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# The influence of segmental errors and stress-placement errors on Polish listeners' perceived degree of foreignaccentedness in non-native speech

## 1. Introduction

According to Bussmann (1996:3), a **foreign accent** can be defined as "[i]diosyncratic pronunciation of a foreign language, especially due to the articulatory or phonotactic characteristics of one's native language". It is typical for most individuals who acquire their L2 after their early childhood and it is usually easily perceived by all native listeners (Munro et al. 2006:67-68). Foreign accent has been previously researched by scholars such as Munro (1993) and Anderson-Hsieh et al. (1992), who determined that it is characterised by deviations from native speech in terms of segmental inventory as well as suprasegmental features.

There has been a significant amount of research on the factors which influence the form and degree of the foreign accent. Various socio-psychological factors can be impactful, as the severity of the foreignaccentedness varies from individual to individual, depending on their situation. As examples of such factors, Piske et al. (2001) list the presence of formal instruction or lack thereof, the motivation to learn, the frequency of L2 use, the age of learning, i.e., how old the individual was when they began to acquire the L2. Another factor that the researchers consider highly significant is length of residence, i.e., how long (and if) the learner has lived in a country where the L2 is spoken. Bongaerts (1999) adds that intensive training focused on the perception and production of the L2 speech sounds can significantly improve one's pronunciation of the second language.

Moreover, it is frequently assumed that individuals vary in their talent for foreign language learning. Aptitude tests such as the Modern Language Aptitude Test (MLAT, Carroll & Sapon 1959) and the Pimsleur Language

Aptitude Battery (PLAB, Pimsleur 1966) were designed to measure such abilities. In terms of accent acquisition, Hummel (2009) found oral proficiency to be linked to phonological memory and some of the measures appearing in the MLAT (Carroll & Sapon 1959). Baker-Smemoe & Haslam (2013) investigated the correlation between PLAB-measured language learning aptitude and pronunciation in a foreign language. The subjects' aptitude scores, especially for auditory aptitude, were linked with their pronunciation performance (Baker-Smemoe & Haslam 2013).

Despite the significance of the socio-psychological factors described above, various researchers claim that they are not as influential as transfer from one's L1. There are various approaches based on L1 transfer in L2 (cf. Weinreich 1953, Lado 1957, Oller & Ziahosseiny 1970, Wardhaugh 1970, Eckman 1977, 1991, Flege 1987, 1995, Major 1987, 2001, Best 1995, Kuhl & Iverson 1995, Best & Tyler 2007, Escudero 2007). There are minor differences between them. For instance, they have varying views on how transfer may be influenced by other factors such as markedness and universals.

The importance of transfer is supported by Bley-Vroman's (1989, 1990) Fundamental Difference Hypothesis, which claims that individuals learning a foreign language have no access to Universal Grammar (UG), making transfer possibly the most influential factor (Major 2008). What is more, Kellerman (1995, as cited in Major 2008) claims that there do not have to be correspondences between the structures of the L1 and the L2 for transfer to operate. According to his Transfer to Nowhere Principle, "there can be transfer which is not licensed by similarity to the L2 and the way the L2 works may very largely go unheeded" (Kellerman 1995:137, as cited in Major 2008:66).

Despite the variability between them, the accounts based on transfer generally agree that when learning the pronunciation in an L2, the individual uses the sound system of their native language as a basis rather than establishing a new, separate sound system for the foreign language. Thus, when hearing a new L2 segment, the learner is most likely to perceive it and consequently produce it as an instance of a similar segment present in their L1 sound inventory.

Therefore, according to the models based on L1 transfer, segments that are absent from one's native language are likely to be the ones to contain pronunciation errors. Similarly, the constraints which are at work in one's L1 may be applied to L2, which is also likely to cause deviations from

native production. Following the same logic, individuals tend to apply native stress assignment rules to utterances they produce in the foreign language (Magen 1998, Major 2001, Missaglia 1999). Additionally, based on the same claims, one could expect that native speakers listening to such speech would easily perceive the errors resulting in the production of incorrect segments present in their sound inventory.

The research reviewed thus far has attempted to explain which factors influence foreign accent production having such a foundation facilitated the design of appropriate stimuli to be employed in this study. It was necessary for the creation of sentences to be read aloud and recorded by learners that would generate a foreign accent which was easily perceivable by the native speaker listeners. As this study focuses on the influence of particular types of pronunciation errors on how foreign accents are perceived, the remainder of this section reviews relevant literature on the issue.

