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Rhotics in Spanish as a foreign language: An intervention study with German–Turkish bilinguals

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While German has one rhotic phoneme, the uvular fricative /ʁ/, which is vocalized to [ɐ] in syllable-final position, Spanish possesses two alveolar rhotics, the tap /ɾ/ and the trill /r/, which never undergo vocalization. Turkish patterns with German in having one rhotic but is closer to Spanish in sharing the alveolar place of articulation and in lacking *r*-vocalization. This article reports on an intervention study carried out with 12 German–Turkish heritage bilinguals learning Spanish in Germany. Reading data were collected before, during, and after the completion of a digital learning module. The phonetic cues considered were (1) consonantal production of the target segment; (2) target-like place of articulation, and (3) target-like

distribution of the tap–trill contrast. Results show that high correctness rates regarding the production of alveolar rhotics are achieved from the outset and that the target-likeness of the tap–trill distribution and the avoidance of *r*-vocalization generally improves across the three measurement points. The case of a single learner who had primarily transferred the German uvular rhotic and showed a considerably increased correctness rate after the intervention indicates that the learners' awareness of similarities and differences between their heritage language and Spanish has a positive effect on rhotic acquisition.

Keywords: *German; heritage bilingualism; Rhotics; Spanish as a foreign language; Turkish*

1. INTRODUCTION

In her seminal study on schooling in Germany, Gogolin (1994) emphasized that dealing with multilingualism in the German school system was essentially characterized by a "monolingual habitus", meaning that the students' multilingual backgrounds were not sufficiently taken into account in teaching practice. About ten years later, Hu (2003) reached a similar conclusion with specific reference to the teaching and learning of foreign languages (FLs), and little seems to have changed in this regard in the second decade of the twenty-first century. As Gabriel & Thiele (2017) have shown in a questionnaire study focusing on pronunciation training, FL teachers hardly make use of the learners' multilingual potentials. This is surprising, since they generally do show a positive attitude towards multilingualism, at least according to Haukås (2016) and Kropp (2020). But from a societal point of view, the widespread disregard for multilingual realities in FL teaching in German schools is astonishing: by 2018, the share of persons with a migration background in Germany had risen to more than a quarter of the total population (20.7 out of 81.6 million citizens); urban agglomerations and, in particular, individual neighborhoods in major German cities have reached much higher figures of over 50 percent. In this context, Turkish plays a key role, since in numerous German states (e.g., Berlin, Hamburg, North Rhine-Westphalia, parts of Baden-Württemberg) Turkey as a country of origin accounts for the largest share, with more than 15 percent of the population (Statistisches Bundesamt, 2018, p. 27). In this light, it seems desirable to make better use of the linguistic potential of German–Turkish students and to develop appropriate teaching materials to support their FL learning.

Systematic linguistic research on the learning of additional languages, whether in terms of consecutive learning of multiple foreign languages (for example, FL Spanish after FL English) or in terms of FL learning by early

bilinguals, has been an established field for about 20 years within the paradigm of third language (L3) acquisition. In this context, research into grammatical and lexical aspects clearly dominated for a long time, while studies on L3 phonological learning have emerged as a full-fledged research paradigm only since the 2010s (Marx & Mehlhorn, 2010; Cabrelli Amaro et al., 2015; Cabrelli Amaro & Wrembel, 2016; Domene Moreno, 2021, pp. 17–42). In addition, the respective studies have largely focused on the learners' phonological competence in terms of their initial discrimination ability (for an overview, see Kopečková, 2016, pp. 211–212) or of perceived foreign accent (e.g., Lloyd-Smith et al., 2017; Lloyd-Smith, 2020, 2021), and the most studied FL is clearly English. Research into L3 phonological acquisition of Romance languages, particularly in the context of migration-induced bilingualism – i.e., in learners who speak a heritage language (HL; see Valdés, 2000; Montrul, 2016; Polinsky, 2018) along with the surrounding language on a regular basis – is still rather sparse and is restricted to specific phonological domains. Some studies have investigated the production of L3 French initial stop consonants, namely Voice Onset Time (VOT) patterns, by early bilingual learners speaking Mandarin Chinese, Russian, or Turkish along with German and found signs of positive transfer from the HLs into the target language in some cases (Llama & López-Morelos, 2016; Gabriel et al., 2016, 2018, 2021; see also Geiss et al., 2021, for VOT in L3 English produced by Italian–German bilinguals). Others have looked at the realization of voiced obstruents and rhotics in syllable-final position as well as at the intonational patterns of L3 French produced by German–Turkish learners, though with contradictory outcomes: Özaslan & Gabriel (2019) and Gabriel et al. (2022) observed less negative transfer of phonological rules (final obstruent devoicing and vocalization of the rhotic sound in coda position)[1] from German to L3 French in these bilingual learners than in their monolingual German peers. However, no such positive effect of the Turkish language background was found in the intonational analyses performed by Grünke & Gabriel (2022), although the bilinguals' Turkish prosody was not significantly influenced by the surrounding language, German, and could thus have served as a basis for positive transfer into L3 French.

[1] The final obstruent devoicing rule neutralizes the voiced–voiceless contrast of plosives and fricatives in syllable-final position, e.g., German *Kin**d**er* (Pl.) 'children' [ˈkɪn.**d**ɐ] vs. *Kin**d*** (Sg.) 'child' [kɪn**t**] and *bra**v**er* (comparative) 'more well-behaved' [ᵬʁa.**v**ɐ] vs. *bra**v*** 'well-behaved' [ᵬʁa**f**]. In Turkish, which allows for voiced fricatives in coda position (*biz* 'we' [biz]), this neutralization process is restricted to plosives, see *kita**b***ım 'my book' [kita.**b**ɯm] vs. *kita**p**larım* 'my books' [kita**p**.la.ɾɯm] (see Özaslan & Gabriel, 2019 for an overview).

