ by speakers whose L1 is Ukrainian or English. VOT is defined as an interval between the stop burst and the onset of a vocal fold vibration and is used to establish a contrast between voiced and voiceless segments, as well as simple unaspirated voiceless stops and aspirated stops. VOT is known to differ significantly between languages as has been shown by Lisker & Abramson (1964). In languages like Ukrainian and Spanish, the voiceless stops /p t k/ are produced with a short lag VOT of less than 30 ms long. In other languages, such as English, these segments are realized with a long lag of more than 30 ms (Nagy & Kochetov, 2011). While numerous studies have been done on the comparison of English and Spanish VOT measurements and their transfer from one language to another (González-Bueno, 1997a; Díaz-Campos and Lazar, 2003; Knightly *et al*, 2003; Díaz-Campos, 2006; Llama, Cardoso and Collins, 2007; Crane and Alvord, 2012; Zampini, 1998, 2014), no such plethora of work can be found on the assessment of the Ukrainian language or the comparison of its features to languages other than English. Previous studies such as Hrycyna (2011) and Nagy & Kochetov (2011) examined Ukrainian heritage speakers (among others) in English speaking environments and the influence of English in their VOT productions of Ukrainian over generations. In contrast to previous studies on VOT in these languages, this investigation provides concrete data on Ukrainian native speakers' VOT measurements, as well as a direct comparison between English and Spanish with a distinct focus on L1 transfer.

## 2 Previous research on VOT in the three languages

The topic of VOT is one of the most studied subjects in the field of phonology due to its considerable variation across languages. Lisker & Abramson (1964) were among the first to demonstrate, with an assessment of spectrographic analysis of high-quality tape recording of eleven languages, how this single element can serve to separate the voiced and voiceless stops in initial position in languages where plosive segments are said to differ in phonetic characteristics and in number. The study showed how languages such as English and Spanish contrast in their presence or lack of aspiration in production of stops. Studies that followed, such as Cho and Ladefoged (1999), revealed that consonants within the voiceless stops category can be further distinguished by their VOT values. Data from multiple speakers of 18 languages was investigated with the conclusion that velar stops have the longest VOTs in the languages that do not contrast between velar and uvular stops, while in many other languages the difference in VOT between bilabial and alveolar stops is not significant. They also concluded that the variation between languages is for the most part predictable if it is assumed that languages choose one of the three options for the degree of aspiration of voiceless stops.

Spanish and English voiceless stops in particular, received significant attention in literature. Castañeda Vicente (1986) set out to test if the results presented by Lisker and Abramson for Puerto Rican Spanish are also applicable to Castilian Spanish. She analyzed ten Castilian speakers pronouncing, for the most part, disyllabic words that contained stops in all possible combinations in stressed and non-stressed contexts. While the results that the author obtained were higher than the ones presented in previously mentioned study (although lower than the ones published in M. Dolores Poch (1984)), the patterns in two varieties were corresponding. In accordance with Cho & Ladefoged, the most posterior plosives proved to have the highest VOT values. The author pointed out that the VOT value tends to increase if the following vowel also has a posterior position, therefore, consonants before /u/ will express higher VOT measurements. In addition, stress was showed to play a role, with plosives in atonic position having on average 1.5 ms longer VOTs than in a tonic environment. Rosner *et al.* (2007) also focused on Castilian variety providing further evidence that Spanish voiceless stops seem to vary with dialect. He used Castañeda and Williams (1977b) studies, which utilized different lists of spoken items and recorded measurements in different ways as a starting point and calculated the VOT of 32 Castilian speakers using items presented in Williams. The results confirmed the main effects of voicing and place that were proved significant for Latin American Spanish dialects by Williams. The author also discovered that the post-consonantal vowel /o/ induced a later voicing for /p/ and /k/ in Castilian speakers,

while Williams did not report such results for Latin American variety, citing three references in support (Klatt, 1975; Smith & Westbury, 1975).

Zlatin (1974) and Klatt (1975) present work on variation of VOT with place within a word in American English. They reported changes in measurements as the identity of the following vowel or sonorant consonant after a plosive sound altered. VOT was reported to be longer before sonorants and high vowels than before middle and low vowels. The VOT for /p t k/ were observed to be shorter in postvocalic and pre-unstressed position; in addition, intervocalic segments were on average 15 ms shorter in word initial position if it followed a vowel from a previous word and 35 ms shorter in other intervocalic position within or at the end of a word, which shows that word initial segments are produced with the greatest amount of aspiration.