Processing foreignaccented speech appears to differ from the processing of unaccented speech. Firstly, several studies confirm that accented speech is processed slower (Floccia et al. 2006, Munro & Derwing 1995, Clarke & Garret 2004). Additionally, even though some non-native speakers who produce accented speech can be rated as high as native speakers on intelligibility (Bent & Bradlow 2003), in the majority of the cases, foreignaccented speech seems to influence the accuracy of the processing (Gass & Varonis 1984**,** Mason 1946, Labov & Ash 1997). Some studies even suggest that different strategies may be employed when processing foreignaccented and native speech. Bürki-Cohen et al. (2001) suggest that listeners heavily rely on lexical information and the frequency of vocabulary items when processing speech produced by non-native speakers (NNS). The researchers claim that this information is not as significant for speech produced by native speakers (NS) (Bürki-Cohen et al. 2001).

The perceived degree of foreignaccentedness may depend on the listener's subjectivity. According to Rubin (1992) and Jannedy & Weirich (2014), merely an expectation of a foreign accent, which may arise e.g., from the speaker's appearance or name, can influence the perception of a speech sample. Moreover, Lindemann (2002, 2010) and Anderson-Hsieh & Koehler (1988) found that listeners' attitudes can impact accent judgements. Factors such as opinions regarding the country of the speaker's origin (Beinhoff 2013) or the perceived pleasantness of how the speech sounds (Radomski & Szpyra-Kozłowska 2014) also appear to be of importance.

However, apart from the subjective judgements, what significantly influences foreignaccent perception are pronunciation differences, which are the main focus of this paper. Scovel (1995) claims that listeners base their perception on the pronunciation of vowels and consonants as well as suprasegmental information.

There have been several studies focusing on the impact of vowel quality on perceived foreignaccentedness. While some researchers (e.g., Magen 1998, who studied Spanish accented English) found the factor to be of little importance, while others found it to be significant (e.g., Munro 1993 for Arabic accented English). Some claim that vowel pronunciation errors are more influential than consonantal deviations (e.g., Rekart 1985 for Spanish accented English, Ingram & Pittam 1987 for Vietnamese accented English). Conversely, researchers such as Magen (1998) found consonant mispronunciation to have a much greater impact.

There are several studies according to which even minor differences in the pronunciation of consonants, such as Voice Onset Time (VOT), are significant for the listeners' perception (see Riney & Takagi 1999 for Japanese accented English). However, many researchers decide to research segmental errors as a whole group of deviations (see Kashiwagi & Snyder 2010 for Japanese accented English, Trofimovich & Isaacs 2012 for French accented English). The same approach will be applied in this study.

Errors in stress assignment also influence the perception of foreignaccented speech. Field (2005) showed that speech with this type of deviation from the native norm is less comprehensible for the listeners. It appears that incorrectly stressed words may make lexical retrieval much more difficult (Knaus et al. 2007).

Some of the previous studies have aimed to establish which factor has the most influence on the participants' (foreignaccentedness) assessments of the foreign accent. Several researchers claim errors related to prosody are more influential than segmental features. Such a pattern was observed by Anderson-Hsieh et al. (1992), who compared segmental, prosodic, and syllable structure errors. The researchers treated different types of prosodic errors as one group. Johansson (1987) compared segmental and intonation-related errors and observed the latter to be of more importance.

Conversely, when Jilka (2000, who studied English accented German) compared the same types of errors, she found segmental deviations to be

more influential. While the studies described above juxtaposed segmental and suprasegmental errors, none of them focused specifically on the difference between segmental errors and stress-assignment errors.

The discrepancies in the results obtained in the research described above are at least partly justified by the different origins of both the speakers and the listeners participating in the studies. Anderson-Hsieh et al. (1992) point out the significance of that factor. The match or mismatch in the phonology and phonotactics of the L1-L2 pair is of great importance. That is why the researchers decided to study different types of errors (e.g. focusing on vowels, consonants or stress assignment). To the best of my knowledge, most studies on the perception of a foreign accent are strongly biased toward the English language. In other words, they most often investigate errors produced by different L1 speakers pronouncing L2 English.