Bearing in mind that German–Turkish learners of L3 French seem to be advantaged over monolingually raised Germans with respect to the avoidance of *r*-vocalization, this learner group should benefit even more from the HL Turkish when it comes to the acquisition of Spanish rhotics. German learners not only have to avoid negative transfer of *r*-vocalization but also need to acquire the new place and manner of articulation of the rhotic sounds. Turkish, by contrast, patterns with Spanish in presenting alveolar (instead of uvular) rhotics and in lacking vocalization of *r* in coda position. The aim of the present study is thus to determine whether German–Turkish learners benefit from their multilingual background and produce target-like rhotic sounds in the L3 Spanish. For this purpose, we conducted an intervention study with the aim of sensitizing the selected learner group both to the Spanish rhotic system and to the similarities and differences between Spanish and Turkish. By comparing three recordings of speech data (made before, during, and after the intervention), we include the developmental aspect and can make a statement about whether and to what extent making multilingual learners aware of the phonic characteristics of their heritage language is beneficial to the acquisition of the rhotic system in L3 Spanish.

This article is organized as follows. We first provide the reader with the relevant background information regarding our empirical study, starting with a description of the rhotic systems of the languages of our sample – i.e., German, Spanish, and Turkish. Since all of the learners have learned English as a first FL before acquiring Spanish, English rhotics are also briefly considered (2.1). In Section 2.2, we summarize earlier studies on the L2/L3 acquisition of Spanish rhotics. Section 3 presents the methodology (3.1) and the results (3.2) of our empirical study before discussing the findings (3.3). Section 4 offers some concluding remarks.

2. BACKGROUND AND SURVEY OF THE LITERATURE

2.1. Rhotics in the languages of our sample

Spanish, which in the present learning setting is the second FL, exhibits two alveolar rhotic phonemes, the tap /ɾ/ and the trill /r/ (Hualde, 2005, pp. 181–188, 2022, pp. 791–792; Blecua, 2001). Note that the identical places of articulation of the two segments have led some authors to postulate a single underlying rhotic (e.g., Harris, 1969). In his account, the intervocalic tap–trill contrast results from gemination (e.g., *carro* /ˈka**ɾr**o/ > [ˈka**r**o] ‘car(riage)’ vs. *caro* /ˈka**ɾ**o/ > [ˈka**ɾ**o] ‘expensive’). We nevertheless follow the bi-phonemic standard analysis. In the unmarked case, both /ɾ/ and /r/

are produced with complete closures, one closure in the case of the former segment and two or more repeated closures in the case of the latter (Martínez Celdrán & Fernández Planas, 2007). Importantly, the tap–trill contrast applies only intervocalically; in other positions, it is neutralized in favor of either variant. Root-initially and following the consonantal segments /n/, /l/, and /s/, the trill [r] is used (*rojo* [ˈroxo] 'red'; *honra* [ˈonra] 'honor'). In syllable-initial obstruent clusters and in coda position, the tap [ɾ] prevails (*tres* [tɾes] 'three', *comprar* [komˈpɾaɾ] 'buy'). However, [r] may occur in coda position in emphatic speech and in Spanish varieties such as Basque or Catalonian Spanish (Hualde, 2005, pp. 182f.). Furthermore, both the tap and the trill can lack the complete closure resulting in fricative and approximant realizations (Blecua, 2001). This particularly holds true for [ɾ], which can undergo weakening to an approximant ([ɻ̞]) in rapid and careless speech. Apart from this, Spanish rhotics display a wide range of variation across dialects like the assibilation of the tap as in *señor* [seɲoʒ] 'sir', as occurs, e.g., in Andean varieties (see Campos-Astorkiza, 2018, pp. 179–181, for an overview). For the present context, however, this dialectal variation is irrelevant, since the teaching of Spanish as a FL in Germany is essentially oriented towards European and American standard varieties. Importantly, in these mainstream varieties, rhotics are never vocalized nor elided but consistently realized as consonantal segments also in coda position.

German, which is part of the participants' linguistic background and which also serves as the language of instruction in the learning setting addressed in the present study, differs from Spanish in that it possesses only one rhotic phoneme, which is commonly produced as a voiced uvular fricative ([ʁ]) in most varieties, including the present-day standard pronunciation (see Kohler, 1995, p. 152, 165; Wiese, 1996; Krech et al., 2009, p. 87; Russ, 2010, p. 85, 110, as well as the dialect maps given in Kleiner, 2011). Following voiceless obstruents, the rhotic frequently undergoes devoicing as in *Trog* [ˈtʁ̥oːk] 'trough', and, in intervocalic position, it may be weakened to a uvular approximant (*Leere* [ˈleːɹ̝ə] 'emptiness'). Most significantly, coda *r* is affected by vocalization across varieties as in *leer* [leːɐ̯] 'empty' (as opposed to *Leere* [ˈleːʁə]), the only exception being very formal or hyperarticulated speech (Wiese, 1996, p. 252–258). Further contraction up to elision (and compensatory lengthening) occurs when the rhotic is preceded by a low vowel as in *Art* [aːɐ̯t] ~ [aːt] 'manner'.

The learners' heritage language, Turkish, patterns with German in presenting only one rhotic phoneme. Yet, the similarities with Spanish are greater, insofar as the surface realization of the Turkish *r* sound – i.e., the

alveolar tap /ɾ/ (Göksel & Kerslake, 2005; Yavuz & Balcı, 2011) – corresponds to one of the two rhotic phonemes of Spanish in terms of place and manner of articulation. However, the Turkish tap is commonly devoiced to [ɾ̥] in the word-final coda (*kar* [kaɾ̥] 'snow'), and in both word-initial and word-final positions, it may be weakened to a fricated tap which lacks a full closure, as in *rüya* [ɻʏˈjaː] 'dream' or *kar* [kaɾ] ~ [kaɻ̊] 'snow'. An important fact for the present context is that Turkish rhotics never undergo vocalization, although they may occasionally be elided in some words in colloquial speech (e.g., in the imperfective affix *-(I)yor* and in the numeral *bir* 'one'; see Göksel & Kerslake, 2005, p. 9).