There are also multiple studies available that look at the Spanish and English VOT values in language learners, focusing on L1 transfer, as well as pedagogical implications. One of the first such investigations was done by González-Bueno (1997a) who looked at the L2 Spanish L1 English speakers' stop pronunciation in fourth semester Spanish learners. An experimental and a control group were interviewed in the beginning and at the end of the semester. The experimental groups received instructions on the pronunciation of the plosive segments throughout the semester, while the control group did not. The results from the pre and post-tests showed that the experimental group demonstrated significant improvement in the pronunciation of /p/ and /g/ in Spanish and there was evidence for a tendency towards improvement in other stop pronunciation. The control group, meanwhile, did not exhibit any significant progress in articulation of these segments. A study of a similar nature was done by Zampini (1998) who examined VOT production in L1 English learners of Spanish registered in an advanced undergraduate Spanish phonetics course. Learners were tested for production and perception 3 weeks prior to the instruction, 6 weeks shortly after training and 15 weeks later. The analysis of the data showed that students' production of /p/ in Spanish was significantly shorter compared to monolingual L1 English speakers. These VOT measurement, however, were still longer than in monolingual Spanish speakers. Also, although the production for this segment improved after instruction, the decrease in VOT did not prove to be significant.

A considerable amount of research on this subject was done comparing learners in a classroom setting in their home country with those registered in Spanish classes while studying abroad. Two of the standout studies are Díaz-Campos and Lazar (2003) and Díaz-Campos (2006). The first study looked at voiceless stop production in L2 Spanish by learners enrolled in a study abroad program in Spain and in those who were enrolled in a regular classroom in the United States. Both groups of students were asked to read a short text before the

start of the semester and then at the end of instruction period. Neither of the groups was taught explicitly any of the phonetic rules. Although, as was expected by the researchers, the VOT values for voiceless stops were influenced by the L1 of the participants, both groups still demonstrated a trend towards improvement in the pronunciation of /p t k/. In fact, those studying in the home country performed better than the learners registered in a study abroad class. What proved to be significant is the amount of instruction and self-reported use of Spanish outside of the classroom and not solely the learning environment. The next study by Díaz Campos expanded on the work of the previously described one by looking at the style of speech: formal, such as reading, versus informal, such as conversational speech. Once again two groups of L2 Spanish learners in classroom and study abroad settings were examined. The author found that students from both groups were more likely to produce /p t k/ with shorter VOTs during an informal conversation rather than during a reading activity. This time, however, it was the study abroad learners who produced more accurate results in word initial voiceless stops.

A study by Knightly *et al.* (2003) took yet another group of learners and explored the effect of childhood exposure to Spanish on the pronunciation of L2 Spanish. Three groups of participants were observed in their production of the voiceless stops: L1 Spanish-English bilinguals, late L2 Spanish learners who heard Spanish during childhood, but spoke English as their L1, and late L2 Spanish learners who qualify as the “typical late learners” and not as “childhood overhearers”. The results revealed that childhood overhearers produced word-initial plosives with shorter VOTs than the late learners, but of a similar duration as that of the L1 Spanish speakers. In addition, the author also asked a group of native Spanish speakers to listen to the recordings of all the participants and rate their production for a degree of foreign accent. Once again, the childhood overhearers were ranked higher on the native-like scale than a typical late learner.

Llama, Cardoso and Collins (2007) conducted a study similar to the present one where they observed the VOT production of L3 Spanish learners looking to establish whether L2 status or typology would influence more strongly the L3 pronunciation. One set of participants was made up of L1 Canadian English speakers with advanced knowledge of L2 Canadian French and another of L1 Canadian French speakers with advanced knowledge of L2 Canadian English. Both groups were intermediate learners of Spanish. French, like Spanish, is classified as a short-lag language for voiceless stops, while English, as was previously discussed, is a long-lag language. If the classification of the language played a stronger role, L1 French speakers are expected to perform better in L3 Spanish, producing native-like VOTs, while L1 English speakers would produce the long-lag durations; however, if the L2 is more significant, than the results would be the opposite. The results proved that L2 status is more influential in the

prediction of the L3 stops than the L1. This interesting outcome is important to keep in mind when discussing the results of the present study.

