

# CROSS-LINGUISTIC INFLUENCE IN THIRD LANGUAGE ACQUISITION OF VOICE ONSET TIME

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## ABSTRACT

The paper aims to investigate the sources of cross-linguistic influence in the acquisition of voice onset time patterns in third language phonology. Thirty two learners of L3 French with L1 Polish and L2 English were recorded reading lists of words in carrier phrases in the three respective languages. The recordings were analyzed for the degree of aspiration of voiceless stops in stressed onset positions. The results revealed interlanguage VOT patterns, including compromise values for L3 VOT that could be attributed to a combined influence of L1 and L2, thus substantiating the existence of both native and non-native cross-linguistic influence in L3 phonology.

**Keywords:** VOT, acquisition of third language (L3) phonology, cross-linguistic influence (CLI).

## 1. INTRODUCTION

Current theories and empirical investigations into the acquisition of the phonology of a foreign language focus primarily on the influence of the native language (L1) on a second language (L2). However, there is a rapidly growing recognition that due to the complexity of cross-linguistic influence, Third Language Acquisition (TLA) is a separate field of inquiry and scholars have started to differentiate between the acquisition of an L2 and other subsequent languages [1, 2]. The acquisition of a third language (L3) phonology is a particularly young subdiscipline and research in this area has been limited in scope compared to that on L3 lexis and morphosyntax [3, 4, 5].

Traditionally, cross-linguistic influence (CLI) has been perceived to be of a one-to-one type between the source and the target language, yet the TLA perspective posits a combined CLI that involves simultaneous influence of more than one previously acquired languages on the target language [2]. Non-native languages have not been regarded as significant sources of CLI in contrast to the widely attested transfer from the L1 of the

multilingual learners [6]. However, more recent research points to an important role of the L2 in L3 phonological acquisition that is referred to as L2 status or 'foreign language effect' [3, 4, 5]. In a longitudinal study Hammarberg and Hammarberg [3] demonstrated the tendency to resort to L2 articulatory setting that overrides L1 transfer at the initial stages of L3 acquisition. Wrembel [5] confirmed these findings in an accent judgement study of L3 learners of English with L1 Polish/ L2 German. Specific aspects related to perceived foreign accentedness in L3 such as voice onset time (VOT) have been investigated in only few preliminary studies to date [4, 7]. Llana et al. [4] concluded that L2 status rather than typological relatedness is the factor determining the source of transfer of VOT patterns for L3 Spanish learners with L1 French/L2 English and L1 English/L2 French. Wunder's [7] results were mixed pointing to some non-native cross-linguistic influence on L3 phonology and combined L1 German and L2 English influence on L3 Spanish aspiration patterns. The present contribution is expected to provide new insights into the multidirectionality of transfer of VOT patterns in trilingual acquisition.

## 2. EXPERIMENT

The study aimed to investigate sources of cross-linguistic influence (CLI) in the acquisition of VOT in L3 French by L1 Polish learners with advanced L2 English. The languages involved make a distinction between 2 categories of stops but differ in terms how they distinguish them phonemically; with voiceless aspirated and voiceless unaspirated in English and voiced and voiceless unaspirated in French and Polish. Thus /p, t, k/ are implemented as short-lag stops in French and Polish (mean VOT of about 20-30 ms) and long-lag in English (c. 60-80 ms) [8, 9, 10].

The following research questions were asked: (1) Do multilingual subjects differentiate between L1/L2/L3 with respect to VOT? (2) Are L1 Polish VOT values affected by L2 or L3 values? (3) Do

L2 English VOT values approximate native English norms? (4) Do L3 French VOT values approximate L1 Polish/L2 English or French native norms? (4) Is there a category assimilation observed for L3 VOT? (5) Is there a group effect found in VOT values with respect to the amount of L3 exposure? (6) Are universal effects of the place of articulation and vowel context observed in L3 VOT patterns?

## 2.1. Method

### 2.1.1. Participants

The participants included 32 Polish university students (24 female and 8 male; with a mean age of 19.8 years) who have been learning English as their L2 and French as L3. They were highly proficient in English (C1 level according to CEFR; mean years of formal training YFT=11; mean age of onset AO=9), however, they differed in the length of French learning experience; Group 1 (N=16, A1 level; YFT=2; AO=17) vs. Group 2 (N=16, B1 level; YFT=5, AO=14).

### 2.1.2. Procedure

The data were collected in all three languages of the multilingual participants. The stimuli consisted of three lists with 12 target words in Polish, English and French. The target words included voiceless plosives /p, t, k/ in stressed onset positions in the following context of high vs. non-high vowels, in mono- and disyllabic words, thus generating a total of 12 items per language list. The words were randomized and embedded in carrier phrases in the respective language (*I am saying ..., Mówię teraz ..., Je dis ...*). The recordings were made in a clearly specified language mode in the natural order of acquisition, with Polish as first, English as second and French as third. The participants were asked to read the lists at a natural speed with a few minutes break interval between the recordings. The interaction with the researcher was carried out in the language of the subsequent recording to promote activation of respective languages. A language background questionnaire was then administered to tap the subjects' language history and use.

