

# PERCEPTION OF RHOTICS BY MULTILINGUAL CHILDREN

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## ABSTRACT

There is scarcity of research into speech perception of multilingual learners, which precludes a full understanding of their phonological acquisition. The present study investigates speech perception development of rhotics in 32 multilinguals (aged 12-13) who all had the same language repertoires (English, German, Polish), with English being their L2 (learnt in school for 5 years), but German and Polish either their L1 or L3. This mirror-image design allowed for examining the effects of L1 on the multilinguals' L2 and L3 rhotic perception. Based on results from a forced-choice goodness task administered at 4 and 9 months of L3 learning, both groups performed at a ceiling level in the perception of English rhotics at both testing times. However, L1 German children consistently perceived Polish rhotics more accurately than L1 Polish children perceived German rhotics. The findings point at a combined effect of L1, markedness and L2/L3 proficiency in multilingual speech perception.

**Keywords:** speech perception, L3 phonology, multilingual, rhotics, mirror-image design.

## 1. INTRODUCTION

Existing non-native speech perception models have been developed to account for learning contexts in which second (L2) language is being acquired during or after the acquisition of the speaker's first (L1) language ([3], [4], [8], [11]). Given that the vast majority of the world's population experiences richer linguistic contexts in the course of their language learning history, it appears problematic to base any predictions of their acquisitional process, including that of speech perception, on these models. Indeed, recent research into third language (L3) acquisition demonstrates that all previously learnt languages will influence additional language learning (for a review in the domain of L3 phonology, see [6]).

Previous research into L3 speech perception has been scarce and largely revolving around the question whether extended language learning experience facilitates the perception of novel sounds. The extant findings are mixed. While [14] could show greater sensitivity in perceived cross-linguistic similarity by young multilinguals as opposed to their monolingual

counterparts, and [10] reported a superior discriminatory performance by adult bilinguals over monolinguals, theorizing that bilinguals possess advanced levels of general cognitive flexibility, [18] found no general bilingual or trilingual advantage in discriminating the sounds of an unfamiliar language. The advantage they found was only due to narrow L1/L2 to L3 transfer. [1] further demonstrated that specific prior experience with a phonetic feature may be especially useful for learning universally "difficult" contrasts while the general advantage of bilingualism will show in the case of learning "easy" contrasts. Also, recent findings on cross-linguistic influence seem to support this reasoning [2].

More research is needed to gain further insights into multilingual speech perception of diverse learners, including the relative role of markedness ([1]). Moreover, such research would ideally be of a longitudinal nature and include perceptual development of all the speaker's languages to capture their acquisitional process in its entirety. In order to disentangle the relative role of the L1 and the L2 in L3 speech perception development, this research would also apply a mirror-image design. The present study attempts to address these considerations by examining longitudinally L2 English and L3 German perception by young L1 Polish speakers as well as L2 English and L3 Polish perception by young L1 German speakers.

Rhotics were considered to be a suitable testing ground, because in spite of belonging to a phonological natural class, they exhibit large interlanguage variability. Among the languages of the world, rhotics can have three places of articulation: alveolar, retroflex and uvular, and five manners of articulation: trill, tap or flap, fricative, approximant and lateral flap ([19]). The most common rhotics are the alveolar or dental trills or taps, followed by retroflex flaps. Only 8% of languages have alveolar approximants, and only four languages have a uvular trill, German being one of them ([17]). In the case of rhotics, the frequency of distribution should not be taken as an argument about their markedness. As [7] notices, the alveolar trill requires precisely fine-tuned articulation and is challenging in the course of language acquisition. It remains an empirical question to what extent frequency of occurrence and/or articulatory complexity coincide with perceptual markedness.

In the three languages considered in the present study, the distribution of rhotics is as follows. Polish has the alveolar trill, which may be produced as a tap in fast speech ([12]). In Standard German the conservative uvular trill /R/, present mainly in word-initial positions, is in most cases produced as the uvular fricative /ʀ/ ([13]). Regarding English, our participants were mostly exposed to British English with a post-alveolar approximant /ɹ/, and to lesser extent to American English with its retroflex approximant /ɹ/ ([15]). Both English rhotics are continuants, as opposed to the “interrupted” types such as taps and trills.