To further complete the picture, we briefly refer to English, the first FL learned by the participants. English patterns with German and Turkish in displaying only one rhotic phoneme, which is produced as an alveolar or retroflex approximant [ɹ/ɻ] in the varieties commonly acquired by FL learners in Germany. In many British English varieties, including Received Pronunciation, the rhotic is elided in coda position (*car* [kaː], so-called non-rhotic English). General American (GA) English, by contrast, is a rhotic variety, in which the final rhotic surfaces as an approximant (*car* [kaːɹ/ɻ], see Carr, 2020, p. 63).

2.2. The acquisition of rhotic sounds in Spanish as a FL

Learners often have problems acquiring (Spanish) rhotics. This is particularly the case when their L1 differs from the target language in terms of the manner and place of articulation of the rhotic sound, as is the case with German. However, previous research has concentrated mainly on English learners of Spanish: in 1986, Major pointed out that American learners who had the GA surface variant [ɾ] of the alveolar stop (*letter* [leɾɚ]) at their disposal quite successfully acquired the equivalent segment in Spanish but needed intensive pronunciation training to master the target-like tap vs. trill distribution. In a later study, Olsen (2012) showed that L1 articulation routines influenced the degree of target-likeness of the Spanish alveolar rhotics, as learners who used a "bunched" (i.e., alveolar) rhotic ([ɹ̈]) realization in their L1 English were advantaged over learners who used the postalveolar approximant ([ɹ̠]). McCandless (2020) showed that learners of Spanish with L1 Canadian English were more successful in acquiring the Spanish trill than the tap, due to the trill's perceptual "distinct[ness] from any Canadian English segment" (p. 14). His findings support the Speech Learning Model (Flege, 1987; Flege & Bohn, 2021), according to which perceptually salient ("new") sounds are easier to acquire than "similar" sounds,

which are not perceived as different from the sounds of the learners' L1 phonemic repertoire. Finally, in a study on Spanish rhotics produced by U.S.-born long-term residents in Central Castile, Face (2018) showed that his participants outperformed the learners of other studies who acquired Spanish in a non-Spanish-speaking environment (see, e.g., the American English learners recorded by Cummings Ruiz & Montrul (2020), who consistently produced [ɹ]), though without "approximat[ing] native-speaker performance" (p. 57)). More precisely, the L1 English immigrants produced significantly less target-like trills in their L2 Spanish across all positions as compared to the native controls and replaced them to a great extent with the articulatorily less complex tap (see Face, 2018, p. 65). The difference in articulatory complexity is also cited by Johnson (2008, p. 30, 224) as a major reason why the Spanish trill is more difficult to acquire than the tap when the phonological system of the learner's L1 lacks the corresponding rhotic sounds. To our knowledge, the literature on the acquisition of Spanish rhotics by German-speaking learners is largely limited to providing teachers with advice for pronunciation training. In this sense, Moreno Muñoz (2002) pointed out that German learners need to be made aware of the *r*-vocalization rule to prevent negative transfer into Spanish (p. 126), as in, for example, intended productions of the infinitive form *dormir* 'sleep', which is likely to be misinterpreted by Spanish listeners as the preterit form *dormía* 's/he slept' when realized with a vocalized final rhotic, i.e., [doɐ̯ˈmiɐ̯]. It should be mentioned in this context that comparable misproductions also occur in German-accented French and that negative transfer of rhotic vocalization is observed less frequently in German–Turkish learners as compared to their monolingual German peers (Gabriel et al., 2022, p. 355).

Only a few studies so far have addressed the acquisition of Spanish rhotics by multilingual learners. Kopečková (2014), for instance, showed that young German learners who were raised bilingually with a HL whose phonemic inventory includes alveolar rhotics (e.g., Russian, Croatian, Polish, or Italian) were able to produce the target-like Spanish trill from the outset, whereas their monolingual German peers did not benefit from their previous acquisition of English as a first FL when speaking Spanish. This outcome was largely confirmed by Kopečková (2016), who showed that monolingual German learners of Spanish were outperformed by bilinguals speaking different HLs along with German, albeit depending on the degree of similarity between their HL and the target language at the phonological level. Finally, Patience (2018, 2019) analyzed the production of Spanish rhotics in L1 Mandarin Chinese learners who had learned English as a first FL and point-

ed out that negative transfer onto Spanish occurred from both previously acquired languages. Note, however, that both Mandarin and English include approximant rhotics, which makes it difficult to decide which of the background languages the cross-linguistic influence on Spanish comes from. To the best of our knowledge, no intervention studies addressing the acquisition of rhotics by multilingual FL learners have been conducted so far.

3. EMPIRICAL STUDY

To investigate the acquisition of Spanish rhotics by bilingual German–Turkish learners, an intervention study with each one recording before, during, and after the completion of a digital learning module was carried out. The learning module aimed at training the learners in the pronunciation of Spanish /r/ and /ɾ/ and at making them aware of the similarities between their HL Turkish and the target language at the phonological but also at the grammatical level. Since bilingual FL learners have (at least) two sound systems at their disposal, the question arises as to which of their background languages constitutes the source of transfer. We thus aim to answer the following research questions (RQ).

RQ1: Do bilingual German–Turkish learners show transfer from German (the environmental language), Turkish (the HL), or English (the first FL) when producing Spanish rhotics?

RQ2: Do bilingual German–Turkish learners benefit from being made aware of the similarities and differences between Turkish and Spanish when acquiring Spanish rhotics?

3.1. Methods and materials

12 bilingual German–Turkish learners of Spanish (3 males, 9 females; ages: 14–18) were included in the study. All subjects were born and raised in Germany. At least one of their parents was born in Turkey, which makes them second-generation immigrants. They were 8–12 graders attending different senior high schools in the German federal states of Berlin, Hessen, and Baden-Württemberg. Since there are hardly any Spanish classes with a sufficient number of German–Turkish bilingual learners in German schools, the participants were recruited using the snowball principle at different schools through the mediation of Spanish teachers known to the authors. To avoid ceiling effects, we only included learners with a level of up to B2 according to the Common European Framework of Reference for Languages (following the teachers' assessment). At the time of data collection, they had been

studying Spanish as a second FL for 2–6 years after English as a first foreign FL. Three of them had attended voluntary Turkish classes for 1–4 years (participants 6, 9, 11). Ten participants reported speaking both German and Turkish at home, while only two stated that they used exclusively Turkish in their families (1, 3). All participants spoke close-to-standard varieties of German and used the rhotic system described for German in Section 2. They were not recorded in German, but since they were informed in detail about the upcoming intervention in a personal interview, it became clear that they used the unmarked uvular fricative realization of the rhotic phoneme in their German and regularly vocalized the rhotic consonant in coda position. No English L2 language data were collected from the experimental participants. However, given that it is well established in recent studies that German-speaking learners rarely transfer the uvular fricative from their L1 into English,[2] we assumed that the participants of the present study would also not do that. Verbal informed consent was obtained from all participants prior to the data collection. Table 1 provides an overview of the background information on the participants.