The variability in native speaker perception depending on their L1 is especially notable when it comes to stress perception. Namely, speakers of some languages experience stress "deafness", which is a "difficulty with the perception of stress at a phonological level" (Peperkamp et al. 2010:423). In other words, speakers of languages characterised by highly predictable lexical stress have a strong tendency not to perceive lexical stress misplacement. The research conducted on the issue suggests that it depends on the number of exceptions to the stress rules of a given language (cf. Dupoux et al. 1997, Dupoux et al. 2001, Peperkamp et al. 2010, Domahs et al. 2012).

The study presented in this paper focuses on Polish listeners. They are an understudied group in terms of foreign accent perception. To the best of my knowledge, the only study related to the issue was conducted by Radomski & Szpyra Kozłowska (2014). However, the aim of their study was not to determine which factors cause non-native speech to be perceived as foreignaccented. Instead, they investigated the influence of the speaker's origins on how Polish listeners assess the accent and personality traits of the speaker. In other words, the authors focused on the listeners' attitudes rather than phonological and phonetic factors of the speech to which they were listening.

Additionally, native speakers of Polish constitute an interesting listener group as the lexical stress rule in that language does not have many exceptions. Consequently, according to Peperkamp et al. (2010), Polish listeners tend to show at least a weak stress "deafness". It is referred to

as "weak" as they perform somewhat better than speakers of languages such as French, which do not have exceptions from the stress rule at all (Peperkamp et al. 2010).

## 2. Characteristics of researched languages

The three speaker groups were chosen based on the characteristics of the languages. Spanish has a sound inventory that is quite different from Polish, compared to the other two languages. Russian, in turn, has the most differing stress pattern (free stress). This section provides some more details about the pronunciation in all four languages.

In Polish, there are six monophthongs ([i], [ɨ], [u], [ɛ], [ɔ], and [a]) and two nasal diphthongs ([ɛ̃w̃] and [ɔ̃w̃]) (Krifka et al. 2014). The language has a rich consonant system (see Table 1). Additionally, consonant clustering is very common (Jassem 2003). Consonant clusters occurring word-initially are not simplified, even during fast-paced speech (Jassem 2003). As far as lexical stress placement is concerned, it most often falls on the penultimate syllable, with some rare exceptions where it falls on the antepenultimate syllable (Newlin-Łukowicz 2012).

Russian, similarly to Polish, has a rich consonant system (Jones & Ward 2010). However, Russian consonant clusters cannot contain more than four consonants (Chew 2003), and when they are comprised of three or more sounds, they are reduced through deletion (Yanushevskaya & Bunčić, 2015). Russian does not contain any of the sibilants [ɕ], [ʑ], [tɕ], [dʑ] or nasal vowels (Jones & Ward 2010). Nonetheless, it does contain palatalised counterparts of consonants such as [s] and [z]. There was a possibility that Polish speakers could perceive the palatalised consonants as foreign-sounding instances of the Polish [ɕ] and [ʑ], respectively. Czech does not contain any of the Polish sounds which are problematic for speakers of Russian, or the vowel [ɨ] (Krifka et al. 2014). Finally, the sounds [ɨ], [ɕ], [ʑ], [v], [ts], and [dz] do not occur in the Spanish language (Martínez-Celdrán et al. 2003), which would make it the most different from Polish out of the three. The author hypothesised that a greater variety in the mispronounced sounds would lead the listeners to perceive the stimuli as the most strongly foreign-accented.

In the Russian language, the stress is free; i.e., it can be assigned to any syllable of a word (Yanushevskaya & Bunčić 2015), which would make it the most different from Polish out of the three languages. The author hy-

Table 1. Polish consonant phonemes (adapted from Jassem 2003, p. 103)

| consonant | | labial, labio-dental | (post) dental | alveolar | alveolo-palatal | palatal | velar |
|---|---|---|---|---|---|---|---|
| plosive | voiceless | **p** | **t** | | | [c] **ki** | **K** |
| | voiced | **b** | **d** | | | [ɟ] **gi** | **G** |
| nasal | | **m** | **n** | | | [ɲ] **ń, ni** | [ŋ] **n** |
| fricative | voiceless | **f** | **s** | [ʃ] **sz** | [ɕ] **ś, si** | | [x] **ch, h** |
| | voiced | [v] **w** | **z** | [ʒ] **ż** | [ʑ] **ź, zi** | | |
| affricate | voiceless | | [ts] **c** | [tʃ] **cz** | [tɕ] **ć, ci** | | |
| | voiced | | **dz** | [dʒ]**dż** | [dʑ] **dź, dzi** | | |
| lateral | | | **l** | | | | |
| flap/trill | | | | r | | | |
| | | **front** | | **back** | | | |
| approximant | | **j** | | [w] **ł** | | | |