Based on the theoretical background and methodological considerations introduced above, the present study aims to examine the relative role of L1 in the development of non-native speech perception in young multilinguals by posing the following research questions:

- How does the perception of L2 English and L3 German rhotics develop over time in young L1 Polish speakers?
- How does the perception of L2 English and L3 Polish rhotics develop over time in young L1 German speakers?

We assume here, according to the Markedness Differential Hypothesis ([9]), that those structures of the target language that differ from the native language and are more marked than the native language will be difficult to acquire and vice versa.

Therefore we hypothesize that both learner groups will show a stable and comparable perceptual performance in their L2 English, given the comparable quality and quantity of exposure to the language. The L1 Polish children are hypothesised, however, to show greater variability than the L1 German children in perceiving their L3 marked uvular fricatives. The German L1 children should have fewer problems perceiving their L3 Polish relatively less marked alveolar trills.

## 2. METHOD

### 2.1. Participants

A total of 32 participants aged 12-13 took part in the study. They were 19 L1 Polish speakers who had learnt English at school for 5-6 years and had just started learning L3 German. Similarly, 13 L1 German speakers had learnt English for 5-6 years and had just started learning L3 Polish. The two groups were carefully matched in socio-economic background and the amount of L2 and L3 instructed learning experience. This background information was

collected in an extensive interview at the beginning of the study.

### 2.2. Perception task and procedure

All participants performed a timed forced-choice goodness task twice: 5 months into their L3 learning (T1) and at the end of the school year, i.e. four months later (T2). The perception task was administered by two research assistants, who were (near) native speakers of the L2 and L3, respectively, on different days in a quiet room in the participants’ schools.

Adapted from [5], the forced-choice goodness task included two renditions of the same phrase which differed minimally on the last stimulus item embedded in a carrier phrase. One rendition was target-like, the other one was “the other-language-like”. For an example, in the L2 English version of the task, the children listened to the target-like phrase “You will hear the word *ring* /ɹɪŋ/” followed by the Polish-like “You will hear the word *ring* /rɪŋ/”. The carrier phrase always remained in the target language. Using headphones, the participants listened to the pair of renditions and decided which one sounded more “natural” in the language being tested.

The inter-stimulus interval was set at 500ms and the response limit at 3,000 ms. The presentation of the stimuli was randomized and counterbalanced across trials in E-prime.

### 2.3. Stimuli

A total of 23 stimuli in the L2 English, 26 stimuli in the L3 Polish and 24 stimuli in the L3 German were presented to the young multilinguals in the perception task, which tested also additional contrastive segments. Out of these, 10 items contained rhotics in each of the three languages (5 stimuli in 2 non-target language combinations, see below). The stimuli all involved real words, checked for familiarity by the pupils’ language teachers. The stimuli were recorded by female native speakers of the respective languages and fluent advanced speakers of the other two languages in the triad of languages. The target rhotics occurred either in the initial or medial position, and included: English: *ring*, *rabbit*, *red*, *round*, *giraffe*; German: *rot*, *Regen*, *Reise*, *Fahrrad*, *verloren*; and Polish: *ryba*, *ręka*, *rok*, *chora*, *stara*.

## 3. RESULTS

The multilinguals’ performance on the timed forced-choice goodness task was examined in terms of accuracy and RT. Due to violation of the assumption of normality and homogeneity of variance of the dataset, non-parametric tests were used for between-

subjects (Mann-Whitney *U*-test) and within-subjects (Wilcoxon signed-rank test) comparisons.

Table 1 presents the accuracy results for the perceptual performance in both L2 and L3 of the L1 Polish group at the two testing points. It shows that the L1 Polish children perceived the L2 English rhotics more accurately than the L3 German rhotics at both testing points. Mann-Whitney *U*-test yielded these differences significant (T1:  $Z=4.41$ ,  $p<.0001$ ; T2:  $Z=9.08$ ,  $p<.0001$ ), and showed that they were driven by L2 and L3 items that included rhotics in the initial position. The L1 Polish children's scores for the perception of English rhotics remained high between T1 and T2. In contrast, the perceptual accuracy of German rhotics by this group dropped significantly between T1 and T2 ( $Z=-2.65$ ,  $p<.008$ ), and this change was driven by a poorer performance on stimuli with rhotics occurring in the initial position. In terms of RT, no significant differences were found for this learner group's perception of either English or German rhotics between T1 and T2. At T2, it took the Polish children significantly longer to perceptually respond to the German than to the English stimuli ( $Z=-2.47$ ,  $p<.01$ ).