Unfortunately, the Ukrainian language has not received much attention in the linguistics community, primarily because it was an oppressed language in its homeland, outlawed from time to time under Russian or Polish domination. Even until very recent years, speaking only or exclusively Ukrainian was often frowned upon by the pro-Russian political supporters, who remained in the country after its independence from Soviet Union in 1991 and who associate and promote this language as a lower class “peasant-talk”. As a result of this unfortunate history, all Ukrainian speakers are simultaneous bilinguals of both Ukrainian and Russian from birth. Nevertheless, throughout the years of repression of the Ukrainian language, the people of Ukraine managed to preserve it in its pure form. Unfortunately, this turbulent history is often falsely misinterpreted to mean that these two languages are the same, when in fact, Ukrainian and Russian are only 62% lexically similar, when Spanish and Italian share 75% of lexicon and English and German 60%. Fortunately, the Ukrainian political situation is changing and the Ukrainian language is now perceived as the ultimate definition of the national identity, which hopefully will bring about a wider interest in the language and more linguistic research. That being said, there is no available data on estimated VOT values for Ukrainian voiceless stops. Most studies that involve Ukrainian rely on the data provided by Ringen and Kulikov (2010) who worked with a group of Russian monolinguals from St. Petersburg and reported the following VOT values: /p/ - 18 ms, /t/ - 20 ms, /k/ - 38 ms. Since both Ukrainian and Russian are short lag languages, it can be safely assumed that these values are applicable to Ukrainian language as well.

To my knowledge, there have been no studies done yet on the cross-linguistic influence in the pronunciation between Ukrainian and Spanish. However, Hrycyna (2011) and Nagy & Kochetov (2011) provide an interesting insight into the speech of Ukrainian heritage speakers in an English environment. Both studies looked at the VOTs of voiceless stops in conversational speech of three generations of bilinguals whose heritage languages are Italian, Russian or Ukrainian (short-lag languages) and who speak English as their L1. The researchers found that the Russian community showed the biggest drift from short-lag to long-lag VOT between generations 2 and 3, possibly due to the lack of cohesive Russian community in Toronto and therefore, little opportunity to talk Russian casually besides at home. On the other hand, there is a large and active Ukrainian speaking community where one has a chance to speak the language casually with other generations. Therefore, the VOT shows the greatest drift from G1 to G2, where the second generation quickly adjusts to the norms of the already established community. Interestingly, no drift in the VOT duration across generations was found among Italian speakers. Nagy and Kochetov mention that

there is great amount of institutional support for Italian in Toronto, which means that many third generation speakers may have the greatest quantity of input from the classroom, and not just family, which attributes to the preservation of short-lag VOT.

### **3 Present study**

Taking into consideration all of the previous research done on the VOT of voiceless stops, this study will examine the production of /p t k/ in word initial position in Spanish by L1 English and L1 Ukrainian speakers who had limited exposure to the language. Our specific research questions are:

1. Will these speakers without knowledge of Spanish and its phonological rules transfer the L1 production of plosives (English – long lag; Ukrainian – short lag) into the unfamiliar language or will they come up with a different production pattern?
2. Will the knowledge of English and long residence in the USA by Ukrainian speakers interfere with their plosive production in Spanish?

Our predictions are that both groups will transfer the VOT features from their native languages into the unfamiliar language, producing the Spanish segments as either long lag in the case of English speakers or short lag in the case of Ukrainian speakers. We also expect to see some influence of English in Ukrainian speakers who lived in the United States the longest and have the largest amount of exposure to English in their daily life.