pothesised that this would lead the listeners to perceive Russian-produced stress placement errors as the most heavily foreign-accented. In Czech, lexical stress is fixed and falls on the word-initial syllable (Dvořak 2008). In Spanish, while most words are stressed on the penultimate syllable, lexical stress can fall on any of the last three syllables of a word. However, even though lexical items ending in -n or -s tend to be stressed on the penultimate syllable, up to 95% of Spanish words "could be described by the following generalizations. If the final syllable is closed, stress is final. If it is open, stress is penultimate" (Kijak 2009:54).

Based on the sound systems of the languages, the author's predictions were as follows:

(1) The L1 of the speakers and the type of errors (segmental vs stress-placement) combined will influence the perceived foreignaccentedness.

(2) For segmental errors, Spanish speakers' speech samples will generate the highest foreignaccentedness ratings.

(3) For stress-placement errors, Russian speakers' speech samples will generate the highest foreignaccentedness ratings.

(4) Generally, segmental errors will generate higher ratings than stress-placement errors.

## 3. Method

The experiment presented in this paper was conducted in the years 2020-2021. It was carried out entirely online[1] employing the research platform FindingFive. The platform was used during the main part of the experiment as well as the pre-tests and stimuli collection.

### Materials

The stimuli consisted of sixty passages, each two to three sentences long (16 words on average). Each stimulus was a separate text unrelated content-wise to the other stimuli. Each passage was designed to contain two lexical items challenging for Polish learners belonging to three L1 groups: speakers of Spanish, Czech, and Russian. The critical words were never

[1] Conducting the experiment in person was impossible, as the regulations introduced in relation to the COVID-19 pandemic were being enforced at the time of data collection.

located at the very beginning or the end of the stimulus. There were twenty passages prepared for each group of learners. Ten of them were meant to generate mispronunciation of segments, i.e., **segmental errors**, the remaining ten were intended to generate **stress-assignment errors**.

In order to design stimuli that would generate the desired errors, Russian, Czech, and Spanish were compared to the Polish language. Each passage intended to generate segmental errors contained two segments absent from the learner's native sound system. For Russian those sounds included, e.g., [ɕ], [ʑ], [tɕ], or [dʑ]; for Czech, e.g., [ɨ], [ɕ], [ʑ], [tɕ], or [dʑ]; and for Spanish, e.g., [i], [ɕ], [ʑ], [v], [ts], or [dz]. Each passage intended to generate stress-placement errors contained two lexical items, which, if the learners applied their L1 stress-assignment rules, would result in the stress being placed on a syllable different from that stressed by native speakers of Polish, who stress most words on the penultimate syllable. For the Czech language, that included words with more than two syllables, as in Czech, it is the first syllable that is stressed. Therefore, the items intended to trigger stress-placement errors in speakers of Czech origin were at least four syllables long. In Spanish, the syllable bearing the stress tends to be the penultimate syllable if the lexical item ends in an open syllable and the word-final syllable if it is a closed syllable. Thus, each passage recorded by a Spanish learner of Polish contained two lexical items ending in a closed syllable. Finally, as Russian has a free stress pattern, in order to generate stress-placement errors, each passage contained two Russian-Polish cognates. The cognates were selected so that the stress would be put on a different syllable in both languages. A complete list of the stimuli can be found in the appendix.

The passages were read out loud and recorded by five speakers from each L1 group. All of them had an intermediate level of proficiency in the Polish language. The level was self-assessed and confirmed by the author's subjective judgement. Every speaker was living in Poland at the time when they recorded their speech. However, none of them grew up as bilingual speakers, meaning that they could be considered representative of most Polish learners with the same national origins. All of the learners were male and of a similar age (between thirty and forty years old) to avoid the influence of the timbre of the voice on the listeners' perception. Initially, the gender of the speakers was intended to be counterbalanced; however, finding enough suitable female speakers was not possible because of the time constraints.