**Table 1:** Mean accuracy in per cent for the perception of English and German rhotics by L1 Polish children at two testing times.

Word position	Time	Accuracy L2 English		Accuracy L3 German	
		Mean	SD	Mean	SD
Total	T1	88	33	69	46
	T2	91	29	46	44
Initial	T1	91	28	71	43
	T2	93	26	42	46
Medial	T1	78	42	66	45
	T2	84	37	52	47

Table 2 presents the accuracy results for the perceptual performance in both L2 and L3 of the L1 German group at the two testing points. It shows that the L1 German children perceived the rhotics in both their non-native languages highly accurately. Yet, Mann-Whitney *U*-test showed that, similarly to the L1 Polish group, the L1 German children were more accurate in perceiving the L2 English rhotics than the L3 Polish rhotics (T1:  $Z=2.21$ ,  $p<.03$ ; T2:  $Z=2.41$ ,  $p<.01$ ), and that these differences were driven by items with rhotics occurring in the initial position.. Yet, an accurate decision on the naturalness of the English stimuli took the L1 German children longer to make than on the Polish stimuli at both T1 ( $Z=3.57$ ,  $p<.0004$ ) and T2 ( $Z=2.41$ ,  $p<.004$ ). No significant differences between the two testing times were found

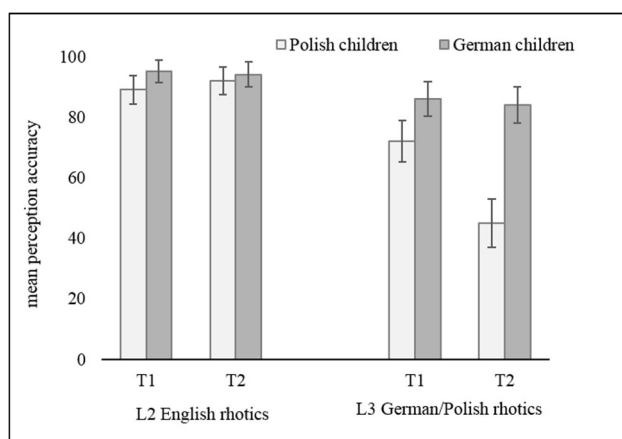
for either the accuracy or the RT scores in both English and Polish for this learner group.

**Table 2:** Mean accuracy in per cent for the perception of English and Polish rhotics by L1 German children at two testing times.

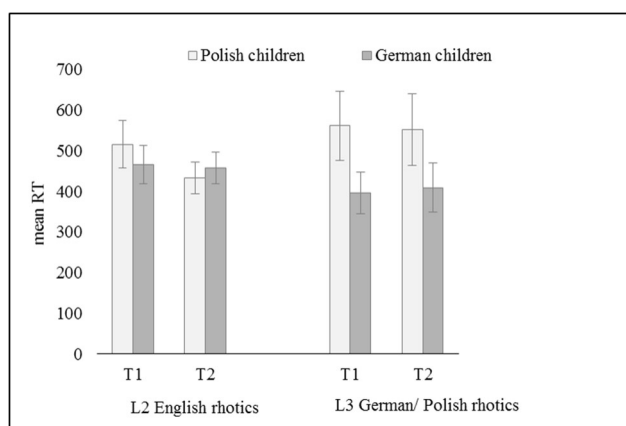
Word position	Time	Accuracy L2 English		Accuracy L3 Polish	
		Mean	SD	Mean	SD
Total	T1	95	21	86	34
	T2	94	23	84	36
Initial	T1	98	13	82	38
	T2	97	17	82	38
Medial	T1	87	35	94	22
	T2	87	35	88	32

Figures 1 and 2 present learner group comparisons on the perception of L2 and L3 rhotics (in both positions) at T1 and T2, accuracy and RT scores, respectively. It shows that the two groups did not differ in their perception of L2 English rhotic sounds at either testing time. However, L1 German children scored significantly higher on the perception of L3 Polish rhotics than their counterparts in the perception of L3 German rhotics at both T1 ( $Z=-3.49$ ,  $p<.0005$ ) and T2 ( $Z=-7.23$ ,  $p<.0001$ ), and were also faster in providing their Polish rhotics naturalness judgements at both T1 and T2 ( $Z=4.18$ ,  $p<.0001$  and  $Z= 3.98$ ,  $p<.0001$ , respectively).