### **4 Methodology**

#### **4.1 Participants**

There were three participants in each group. All of the contributors were recruited by the author of the study herself who knew them personally and was aware that they had limited exposure to the Spanish language and were also not familiar with any of the linguistic fields – especially phonetics and phonology. While it was relatively easily to find participants for the L1 English group who spent all of their lives in the United States and did not speak any other languages, it proved to be a challenge to do so for the L1 Ukrainian group. As was mentioned previously, nearly all Ukrainians are simultaneous bilinguals in Ukrainian and Russian. While all of the participants went to Ukrainian schools and Ukrainian was the language spoken at home, they were also constantly exposed to Russian through various means of communication, such as friends and family members, and at the

universities where the official language of instruction was Russian during the Soviet Union period. In general, it is very difficult to find true Ukrainian monolinguals, but since Ukrainian and Russian share the short lag feature in voiceless plosives, the Russian influence is not expected to have any effect. Also, all of the Ukrainian participants currently reside in the United States and have been living in this country for 11-21 years, making English their L3. More information on the participants based on their personal assessments can be found in the charts below. NU stands for native Ukrainian speakers and NE for English native speakers.

Table 1. L1 Ukrainian participants

Participant	Years in US	L2	Years of exposure to L2	Exposure to Spanish	Age	Gender	Place of birth
NU1	21	English	38	limited	51	F	Kam'yanec Podilsk
NU2	12	English	38	limited	49	M	Vyshneve
NU3	11	English	38	limited	49	F	Kyiv

Table 2: L1 English participants

Participant	L2	Years of exposure to L2	Proficiency in L2	Age	Gender	POB
NE1	Spanish	2 years	"Poor"	51	M	WI
NE2	Spanish	2 years	"Terrible"	49	M	PA
NE3	Spanish	2 years	"Low"	49	M	TX

## 4.2 Procedures

Each speaker was interviewed individually. On the day of the interview the participant was greeted and spoken to exclusively in his or her L1. They were first asked to fill out a short language history questionnaire [included in Appendix A] that took approximately 5-10 minutes, to acquire general information about gender, age, place of birth, languages spoken and studied, place and length of residence in a particular location.

After the questionnaire, participants were recorded using a Lenovo IdeaPad Yoga 13 laptop, a Blue Snowflake Compact USB microphone and *Praat*

in a quiet location. They were asked to read a list of sentences in the format of “*I say + [word]*” in their L1 and then in Spanish [included in Appendix B]. Each set of sentences was randomized and also included ten additional distracter words in order to prevent speakers from guessing what they were being tested for. English and Spanish lists had 15 items that were tested and Ukrainian had 24. More words were added to the Ukrainian list since there is very limited data available on the language and it was useful to have extra tokens. Each word was selected so the voiceless plosive element appeared in the word's initial position followed by a noun. For the Ukrainian tokens the position within the word – word initial or word median – was also taken into consideration, once again, because very little information is available on this language and it was important to establish whether word position played a significant role.

The words in the Ukrainian and Spanish lists were disyllabic with a stress on the first syllable. The English words also carried a stress on the first syllable, but the list included monosyllabic, disyllabic and multisyllabic words because of the difficulty finding only appropriate disyllabic tokens in this language.

The words in the L1 were real words, while in Spanish they were nonce words. It was important to select real words in the native languages since speakers are able to speak, read and write them and, therefore, pronounce the statements naturally. Choosing nonce words for L1 would have provided unnatural results and possibly would have affected data negatively. Alternatively, it was essential to choose nonce words for Spanish since speakers were not familiar with the language. Reading real Spanish words would have been too challenging for the participants and might have raised their affective filter. Therefore, instead of providing natural, instinctual production of the elements, the results would most likely will have been skewed.

## 5 Data analysis

Each token was analyzed in *Praat* to determine whether the voiceless stops were produced with a long lag or short lag. Each plosive segment was measured in ms between the plosive moment where the wave changed from an inactive to active state and the initial voiced moment – the initial cycle of a periodic wave. The measurements were entered into an Excel file for each segment individually whereas later they were compiled into a separate graph for each speaker, as well as for each of the two speaker groups.

Below three examples of spectrograms taken from *Praat* show a voiceless plosive segment production in English (figure 1), Spanish (figure 2) and Ukrainian (figure 3).