Table 1

Background information on participants (f = female; m = male; G = German/Germany; T = Turkish/Turkey)
Informacije o sudionicima (f = žena; m = muškarac; G = njemački/Njemačka; T = turski/Turska)

	Gender	Age	Birthplace of father/mother	Home languages	Grade	Year of formal instruction in Spanish	Year of formal instruction in Turkish
1	f	18	T/T	T	12	6	–
2	f	15	T/T	G, T	9	3	–
3	f	16	T/T	T	11	5	–
4	f	16	T/T	G, T	11	5	–
5	m	15	T/T	G, T	9	3	–
6	f	17	T/T	G, T	11	4	4
7	m	14	G/T	G, T	8	2	–
8	f	16	T/T	G, T	11	5	–
9	f	16	T/T	G, T	11	5	2
10	f	16	G/T	G, T	10	4	–
11	m	16	G/T	G, T	10	4	1
12	f	16	T/G	G, T	10	3	–

[2] For example, Sönning (2020, p. 133) and Wrembel et al. (2022, p. 9) recorded correctness rates of 87% and 80%, respectively, for the L2 English rhotics produced by L1 German learners. In the results reported by Kopečková et al. (2022, p. 11), approximately 50% of the realizations were correct ([ɹ]) and over 40% were non-target productions of the target segment as a bilabial glide [w]; negative transfer of the German uvular fricative [ʁ], however, was not recorded.

The data were collected in spring/summer 2021 and included several recordings of read speech (see **APPENDIX**) which were made by the learners themselves after having received detailed instructions via e-mail. The learners were asked to train reading the sentences at least once before recording their productions and could make as many recordings as they wished. In most cases, they used their mobile phones and sent their recordings back either as voice messages via WhatsApp or as audio files via e-mail. The time elapsing between the first and the last recording was usually around 8 weeks. Recording 2 was made after two weeks (see Section 3.1.1.)

3.1.1. The learning module

In the intervention, the participants were provided with eight learning units based on Gabriel et al. (2020), which aimed to raise their awareness of the characteristics of Spanish pronunciation in a cross-linguistic comparison with German and Turkish. The learning units were designed as worksheets, the first two of which focused on the rhotic phonemes /r/ and ɾ/. The remaining units addressed further aspects of Spanish pronunciation and grammar (VOT, spirantization, speech rhythm, production of vowels in unstressed vowels, differential object marking[3]). The individual learning units comprised different task formats. They all made use of digital media such as videos, podcasts, and online platforms, and provided practical exercises that allowed learners to apply their newly acquired knowledge. For example, in worksheet 1, the participants were asked to look up a series of words containing the two Spanish rhotic phonemes in an online pronunciation dictionary, to listen to the native pronunciation, and to repeat the words three times. In worksheet 2, they were first made aware of the German *r*-vocalization and then asked to record some Spanish and Turkish words ending in [ɾ] (e.g., Spanish *comer* 'eat', Turkish *kültür* 'culture') with an intentional German accent to better understand what must be avoided in the pronunciation of the syllable-final rhotic in Spanish (i.e., *comer* produced as *[ko.ˈmeɐ̯]). The worksheets were designed to be worked on individually and outside the classroom in a time frame of approximately one worksheet per week (i.e., 8 weeks in total; processing time per unit: 10–20

[3] The comparison of Spanish differential object marking as in *¿Viste a mi amigo*$_{[+human]}$*?* 'Did you see my friend?' vs. *¿Viste mi bicicleta*$_{[-human]}$*?* 'Did you see my bike?') and the distribution of the agglutinative accusative marker in Turkish as in *Kitap*$_{[-specific]}$ *aldım* 'I bought books / a book' vs. *Kitabı*$_{[+specific]}$ *aldım* 'I bought the book' was included to raise the participants' awareness of structural parallels also at the grammatical level.

min). Concerning the rhotics, the first sequence addressed the surface realizations and the distribution of Spanish /r/ and /ɾ/, while the second one was aimed at the avoidance of rhotic vocalization. Both units explicitly referred to Turkish, where (as in Spanish but unlike German) rhotic sounds are produced as alveolar sonorants that never undergo vocalization. The second learning sequence ended in an exercise in which the learners were asked to record a short reading text including /r/ and /ɾ/ in different positions (see **APPENDIX**). It was deliberately decided not to include the participants' L2 English in the training module for comparison purposes. For one thing, the English sound system is not helpful for the phonetic acquisition of Spanish on any of the levels covered in the worksheets (e.g., the production of rhotics and VOT, speech rhythm). Second, we intended to keep the scope of the tasks as narrow as possible due to time constraints.

For the present purpose, only learning units 1 and 2 were assessed based on the intended learning outcomes. Credit points were granted when the learners managed to explain and apply the theoretical knowledge that was to be acquired during the completion of the tasks, e.g., when they correctly indicated which rhotic phoneme occurred in a particular Spanish word. Note that the awarding of credit points was not dependent on whether the learners produced the respective segments in a target-like manner in the individual speech recordings. The evaluation of the worksheets was done independently by three teachers. When different final scores were obtained, the mean value of the three evaluators was calculated. The results were expressed as percentages.