The learners were instructed to read the passages as fluently as possible. They had the possibility of re-recording each passage in order to obtain high-quality data containing no stuttering or background noises. However, it was made clear that the Polish learners should not correct pronunciation errors that did not disrupt the fluency of their speech. The speakers used their own equipment (microphones and computers) to record the speech samples, as the research was carried out entirely online. The speakers were provided with a link to an online form with detailed instructions on how they should record themselves. The audio files were then saved as the participants' answers and became immediately available for the author to download. Despite the procedure being unsupervised in real time, carefully prepared stimuli allowed for the collection of high-quality recordings containing the desired pronunciation errors.

After obtaining the recordings, I chose those produced by three native speakers of each language based on the quality and the similarity of the voices. Not all items recorded by every chosen speaker were delivered exactly in the way it was intended; therefore, additional sessions were scheduled for the speakers so that they could record some of the stimuli again. That was repeated until the stimuli contained the predicted errors and no additional errors that could impact the study results. For some stimuli, the speakers were instructed on which items should be mispronounced. That may have made the recordings somewhat unnatural, but the author felt that such a measure was necessary to control the stimuli and obtain reliable results.

As my judgements regarding the degree of foreignaccentedness might have been subjective, pre-tests were conducted to confirm the comparability of the recordings. Each pre-test concerned speakers of only one of the three L1 groups. The structure was the same, with the pre-tests differing only in the native language of the Polish learners. The respondents listened to the recordings of the learners and provided judgements regarding their foreignaccentedness. The rating was done by employing a 5-point Likert scale ranging from 1 – 'no foreign accent' to 5 – 'strong foreign accent.' Additionally, to confirm that all of the speech samples were comprehensible, the respondents were instructed to transcribe the passages they heard.

Ten listeners participated in each of the pre-tests. None of them took part in more than one pre-test or in a pre-test as well as the main part of the experiment in order to avoid the influence of stimuli familiarity. Based on the results of the pre-tests, recordings provided by one of the speak-

ers from each L1 group were excluded. The recordings provided by the speakers of Russian chosen for the main part of the experiment obtained average ratings of 2.6 (speaker 1) and 3.1 (speaker 2), the speakers of Czech obtained average ratings of 2.9 (speaker 1) and 3 (speaker 2), and the speakers of Spanish, 3.2 (speaker 1) and 2.8 (speaker 2). The speakers who obtained average ratings of 4.4 (Russian), 3.3 (Czech), and 4.7 (Spanish) were excluded. This was done to obtain a group of speakers with possibly the most similar level of Polish proficiency. The excluded Czech speaker obtained a rating similar to the speakers selected for the main part of the experiment. However, his inclusion would have resulted in an uneven number of speakers per L1 group. Thus, the recordings provided by that learner were not employed in the experiment.

From the materials provided by each learner who was selected to be in the main part of the experiment, five segmental error recordings and five stress-placement error recordings were selected. Thus, each speaker provided ten recordings, making it twenty recordings per L1 group and sixty recordings in total. There were six conditions: the Spanish-speakers produced stress-assignment errors (SPANISH_STRESS), the Spanish-speakers produced segmental errors (SPANISH_SEGMENTAL), the Czech-speakers produced stress-assignment errors (CZECH_STRESS), the Czech-speakers produced segmental errors (CZECH_SEGMENTAL), the Russian-speakers produced stress-assignment errors (RUSSIAN_STRESS), and the Russian-speakers produced segmental errors (RUSSIAN_SEGMENTAL). As the experiment was conducted entirely online, ensuring an appropriate environment for the participants was very challenging. Therefore, a decision was made not to include a control condition, which would have added more items to the already lengthy stimuli list.

**Participants**

Fifty native Polish listeners took part in the experiments. All of them had been university students or were studying at university when they participated in the study, and they were all twenty to forty years old. Additionally, none of them spoke any of the speakers' native languages, nor did they use the English language in their daily lives. That requirement was introduced to avoid the influence of foreign language systems. Since stress can be a contrastive feature in English, very frequent use of that language could influence the listeners' expected stress-deafness, i.e., it could improve their ability to perceive stress-placement errors.

**Procedure**

All of the recordings were presented to all of the participants. Similarly to the recording procedure, the experiment was carried out on the FindingFive platform, and the participants used their own computers to listen to the speech recordings and provide their judgements on foreignaccentedness. In addition, they were instructed to use earphones and access the FindingFive website using the Google Chrome browser, which is the most compatible with the platform.