Figure 1: English production of /t/ in *television* /'telɪvɪʒən/

## Influence of L1 on VOT production in Spanish

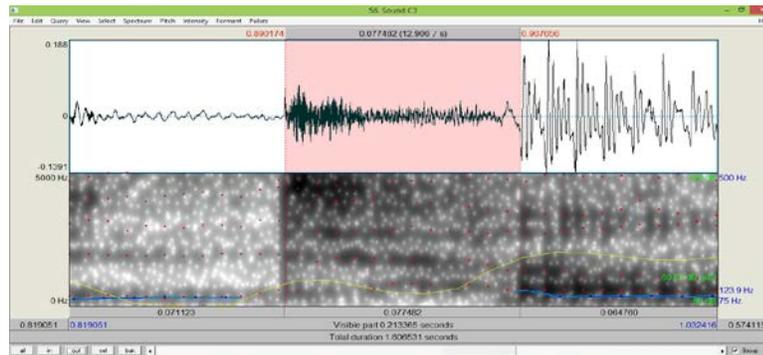


Figure 2: Spanish production of /p/ in *papa* /'papa/ “potato”

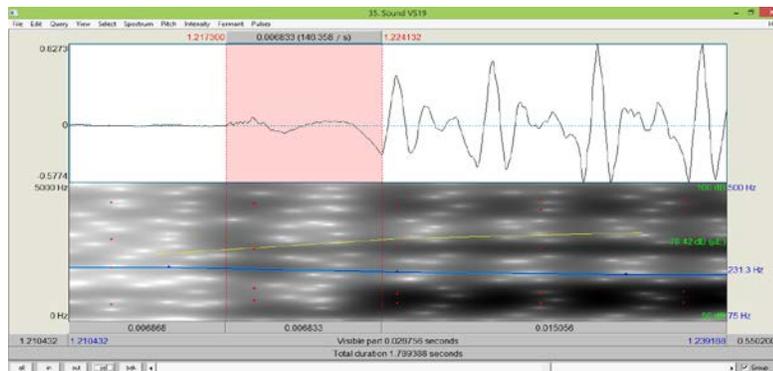
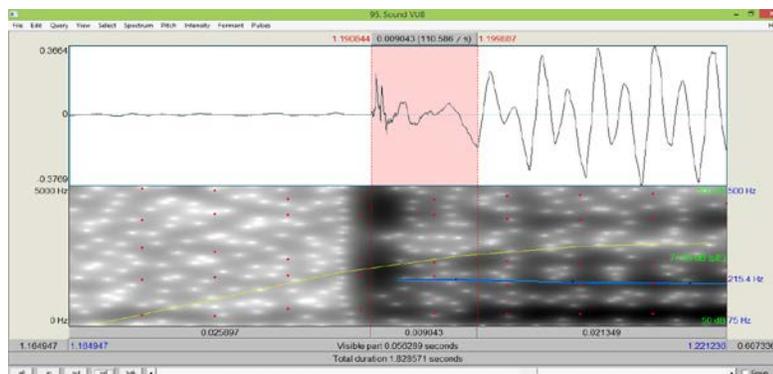


Figure 3: Ukrainian production of /p/ in *numu* /'piti/ “to drink”



From the following examples we can see that the English voiceless plosive segment is produced with a long lag, measuring at 77.5 ms; the Spanish and Ukrainian stops are produced with a short lag, measuring at 6.8 and 9 ms each – well below the 30 ms mark.

During the analysis of the data one issue was discovered. In Ukrainian, when a consonant is followed by high front vowel /i/, it goes through the process of palatalization or partial palatalization. In case of voiceless stops, /t/ becomes completely palatalized and /p/ and /k/ partially palatalized. While any words that included a pairing of a voiceless plosive with /i/ were avoided from the very beginning in the Ukrainian word list, in Spanish, words like /pipi/, /titi/ and /kiki/ were included since both English and Ukrainian speakers were asked to pronounce these words. When the data was analyzed in *Praat* and the sounds did not appear as plosives in the production of Ukrainian speakers, these tokens were removed from the analysis.