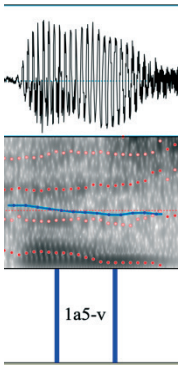
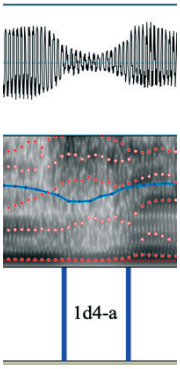
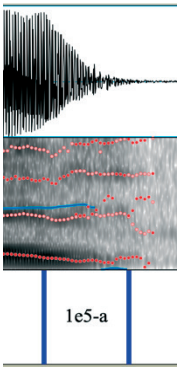
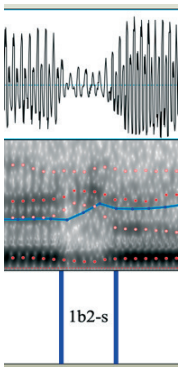
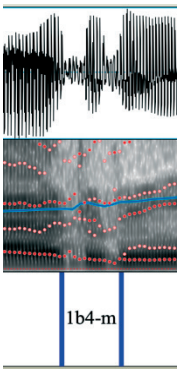
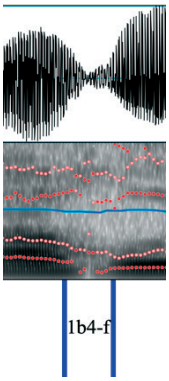
3.1.2. Phonetic analysis

The speech data were analyzed to establish the degree of target-likeness of each target segment (see **APPENDIX**), based on an acoustic and auditory examination via visual inspection of the spectrogram and the oscillogram. In accordance with Blecua's (2001) classification of Spanish rhotics, the target segments were evaluated using the following criteria and phonetic cues.

(1) Realization as a consonant, i.e., no vocalization: phases without a continuous, clearly discernible formant structure (only relevant for the tap in coda position)
(2) Realization as an alveolar tap or trill: presence of at least one clearly discernible closure phase
(3) Target-like distribution of tap and trill: number of closure phases

Obvious misproductions (e.g., [p**ɾ**emite] for intended *p**er**mite* 'allows') and items over which no full agreement was reached were excluded. Table (2) provides an illustration of the analysis.

Table 2
Exemplary illustration of the analysis
Primjeri prikaza analize

	personas	*tan rica*	*correr*
waveform, F0, and spectrogram			
cues	continuous formant structure	clear dip in the oscillogram and the F0 contour without a full closure	interruption of F0, decrease of the amplitude
analysis	vocalized/elided	alveolar (fricated) tap without a full closure [ɾ̞]	partially devoiced approximant / fricated tap [ɾ̝]
	perros	*perros*	*carro*
waveform, F0, and spectrogram			
cues	one clear closure phase	alternating closure and vocalic phases	friction noise and interruption of formant structure
analysis	alveolar tap [ɾ]	alveolar trill [r]	uvular fricative [ʁ]

After determining the kind of sound produced, the individual productions were rated according to their context to determine the degree of target-likeness. Consonantal productions of coda rhotics were scored with one first point. For both onset and coda rhotics, one point was assigned if the consonant was produced as an alveolar segment; another point was added when it was an alveolar tap or trill. A further point was given when an alveolar tap or trill was used according to target-like distribution. Intended alveolar trills /r/ which were realized at the wrong place of articulation (i.e., uvular [ʀ]) were scored with one point. Table 3 summarizes this scoring system. The points attained by the learners were summed up to obtain a score indicating the overall degree of target-likeness (maximum possible score: 85). To facilitate comparisons across different syllabic positions, the absolute values were transformed into percentages.

Table 3
Scoring system used for the assessment of target-likeness
Sustav bodovanja za određivanje sličnosti s ciljnim izgovorom

		/r/		/ɾ/		
produced sound category		**word-initial**	**intervocalic**	**intervocalic**	**word-internal coda**	**word-final coda**
vocalic	[ɐ̯]	0	0	0	0	0
uvular fricative or approximant	[ʁ]/[ʁ̞]	0	0	0	1	1
uvular trill	[ʀ]	1	1	0	1	1
alveolar (fricated) tap without full closure	[ɾ̝]	1	1	1	2	2
alveolar trill	[r]	3	3	2	3	3
alveolar tap	[ɾ]	2	2	3	4	4

3.2. Results

This section is devoted to the presentation of the outcomes of the empirical study. We first turn to the results of the phonetic analysis performed on the speech data (3.2.1.) before turning to the evaluation of learning units 1 and 2 (3.2.2.).

3.2.1. Speech data

In total, 895 target segments were included in the analysis. As shown in Table (4), the rhotics produced by the German–Turkish learners were quite target-like from the beginning (mean degree of target-likeness: 66%). With a standard deviation (SD) of 19%, their productions can be considered quite

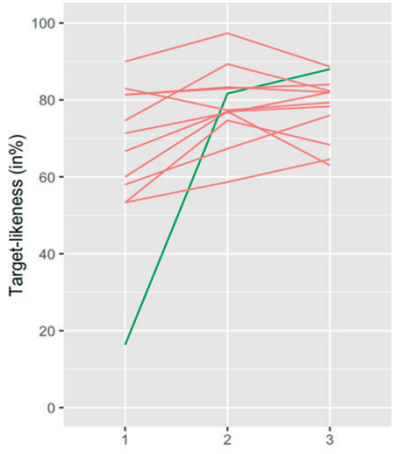
homogeneous; if the outlier (Learner 10) is removed from the calculation, the SD decreases to 12%.

Table 4
Degree of target-likeness of the rhotics (%) produced by learners 1–12 in the three recordings.
Stupanj sličnosti s ciljnim izgovorom za rofone glasove (%) za ispitanike 1–12 na tri snimka

Learners / Recordings	1	2	3	4	5	6	7	8	9	10	11	12	Mean	SD
1	60	71	75	53	83	81	67	90	53	16	58	81	66	19
2	77	77	89	75	77	83	77	97	59	82	67	83	79	9
3	78	82	82	68	79	84	63	89	65	88	76	82	78	8

The degree of target-likeness increased during the intervention; the improvement from recording 1 (before the intervention) to recording 2 (during the intervention) reached statistical significance (t = 2.42, p = .034, Cohen's d = 0.820). Only Learner 10 could be characterized as a strong improver, while the remaining participants attained correctness rates of above 50% from the outset and thus qualify as high performers. After the intervention, none of the participants achieved correctness rates of less than 50%, so none was classified as a low performer. Figure 1 illustrates the development of target-likeness across the three recordings. The steepest rising line represents learner 10. Note that the lines representing the results achieved by learners 6 and 12 overlap completely in the left part of the graph due to the identical correctness rates achieved in recordings 1 and 2.