**Figure 1:** Group comparison of mean accuracy in per cent for the perception of L2 English and L3 German/Polish rhotics by L1 Polish and L1 German children at T1 and T2. Error bars represent 95% confidence intervals.



**Figure 2:** Group comparison of mean RT scores for the perception of L2 English and L3 German/Polish rhotics by L1 Polish and L1 German children at T1 and T2. Error bars represent 95% confidence intervals.



#### 4. DISCUSSION

The results of the present study show that both Polish and German children can perceive L2 English rhotics highly accurately and consistently after about five years of instructed learning experience. They differ, however, on how accurately they perceive novel rhotics in the beginning stages of L3 learning. The L1 Polish children perceived the most marked L3 German uvular fricatives (the variant occurring in the German stimuli) less accurately and less consistently than the L1 German children perceived the least marked L3 Polish alveolar trills. This would be in agreement with the predictions of the Markedness Differential Hypothesis ([9]). This prediction also seems true for our finding that the L1 Polish children further perceived the L3 rhotics less accurately than the lesser marked L2 English post-alveolar approximants, while the L1 German children, whose L1 uses the most marked rhotics, perceived relatively marked English rhotics better than the Polish unmarked alveolar trills and taps. Recall that the German children perceived English rhotics with 95% and 94% accuracy rate, and Polish rhotics with 86% and 84% accuracy rate at T1 and T2, respectively. In other words, the rhotic sounds of both their non-native languages were perceived with high accuracy; yet, perceiving the English rhotics resourced significantly more processing time of the German children than perceiving the Polish rhotics, suggesting a degree of perceptual challenge on their part with respect to post-alveolar approximants as compared to alveolar trills.

Another explanation of our results, not necessarily incompatible with the proposed markedness account, might be that certain phonetic structures are perceptually more salient than others,

and/or that certain physical/acoustic or articulatory configurations are easier to perceive and produce, and consequently to learn ([9]). These two accounts may help illuminate why previous research into bilingual advantage in phonetic discrimination of novel sounds sometimes yielded mixed results.

Finally, brief teacher interviews at T3 revealed rather inconsistent realisations of the uvular fricative by the German teacher of the Polish children, which may have influenced their developing sense of naturalness of German rhotics.

Growing, though still limited experience (fifth to ninth month of instructed learning) with the L3 did not result in a measurable change in accuracy of L3 rhotic perception for the learners of the present study. In the L1 German group, the results for L3 Polish rhotics were relatively high and stable between T1 and T2. In turn, the L1 Polish group performed at chance levels and had significantly lower scores in L3 German rhotic perception at T2 than at T1. This perceptual instability on the part of the Polish children would be important to further follow as it likely points at an important transitional stage in the development of their L3 speech perception, as theorized in process-oriented, non-linear accounts of foreign language acquisition ([16]). For L2 English rhotics, no significant changes in perceptual accuracy or reaction time between T1 and T2 were found for the two learner groups as a result of the additional experience with L3 learning. This result may be seen as the young multilinguals reaching a stable, optimal state of L2 rhotic perception after five years of instructed learning, which, however, is not to be interpreted as indicating an end state but rather also deserving further longitudinal investigation.

#### 5. CONCLUSION

Our findings show that multilingual speech learning depends on a complex interaction between learner-internal and learner-external factors. The learner's L1, markedness and L2/L3 proficiency all interact in determining the development of non-native speech perception. With regard to the interplay of language proficiency, as an index of the quantity and quality of language learning experience, and markedness, other configurations of marked and unmarked sounds in the L1, L2 and L3 should be tested in further longitudinal research to reveal the relative importance of both factors in the development of multilingual speech perception. Validating a suitable measure of (phonological) proficiency for multilingual learners will also be paramount in the endeavour.

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