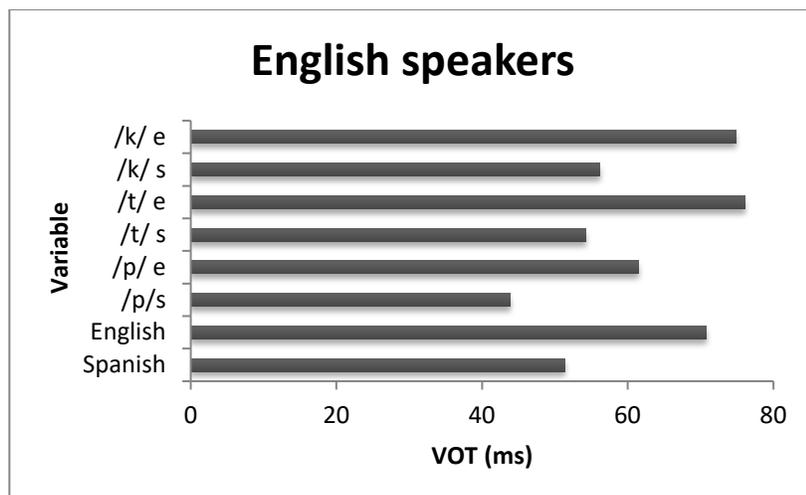
## 6 Results

The VOT measurements for native languages and Spanish obtained for both groups of speakers for voiceless plosives /p t k/ in initial stressed position are displayed in the following two tables:

Table 3: VOT measures for Ukrainian speakers



Table 4: VOT measures for English speakers



The results displayed above follow rather closely the initial predictions. English speakers' data confirmed the classification of English as a long lag language, measuring the VOT on average at 70.8 ms. Ukrainian speakers' data placed the language at a little over the 30 ms limit, at 31.2 ms, which technically is reserved for a long lag language. Nevertheless, when we look at the phonemes individually, it becomes clear that the results were strongly affected by the velar stop /k/, which displayed a VOT of 40.25 ms. While at first this seems to be unexpected considering that Ukrainian is classified as a short lag language, Kulikov has presented similar results in Russian monolingual speech where /k/ was the longest phoneme with a 38 ms VOT. As was previously reported in Cho & Ladefoged (1999), it is expected that the velar segments will have the longest VOT measurements due to their furthest point of articulation and the amount of time it takes for the sound to travel. The bilabial and dental phonemes /p/ and /t/ at 19.08 and 17.9 ms respectively, clearly show that Ukrainian is a short lag language, especially, when this data is compared to English where these phonemes measures at 61.5 and 76.1 ms. Not displayed on the graph are the VOT values for initial versus internal position in Ukrainian. It was found that the VOT value for initial stressed position, which measured at 33.3 ms, was longer than the internal unstressed position, measured at 29.2 ms. The current study will not focus on these results, but it will definitely need more investigation in the future to confirm the significance of word position and stress.

When looking at the participants' production of Spanish segments, the hypothesis that L1 language transfer will influence the results are confirmed. Ukrainian speakers produced Spanish voiceless stops with a short lag, with an average VOT length of 27.2, while English speakers pronounced the same segments with a long lag, with an average VOT of 51.4. Not only do we see the short and long lag features being transferred, the general patterns from L1 are also

appearing in Spanish. For example, Ukrainian speakers produced the Spanish velar segment with a considerably longer VOT like in their native language, while /t/ and /p/ were much shorter, with the former being the shortest and the latter slightly longer – the same pattern displayed in Ukrainian. English speakers also followed rather closely the pattern presented in their L1. Although English /t/ was slightly longer than /k/, the bilabial segment was the shortest in both languages.

The second question was whether Ukrainian speakers will display an influence of English (due to the many years of residence in the United States and everyday exposure to the language) in their pronunciation of the Spanish phonemes. Looking at the group of participants as a whole, it is hard to draw any definite conclusions. It is the individual results for each speaker that give us better insight into the issue.