Figure 1
Development of target-likeness (%) per learner across recordings 1–3
Razvoj sličnosti s ciljnim izgovorom (%) po ispitaniku na snimcima 1-3



To identify possible transfer from the learner's background language(s), it is essential to determine which sounds they produced at each step. Table (5) provides a summary of the productions before the intervention: underlying trills (/r/) are rarely produced in a target-like way (7–13%) but are mostly realized as taps ([ɾ], 48–67%). This is particularly true for the word-initial position, where the fricated alveolar tap and approximant realizations ([ɻ̝]) are common surface realizations. Concerning the underlying tap (/ɾ/), 88% of the intervocalic tokens are pronounced according to the target norm. However, this figure drops to 45–48% in coda position, where taps without full closure ([ɻ̝]) as well as vocalic realizations occur. Uvular realizations are rare (4%), the few occurrences stemming almost entirely from Learner 10.

Table 5
Realizations of rhotics in recording 1 (% and absolute numbers)
Ostvareni rofoni glasovi na snimku 1 (% i apsolutni broj)

		/r/		/ɾ/			
produced sound category \ **position**		**initial**	**intervocalic**	**intervocalic**	**internal coda**	**final coda**	**all**
vocalic	[ɐ̯]	0	0	0	27	20	9
uvular	[ʁ]/[ʁ̞]/[ʁ̝]	5	7	3	2	3	4
alveolar (fricated) tap without full closure	[ɻ̝]	40	12	7	20	30	22
alveolar trill	[r]	7	13	2	3	2	5
alveolar tap	[ɾ]	48	67	88	48	45	59
total		100	100	100	100	100	100
n		*60*	*59*	*60*	*60*	*60*	*299*

In recording 2, target-like /r/ realizations increased (Table 6), with intervocalic trills being more often target-like than not (increase from 13% to 60%). Word-initially, the number of correct productions of /r/ rose from 7% to 22%. However, with an occurrence of 60%, [ɾ] was still the predominant (non-target-like) realization. In addition, closureless productions of the tap dropped from 22% to 13%. In coda position, an improvement was observed concerning the underlying /ɾ/, in that the occurrences of closureless (fricated) taps and vocalizations were approximately halved. Uvular realizations were virtually absent.

Table 6
Realizations of rhotics in recording 2 (% and absolute numbers)
Ostvareni rofoni glasovi na snimku 2 (% i apsolutni broj)

		/r/		/ɾ/			
produced sound category \ **position**		**initial**	**intervocalic**	**intervocalic**	**internal coda**	**final coda**	**all**
vocalic	[ɐ̯]	0	0	0	15	12	5
uvular	[ʀ]/[ʁ]/[ɣ]	3	0	0	0	0	1
alveolar (fricated) tap without full closure	[ɻ̝]	13	5	12	13	20	13
alveolar trill	[r]	22	60	3	7	10	20
alveolar tap	[ɾ]	60	35	83	65	58	60
total		100	100	100	100	100	100
n		*59*	*59*	*59*	*60*	*61*	*298*

In recording 3, the production of /ɾ/ was still slightly more target-like, as the occurrences of fricated and vocalized taps decreased in most positions (see Table 7). However, there were also some deteriorations compared to recording 2: these concern the production of /r/, in the form of more non-target-like word-initial taps without full closure ([ɻ̝], increasing from 13% to 27%) and more intervocalic tap realizations ([ɾ], increasing from 36% to 45%).

Table 7
Realizations of rhotics in recording 3 (% and absolute numbers)
Ostvareni izgovor rofonih glasova na snimku 3 (% i apsolutni broj)

		/r/		/ɾ/			
produced sound category \ **position**		**initial**	**intervocalic**	**intervocalic**	**internal coda**	**final coda**	**all**
Vocalic	[ɐ̯]	0	0	0	10	15	5
Uvular	[ʀ]/[ʁ]/[ɣ]	2	0	0	0	0	0
alveolar (fricated) tap without full closure	[ɻ̝]	27	5	10	10	19	14
alveolar trill	[r]	10	50	2	7	7	15
alveolar tap	[ɾ]	60	45	88	73	59	65
total		100	100	100	100	100	100
n		*59*	*60*	*60*	*60*	*59*	*298*

Viewed in aggregate, the learners' performance improved during the intervention in that vocalization of coda rhotics and uvular productions – most likely the result of negative transfer from German – virtually disappeared in recording 3. However, the participants still had problems regarding the distribution of /ɾ/ and /r/, and continued to produce some [ɻ̝] realizations, which can conclusively be interpreted as negative transfer from Turkish.

Note that no alveolar or retroflex approximant [ɹ/ɻ] realizations occurred in the data. Thus, no obvious evidence of transfer from English was found.

3.2.2. Learning units

The results of the evaluation of the exercises addressing the production of rhotics in Spanish and Turkish that were completed by the participants are displayed in Table (8) as the proportion of credit points out of the maximum achievable score. For convenience, the correctness rates obtained in recording 3 are repeated. All in all, the results attained by the learners, which ranged between 50% and 98% (mean: 82%), indicate that they understood the theoretical information on the rhotic systems of Spanish and Turkish quite well.

Table 8

Results obtained in learning units 1 and 2 (%) and correctness rates for the rhotics produced in recording 3 (%)
Rezultati za nastavne cjeline 1 i 2 (%) i stopa točnosti za rofone glasove izgovorene na snimku 3 (%)

	1	2	3	4	5	6	7	8	9	10	11	12	mean
Results of learning units 1 and 2	98	99	93	89	95	94	74	92	31	86	85	50	82
Correctness rate of rhotics	78	82	82	68	79	84	63	89	65	88	76	82	78

As can be seen from the comparison of the results obtained in the two learning units and the results from the analysis of the production data (recording 3), a good command of the theoretical background does not necessarily correspond to target-like production. This is reflected in a rather moderate correlation (r = 0.47).