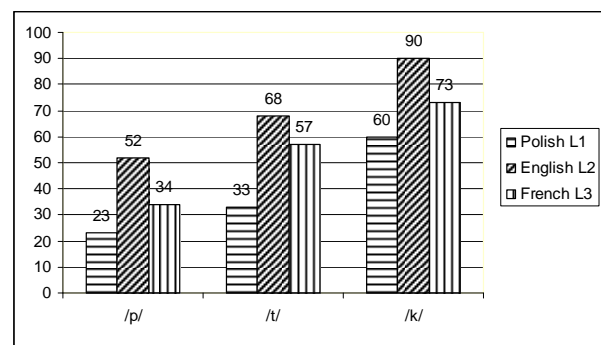
The stimuli were recorded using CoolEdit 96 as 16-bit mono files at 16 000Hz sampling frequency. Tokens were excluded from the analysis if the target words were mispronounced. A total of 1148 tokens was subject to an acoustic analysis

performed using PRAAT 5.2.15. Voice onset time was measured in milliseconds (ms) as the interval between the release burst and the beginning of regular vocal cord vibrations.

## 2.2. Results

The acoustic measurements of voice onset time in Polish, English and French target words yielded mean values presented in Figure 1. A pairwise comparison of the mean VOT values for the subjects' L1, L2 and L3 productions indicated that they differed significantly for all the pairs of the respective languages ( $p < 0.01$ ).

**Figure 1:** Mean VOT values in ms for /p, t, k/ in L1 Polish, L2 English and L3 French



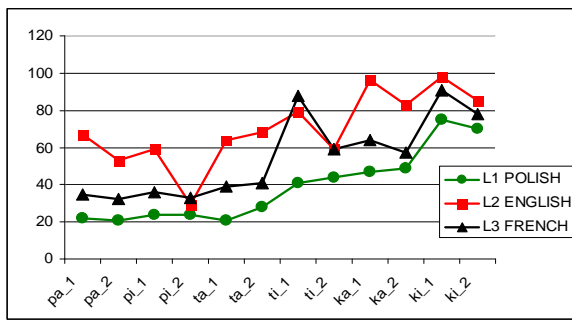
Independent t-tests were used to measure group effect for each target word separately (N=12) in Polish, English and French. No significant differences were found between VOT values with respect to the French language proficiency (Group 1 vs. Group 2), although more advanced subjects had a tendency for higher VOT (see Table 1).

**Table 1:** Group comparison for mean VOT (ms)

	Group	N	VOT	SD	t	p
Polish L1	1	16	37	18	0.34	0.67
	2	16	40	20		
English L2	1	16	68	19	0.46	0.64
	2	16	72	20		
French L3	1	16	53	21	0.29	0.7
	2	16	56	23		

The observed VOT patterns in L1, L2 and L3 revealed significant universal effects of the place of articulation (POA) and the vowel context as progressively longer VOT values were found in velars than in alveolars and bilabials ( $p < 0.01$ ); and VOT tended to be longer when a plosive followed a high rather than a low vowel, except for /p/. See Figure 2 for mean VOT distribution in C/i/ vs. C/a/ contexts in 3 sets of 12 target words.

**Figure 2:** Distribution of mean VOT for 12 target words in L1, L2 and L3; 2x /pa-, pi-, ta-, ti-, ka-, ki-/



The VOT measurements were compared to the reference values for Polish, English and French previously established in the literature [8, 9, 10] (see Table 2) and the subjects' mean VOT values were analysed to what extent they diverged from the monolingual norms.

**Table 2:** Reference VOT values in ms.

	Polish	English	French
/p/	22	59	18
/t/	28	67	23
/k/	52	84	32
	Keating et al. 1981	Lisker & Abramson 1964	Caramazza et al. 1973

The t-test comparisons for English yielded no significant difference between the subjects' L2 English VOT and the reference values. The results for L2 VOT measures fell within the accepted native range (5-10 ms difference). The aspirated English stops were implemented as long-lag and the subjects approximated the L2 phonetic norms successfully. The subjects were observed to 'overshoot' the VOT norms of English for /k/ (90ms vs. 84ms norm), while mean /p/ values in L2 English were produced with a shorter lag (52ms vs. 59ms norm), and /t/ equaled the mean standard values (68ms vs. 67 ms).

Significant differences were found for mean VOT for /p, t, k/ in L3 French compared to the monolingual norms (/p/  $t=7.4$ , /t/  $t=16.6$ , /k/  $t=14.6$ ,  $p<0.01$ ). The observed VOT lengthening in L3 French (/p/ 34ms vs. 18ms norm; /t/ 57ms vs. 23ms norm; /k/ 73ms vs. 32ms norm) resulted in 'compromise' values longer than typical Polish or French values but shorter than the English ones.