Table 5: NU3

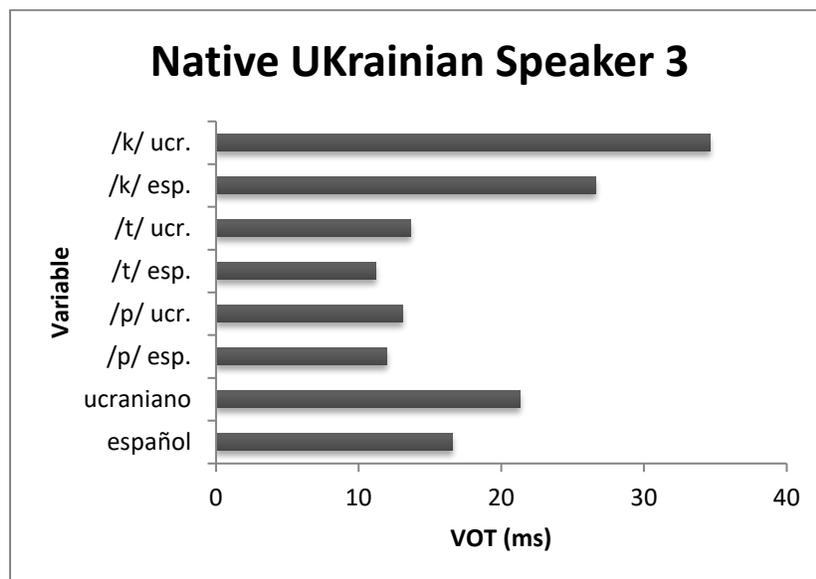


Table 5 shows results produced by a Ukrainian speaker (NU3) that spent the least amount of time in the United States among the three participants. This informant also started working at a full time job in this country the latest and, therefore, a steady and constant exposure to the English language began later for her as well. In addition, it is also known that this speaker rarely utilizes the English language outside of the working environment and prefers to communicate in Ukrainian on a daily basis. She is the only participant among the three that travels to Ukraine regularly (at least once a year) and maintains daily and very close contact with the family in her home country. Also, this speaker regularly reads Ukrainian (and Russian) books and newspapers, listens to Ukrainian music

and watches Ukrainian news and movies, much more often than the other two speakers. This attitude and close connection to the Ukrainian language is clearly reflected in the VOT results of the speaker, since this informant displayed the lowest VOT values for both Ukrainian and Spanish in the experiment. The other two participants' individual results have crossed over the 30 ms cutoff line for the short lag VOT measures.

All three English speakers produced regular patterns in their data; most likely, it is due to the fact that they share a more similar background in contrast to the Ukrainian speakers. Also, there is no influence of any other language besides English.

From the results of both Ukrainian and English speakers it can be seen that, as a general pattern, the Spanish voiceless plosive segments were produced with a shorter VOT than in their native languages. One possible explanation for this outcome is the format of the task. Speakers were asked to read a list of sentences instead of reading a paragraph or a short story, or answer questions in an informal conversation. This type of task is usually less distracting and allows participants to focus more on their pronunciation, often exaggerating the items that are being recorded. This effect is noticeable in the native language data when speakers speak slower, louder and more clearly, but it is even more obvious in the production of the unfamiliar foreign words. It is only natural for a person to pronounce very carefully a word that they are not used to seeing or saying, which is most likely the reason behind shorter Spanish VOT measurements.

## **7 Discussion and Conclusion**

The following study set out to examine the VOT production of Spanish voiceless plosive segments /p t k/ by native speakers of Ukrainian and English. Ukrainian and Spanish are languages with a short lag VOT, while English is a long lag language. The question was whether the speakers of these two languages with limited knowledge of Spanish and its phonological rules will transfer the VOT features of their L1 or display different results. Also, it was investigated whether English influenced the VOT production of Ukrainian speakers who lived in the United States for over ten years and have daily exposure to the language. The results supported our initial hypothesis that Ukrainian speakers will perform better on the task and produce Spanish segments with a short lag VOT in comparison to the English speakers who pronounced the same segments with a long lag VOT. While the large scale results did not indicate English influence in the speech of Ukrainian participants, looking at individual reports for each informant demonstrated that those individuals who lived in the US the longest and who had the least amount of daily exposure to Ukrainian also demonstrate the longest VOT values in Ukrainian.

The main contribution of the current study is that it has allowed us to establish a comparison between the languages that have never been looked at together in this particular combination – Ukrainian, English and Spanish. It has also provided critical information about the VOT values in the Ukrainian language that will allow future research either in Ukrainian or other Slavic languages to have a point of reference. In addition, it further investigated the role of L1 in the acquisition of foreign languages and how its interference and transfer influences the production.

In the future, this study can be expanded to investigate truly monolingual populations (or bilinguals in case of Ukrainian and Russian) to avoid problems of another language's interference. It can also take into consideration the phonological environments and look at the behavior of voiceless plosives around different vowels and consonants, in various positions of a word or sentence and under different stress conditions. To obtain perhaps more natural results, it is also advised that speakers perform tasks such as reading a longer text or participating in an informal interview.

This study, although just the first step towards a more extensive research on Ukrainian, is able to provide better insight into other Slavic languages as well, and their influence on the acquisition of Spanish and other Romance languages.

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