3.3. Discussion

The analysis of the participants' progression in the acquisition of Spanish rhotics in connection with the intervention shows that the bilingual German–Turkish learners already produced Spanish rhotics in a rather target-like manner before completing the learning module, that is, without having received explicit instruction. This particularly holds true for the tap phoneme /ɾ/, which is part of both the Turkish and the Spanish consonant system. Within the scope of the Speech Learning Model (Flege, 1987; Flege & Bohn, 2021), this can be interpreted as follows. For monolingually raised German learners (who have no command of Turkish and constitute the majority of students in the classrooms where the participants learn Spanish as a FL), the formation of a new *phonological* category for the Spanish rhotics should not pose a hurdle, since these sounds are recognizable as

"new sounds" due to the salient differences in the place (alveolar instead of uvular) and manner of articulation (vibrant instead of fricative). However, this does not guarantee a target-like production at the *phonetic* level, due to articulatory difficulties in producing alveolar vibrant sounds (which are not part of the German consonant system). For the German–Turkish bilinguals addressed here, the picture is somewhat different: Spanish alveolar rhotics are known segments, i.e., "old sounds". However, the contrast between Spanish /r/ and /ɾ/ falls into the category of "similar sounds", which means that the difference regarding the number of alveolar closures – one in the case of the tap and at least two for the trill – might be difficult for the participants to perceive without explicit instruction, probably due to the fact that neither Turkish nor German display a comparable distinction. Recall that in recording 1, only 13% of the intervocalic /r/ targets were produced in a target-like way, whereas 88% of the intervocalic /ɾ/ tokens were pronounced correctly. Regardless, the lower correctness rates of the trill across all learners – even in the third recording – seem to be related to the fact that this segment is characterized by higher articulatory (aerodynamic) complexity than the tap (Johnson, 2008; Kopečková, 2016; Patience, 2018). This seems to complement the explanation provided by the Speech Learning Model: while this approach can explain well why the learners have difficulty producing target-like tap–trill distribution, the difference in terms of aerodynamic complexity between the two segments helps motivate why the overall correctness rate for tap is significantly higher, regardless of the learners' background languages. Note, however, that the radical improvement made by learner 10 from recording 1 to recording 2 suggests that she had not yet formed a new category for Spanish rhotics prior to the intervention and that this step only took place after her awareness of the similarity of Spanish and Turkish rhotics had been raised. This is particularly interesting, since it suggests that her phonological knowledge of Turkish had been inhibited prior to the intervention and was activated only in its course. For the remaining eleven learners, a certain ceiling effect was achieved regarding the target-likeness of the alveolar place of articulation. However, the use of the learning module was not useless for these participants either, as they were able to improve their pronunciation concerning two aspects: (1) the avoidance of the negative transfer of the "Turkish" allophones, and (2) the target-likeness of the tap–trill distribution.

Furthermore, our findings show that (positive and negative) transfer occurs from both the HL (Turkish) and the environmental language (German), though to a different extent. More precisely, the bilingual learners most

often realized the Spanish tap phoneme correctly as [ɾ] from the outset, while uvular realizations (as in German), which rarely occurred in the first recording (4%), dropped down to 1% in recording 2, and were completely absent in recording 3. Similarly, the vocalization rates of coda /ɾ/ were rather low (20–27%) and decreased even more upon intervention. However, the tap [ɾ] was incorrectly used for /r/ (67% in recording 1), which may suggest that the learners were not yet aware of the phonemic Spanish tap–trill distinction. Target-like use of [ɾ] and [r] improved as a result of the intervention (with incorrect use of [ɾ] for /r/ dropping from 67% in recording 1 to 35% in recording 2 and 45% in recording 3), but the fundamental problem remains. In word-initial and in coda positions, the closureless (fricated) tap [ɾ̝] was a recurrent realization for both Spanish phonemes (20–40%). Given that this allophone is rare in Spanish but commonly appears in Turkish (see Section 2.1), this strongly points to (negative) transfer from the HL. This view is supported by the fact that uvular and vocalized productions, which suggest negative transfer from German strongly diminished during the intervention. As already pointed out in the previous section, no clear negative transfer from English could be found in the data.

In sum, in response to **RQ1**, we can state that German–Turkish learners of Spanish show less transfer from German (environmental language) than from their HL, Turkish. English, their first FL, at best seems to play a minor role in this context. This suggests that phonological transfer does not come only from one language but occurs "property by property" – i.e., based on similarities or overlapping between the grammars of the languages involved. In our specific case, transfer mostly seems to rely on the alleged perceived similarities between the alveolar rhotics of Spanish and Turkish. This largely supports the assumptions of the Linguistic Proximity Model (LPM, Westergaard et al., 2017; Westergaard, 2021), which was applied to phonological learning by Domene Moreno (2021). Note, however, that such conclusions must be drawn with due caution until further aspects of the acquisition of Spanish pronunciation by the same learner group have been explored. Besides that, the outcomes of our study indicate that the bilinguals perceive Spanish through the "double filter"[4] of both the surrounding language and their HL (Westergaard et al., 2017), even though the degree of activation of Turkish can be considered low in the German-medium

[4] This idea goes back to Trubetzkoy's (1939/1958, p. 47) concept of the L1 phonology as a "sieve" through which the sounds of the FL are perceived by the learner. The peculiarity of bilingual learners is that they dispose of two such "sieves" or "filters" in parallel.

education system, from which Turkish is largely absent. In this regard, the bilinguals' behavior confirms that Spanish rhotics must be comparatively salient and easily perceived, since previous studies have shown that less accessible areas of phonology, such as suprasegmentals, failed to activate the HL throughout the learning process even in the light of striking similarities with the target language (see, e.g., Grünke & Gabriel, 2022, on the acquisition of L3 French intonational contours by German–Turkish learners).