After hearing each recording, an instruction was displayed, asking the respondent to rate the strength of the foreign accent on a 5-point Likert scale ranging from 1 – no foreign accent, to 5 – strong foreign accent. The rating was provided by clicking on the chosen number. After that, the following recording was played automatically. The order of the stimuli was randomised and different for every participant. Every respondent was free to take a break whenever they pleased. However, leaving the website was not possible without stopping the experiment, which would prevent the participant from accessing it again. After rating every ten passages, a simple yes-no question regarding the content of the sentence was displayed. The participants answered by clicking on the button with the correct answer. Including the questions in the experiment was intended to encourage the respondents to pay attention to the stimuli. The main part of the experiment was preceded by a training session consisting of ten passages which were excluded after the pre-test. The task in the training session was identical to that in the main part of the experiment. Completing the experiment required approximately twenty minutes.

## 3. Results

A vast majority (86%) of the participants provided only correct answers for all six of the yes/no comprehension questions. That means that out of fifty respondents, only seven provided any incorrect answers. Additionally, two of those seven participants answered incorrectly twice, and the remaining five answered incorrectly only once. Thus, it has been assumed that all of the participants actively listened to the stimuli. Therefore, all of the answers were considered representative of perceived foreignaccentedness.

I conducted a repeated-measures analysis of variance with the within-subjects factors LANGUAGE (three levels: Spanish, Czech, Russian) and ERROR

TYPE (two levels: stress-assignment errors, segmental errors). That resulted in 6 conditions: Spanish-speakers produced stress-assignment errors (SPANISH_STRESS), Spanish-speakers produced segmental errors (SPANISH_SEGMENTAL), Czech-speakers produced stress-assignment errors (CZECH_STRESS), Czech-speakers produced segmental errors (CZECH_SEGMENTAL), Russian-speakers produced stress-assignment errors (RUSSIAN_STRESS), Russian-speakers produced segmental errors (RUSSIAN_SEGMENTAL). There were no outliers, as assessed by the lack of studentised residuals for values larger than ± 3.

Fig. 1 presents the mean ratings of the participants for all of the conditions. The Shapiro-Wilk test confirmed a normal distribution of the data. Additionally, Mauchly's test of sphericity showed that the assumption of sphericity was met for the two-way interaction ($\chi^2(2) = 2.41$, $p = .3$ ($p > .05$).

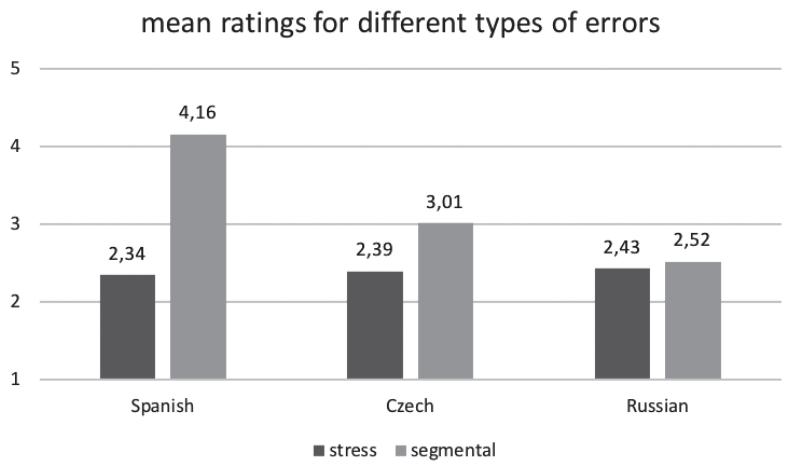


Figure 1: Mean ratings provided by the participants for all types of errors appearing in the experiment.

There was a statistically significant two-way interaction between LANGUAGE and ERROR TYPE, $F(2, 98) = 199.4$, $p < .001$ (see Fig. 2). Therefore, simple effects of language among the stress errors and among the segmental errors were run.