For Polish the difference between the monolingual norm and the subjects' production was not significant for /p/ (23ms), yet it narrowly reached significance for /t/ ( $t=3.9$ ), and /k/ ( $t=4.8$ ,  $p<0.01$ ). The values for /t, k/ were higher than for

Polish monolinguals; /t/ 33 vs. 28ms; /k/ 60 vs. 52ms, yet still within the accepted 5-10ms range.

A series of multivariate analyses of variance were performed to test whether there are interactions between (1) mean VOT measurements for /p, t, k/, (2) VOT for individual target words, and a combination of independent variables, including place of articulation (POA), language (Polish, English, French), group proficiency level (Group 1 vs. Group 2), and the target word. The results of the first ANOVA indicated that there are significant effects of POA ( $F=292$ ,  $p<0.01$ ), language ( $F=94$ ,  $p<0.01$ ) and language and POA interaction ( $F=15$ ,  $p<0.01$ ) on /p, t, k/ mean VOT values, however, no group effect was found. The second analysis, a mixed design ANOVA ( $3 \times 12 \times 2$ ), i.e. 3 languages, 12 target words, 2 groups, was performed to test individual VOT values in the target words. The results point to significant effects of language ( $F=83$ ,  $p<0.01$ ), target word ( $F=132$ ,  $p<0.01$ ), and language and word interaction ( $F=41$ ,  $p<0.01$ ). The means are not significantly different, however, for language and group or group and word interactions.

A regression analysis was performed to measure the interdependence between L3 French VOT values and independent variables including L1 Polish, L2 English, group effect (language proficiency) and place of articulation (POA). The R squared result indicated that 51% of the variance is accounted for by the independent variables, the exact contribution to R squared being: 61% - effect of POA ( $p<0.01$ ), 32% - effect of the Polish variable ( $p<0.01$ ), 7% - effect of the English variable ( $p=.05$ ). No significant effect of group on L3 values was found.

### 2.3. Discussion

As it was shown in numerous SLA studies, L2 production is affected by L1 interference and even experienced L2 learners produce L2 stops with VOT values between L1 and L2 phonetic norms [11, 12]. However, in the present study the multilingual subjects contrasted between VOT length in L1 Polish, L2 English and L3 French. The results show that Polish advanced learners of English produce long-lag voiceless plosives in L2 English with native-like values. This finding can be accounted for as a cumulative effect of several factors, including the subjects' early age of onset for L2 acquisition ( $M=9$ ), long exposure to the target language ( $M=11$  years), recency and

intensity of L2 use and explicit phonetic training. Still, the extent to which L2 values equaled or exceeded the English native norms is noteworthy compared to the results reported in SLA studies [8, 12]. On the other hand, some VOT lengthening in L1 Polish stops under the influence of well established L2 long-lag values can be interpreted as an evidence for the bi-directional nature of CLI or ‘regressive transfer’ and was observed previously in the SLA literature [11, 12].

The study focused on sources and directions of CLI for L3 acquisition of VOT patterns. It was expected that by transferring L1 VOT values into L3 the participants should be able to produce French voiceless stops in a native-like manner. This assumption of a prevailing L1 influence [6] was not substantiated as both elementary and lower-intermediate learners of L3 French produced French /p, t, k/ with significantly longer VOT values than French monolinguals. The reported L3 values corresponded to intermediate L1 and L2 mean VOT. The compromise or ‘hybrid’ VOT values provide evidence for the co-existence of L2 effect and underlying L1 interference, thus substantiating the assumption of a combined CLI in L3 acquisition [2]. The findings are consistent with previous L3 foreign accent studies [5, 7].

The category assimilation observed in L3 VOT values seems to be of a different nature than the one reported in the SLA literature [11] where we tend to have a hybrid between the native and target values. This is not confirmed in the present study as L3 VOT deviates both from the native Polish and target French values pointing to an intervening influence of a previously acquired foreign language (L2). The resulting category merger for L3 is between L1/L3 and L2 VOT values.

The difference in L3 French proficiency level between Group 1 and 2 was not found to be a significant predictor of VOT production. It would be interesting to investigate further the group effect on more diverse level samples (e.g. elementary vs. advanced). Finally, universal effects of the place of articulation on VOT length were observed systematically in all three language systems.

### 3. CONCLUSIONS

The study provides new insights into the growing area of phonological acquisition of a third language by identifying unique interlanguage VOT patterns. The multilingual subjects produced VOT with significantly different values differentiating

between /p, t, k/ plosives in all three language systems. In L1 Polish and L2 English they fell within the respective native VOT ranges with a tendency to exaggerate the norm. In the less proficient L3 French the subjects failed to approximate the norm although it could have been achieved by transferring the established L1 Polish short-lag values to L3 French. Instead, a combined cross-linguistic influence from L1 Polish and L2 English was observed resulting in compromise VOT values for L3 French. It provides further evidence for the L2 effect in the phonological acquisition of a third language although not to the extent found in previous L3 studies [3, 4, 5]. Future research will investigate whether this effect would be strengthened if L2 and L3 were typologically related languages.

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