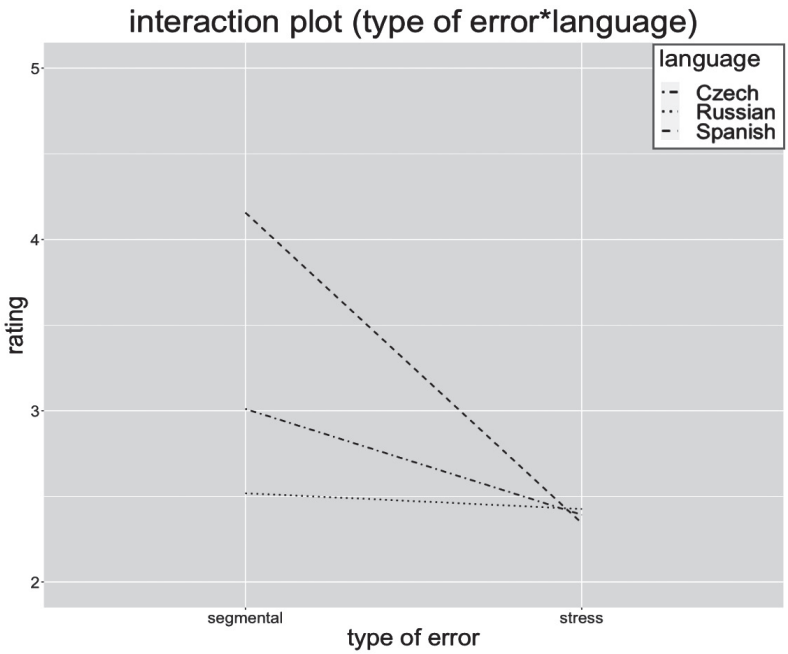


Figure 2: Interaction plot for the type of error*language.

The change in the perceived foreignaccentedness was not significant for stress errors. However, it was statistically significant for the SEGMENTAL error conditions $F(1.539, 75.392) = 194.61$, $p < .001$. Thus, post hoc analyses with a Bonferroni adjustment were run. They revealed that there was a significant increase in foreignaccentedness from $2.52 \pm 0.56$ for Russian to $3.01 \pm 0.45$ for Czech (an increase of 0.49 (95% CI, 0.33 to 0.66), $p < .001$)). Furthermore, there was a 1.15 difference between Czech and Spanish, which obtained a mean rating of $4.16 \pm 0.5$ (95%, CI, 0.96 to 1.34). The difference was statistically significant ($p < .001$). The difference between Russian and Spanish segmental errors amounted to 1.64 ((95% CI, 1.37 to 1.9), $p < .001$).

For all three languages, the ratings obtained for the recordings characterised by segmental errors had higher foreignaccentedness ratings than those with stress-placement errors.

For Spanish and Czech, these differences were statistically significant. For Spanish, the difference amounted to $2.34 \pm 0.49$ for stress and to $4.16 \pm 0.5$

for segmental errors (an increase of 1.81 (95% CI, 1.68 to 1.94), $F(1, 49) = 757.97$, $p < .001$). For Czech, stress errors produced mean ratings of 2.39 ± 0.41, while segmental errors, 3.01 ± 0.45 (an increase of 0.62 (95% CI, 0.49 to 0.74), $F(1, 49) = 96.73$, $p < .001$). For Russian, the difference was not significant. The mean ratings obtained were 2.43 ± 0.51 for stress and 2.52 ± 0.56 for segmental errors (an increase of 0.09 (95% CI, 0 to 0.19), $F(1, 49) = 3.67$, $p = .061$ ($p > .05$).

## 4. Discussion

The results that were obtained confirmed all of the predictions except for prediction (3).

**The L1 of the speakers and the type of errors (segmental vs stress-placement) combined influenced perceived foreignaccentedness.** There was a statistically significant effect of interaction; thus, the study shows that the two factors combined impact Polish native speakers' perception.

**For segmental errors, Spanish speakers' speech samples generated the highest foreign-accentedness ratings.** The recordings provided by native speakers of Spanish received higher foreignaccentedness ratings than those by Czech speakers, followed by those recorded by Russian speakers. It is likely that this is caused by the relative similarity of Polish and Russian sound systems and more significant differences between Polish and Czech or Spanish sound systems.

**For stress-placement errors, Russian speakers' speech samples did not generate the highest foreignaccentedness ratings.** Prediction (3) was not confirmed. The L1 differences had no statistically significant influence on foreignaccentedness ratings. Thus, the similarity of the stress-placement rules in the languages did not influence the ratings. This finding is in line with the results obtained by Domahs et al. (2012) and, as such, it is likely to be the consequence of Polish speakers' stress deafness.

**Generally, segmental errors generated higher ratings than stress-placement errors.** There was a statistically significant difference between the ratings of segmental vs stress-placement errors produced by native speakers of Spanish and Czech. While the difference between the judgements of different error types in Russian was not statistically significant, it can be observed that the ratings for the stress-placement errors obtained somewhat lower scores (mean 2.43) than segmental errors (mean 2.52). That is most likely the consequence of Russian speakers' errors receiving

generally low judgements. Thus, the difference that emerged was not statistically significant. However, regardless of that, it still fits the expected patterns of the stress-placement errors receiving lower ratings. Therefore, it can be assumed that overall segmental errors do generate higher ratings of foreign accentedness than stress-placement errors. That would be in line with the stress deafness observed in the native speakers of Polish.

## 5. Summary and conclusions

In conclusion, it appears that the type of errors produced by non-native Polish speakers as well as their native languages influence the degree of foreignaccentedness perceived by the speakers. Segmental errors appear to be of higher significance, which, in parallel with Domahs et al. (2012), is attributed to Polish speakers' stress deafness. It is probably for that same reason that the stress-placement errors are perceived as similar (and obtained relatively low ratings) regardless of the speaker's origin.

Furthermore, segmental errors produced by the speakers of Spanish are perceived as the most foreign-sounding of the segmental errors in the speech of the native speakers in the groups researched in this experiment. The perceived foreignaccentedness of the errors produced by Spanish learners was then followed by those produced by Czech and Russian speakers. Those differences are assumed to arise based on the degree to which the sound systems of those languages differ from the Polish sound system. That is, Russian appears to be the most similar to Polish of the three languages. Thus, the errors produced by Russians appear least significant to Polish listeners. Czech is less similar; thus, Czech speakers' errors are perceived as more significant. Finally, the sound system of the Spanish language is pretty dissimilar to the Polish system. Thus, Polish listeners perceive errors produced by the speakers of Spanish as the most significant.

The findings of this study could be expanded in future research. It would contribute to obtaining a more comprehensive picture of how different deviations from native speech influence Polish listeners' perception. Moreover, it would confirm the results obtained here by overcoming some of the limitations of this study. For instance, intonation errors were not accounted for in this study because of time limitations. Considering them in future research would confirm that the results obtained are not impacted by the speaker's intonation, which could have influenced the listeners in this experiment.

Moreover, in this study, the speakers' level of proficiency in Polish was based on self-assessment and the author's subjective perception. This limitation was addressed by employing pre-tests, which helped obtain a more objective picture of the speakers' level. Future research could use a standardised measure such as the European Frame of Reference. Finally, this experiment was conducted entirely online, which made it significantly more challenging to ensure appropriate conditions for the participants. The list of stimuli was also quite long, making it impossible to include a control condition containing no pronunciation errors. Perhaps, if future research on the topic can be conducted in person, expanding the list of stimuli could be possible.

Future studies on Polish listeners' perception of non-native speech could also consider speaker groups, prosody errors, and measures different to those investigated in the study presented here. As far as stress-deafness in Polish speakers is concerned, a similar study employing ERP measures could shed light on how much the conscious perception of stress-placement errors in non-native speech differs from the processes on the neurological level. It is highly likely that online perception would be observed as suggested by the findings obtained by Domahs et al. (2012). Their study showed that despite the lack of conscious differentiation between differently stressed lexical items, a P300-like effect was triggered in Polish speakers by stress changes. The authors of the study interpreted the results as suggesting that there is no conscious perception of stress-placement errors, but that the errors are still perceived on the neurological level.

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## The influence of segmental errors and stress-placement errors on Polish listeners' perceived degree of foreignaccentedness in non-native speech

Polish listeners' perception of different types of errors in non-native speech was studied with a focus on segmental and stress-placement errors. The stimuli consisted of the speech produced by Polish learners of Russian, Czech, and Spanish origins. The results which were obtained suggest that segmental errors (i.e., errors related to the pronunciation of segments) influence the foreignaccentedness perceived by Polish listeners significantly more than stress-placement errors. That is probably due to stress-deafness experienced by native speakers of Polish. While stress-placement errors resulted in relatively low scores in terms of foreignaccentedness, the ratings for segmental errors depended on the L1 group of the speakers. Segmental errors produced by speakers of Spanish were rated as the most foreign-sounding, followed by Czech and Russian. One possible explanation is that it was caused by the sound systems of Russian, Czech, and Polish being pretty similar, while the Spanish sound system is somewhat different.

**Keywords:** foreign accent perception, stress-deafness, non-native speech.