Turning to **RQ2**, the improvement observed in our developmental data shows that bilingual German–Turkish learners do benefit from being made aware of the similarities and differences between Turkish and Spanish as part of a digital learning module. This particularly holds true for learner 10, who seems to have realized during the intervention that to achieve a target-like production of Spanish rhotics, the place and manner of articulation should be taken from Turkish rather than from German, but also for the remaining learners, whose rhotic productions showed less uvular and less vocalized realizations in recordings 2 and 3. This clearly shows that the activation of the HL plays an essential role for positive transfer from the learners' multilingual background to occur. Note, however, that even learners 9 and 12, whose results of the evaluation of the worksheets were in the lower range, showed an improvement in target-likeness across the three recordings. Such cases of improvement without in-depth theoretical knowledge speak in favor of an individual-based conception of the acquisition of pronunciation skills, in the sense that individual learners draw on theoretical knowledge to a greater or lesser extent.

4. CONCLUDING REMARKS

We have examined the acquisition of the Spanish rhotic system in German–Turkish heritage bilinguals. By comparing three measurement points (before, during, and after an intervention), a developmental perspective was adopted. The results evinced a positive effect of the learning module in the participants – i.e., fostering their awareness of the similarities and differences between the phonological systems not only provided them with the necessary theoretical knowledge on the pronunciation of Spanish rhotics but also led to improved pronunciation. In this context, the question arises as to whether this is an outcome of the bilingual learners' increased awareness of their HL (which would suggest positive transfer from Turkish) or rather of the clarification of the Spanish target system. The obvious case of learner 10 points to the first assumption. The remaining learners,

who largely produced alveolar rhotic segments from the outset, seem to have been aware of the relevant similarities even before the intervention, at least to a certain extent. However, clarifying the differences between the two languages seems to have had a positive effect, which was evidenced in the decreasing occurrences of non-target-like "Turkish" allophones and of the German-like vocalized and uvular rhotics. The slight decrease of target-likeness of /r/ productions from recording 2 to recording 3 finally suggests that more training is necessary to master the complex distribution of the "similar sounds" [r] and [ɾ] in the long term.

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r-Laute in der Fremdsprache Spanisch: eine Interventionsstudie mit deutsch-türkisch Bilingualen

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Während das Deutsche mit dem uvularen Frikativ /ʁ/ ein r-Phonem hat, das in Coda-Position zu [ɐ] vokalisiert wird, besitzt das Spanische zwei alveolare Phoneme, den Tap /ɾ/ und den Trill /r/, die nie vokalisiert werden. Das Türkische weist wie das Deutsche ebenfalls nur ein Phonem auf, ist aber dem Spanischen näher, da es mit diesem den alveolaren Artikulationsort teilt und keine *r*-Vokalisierung kennt. Wir berichten über eine Interventionsstudie mit 12 deutsch-türkisch Bilingualen, die in Deutschland Spanisch lernen. Die Lesedaten wurden vor, während und nach dem Abschluss eines digitalen Lernmoduls erhoben. Als phonetische Korrelate wurden (1) die konsonantische Produktion des Zielsegments, (2) der Artikulationsort und (3) die Verteilung des Tap-Trill-Kontrasts berücksichtigt. Wir zeigen, dass hinsichtlich des alveolaren Artikulationsorts von Beginn an hohe Korrektheitsraten vorliegen und dass sich sowohl die Zielsprachlichkeit der Tap-Trill-Verteilung als auch die Vermeidung der *r*-Vokalisierung über die drei Messzeitpunkte hinweg verbessert. Der Fall einer Lernerin, die zunächst aus dem Deutschen transferiert hatte und nach der Intervention eine erhöhte Korrektheitsrate aufwies, zeigt, dass sich das Bewusstsein der Lernenden für Ähnlichkeiten und Unterschiede zwischen ihrer Herkunftssprache und dem Spanischen positiv auf den Erwerb auswirkt.

Schlüsselwörter*: r-Laute; Fremdsprache Spanisch; Türkisch; Deutsch; herkunftsbedingter Bilinguismus*

R-glasovi u španjolskom kao stranom jeziku: intervencijska studija s njemačko-turskim dvojezičnim govornicima

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Dok u njemačkom postoji jedan r-fonem, uvularni frikativ /ʁ/, koji se u odstupnoj poziciji vokalizira u [ɐ], španjolski raspolaže dvama alveolarnim fonemima, dodirnikom /ɾ/ i titrajnikom /r/, koji se nikad ne vokaliziraju. Kao i njemački, i turski ima samo jedan fonem, no on je bliži španjolskom jer s njim dijeli alveolarno mjesto tvorbe i ne poznaje vokalizaciju. U ovome radu izvještavamo o intervencijskoj studiji s 12 njemačko-turskih dvojezičnih govornika, koji u Njemačkoj uče španjolski. Uzorci čitanoga teksta prikupljeni su prije, za vrijeme i nakon što su ispitanici prošli digitalni modul za učenje španjolskoga. Kao fonetski korelati u obzir su uzeti (1) konsonantska produkcija ciljnoga segmenta, (2) mjesto artikulacije i (3) distribucija kontrasta između dodirnika i titrajnika. Što se tiče alveolarnoga mjesta artikulacije, rezultati pokazuju da se od samoga početka bilježi visoka stopa točnosti, a što se tiče distribucije kontrasta između dodirnika i titrajnika u ciljnom jeziku te izbjegavanja vokalizacije, opaža se poboljšanje u trima mjernim točkama. Slučaj jedne od ispitanica, koja je najprije transferirala iz njemačkoga, a nakon intervencije imala višu stopu točnosti, pokazuje da svjesnost učenika o sličnostima i razlikama između ishodišnoga i španjolskoga jezika pozitivno utječe na jezično usvajanje.

Ključne riječi: *rofoni glasovi, španjolski kao strani jezik, turski, njemački, podrijetlom uvjetovana dvojezičnost*

Appendix

Reading task

Es increíble, pero yo conozco a un perro que canta en un coro de perros y a un ratón que toca la guitarra en una orquesta de ratones. Pero a ninguno de los dos les gusta escuchar la radio.

Mi prima es tan rica como una reina. Tiene mucho dinero para comprar todo que le gusta: un carro de lujo, ropa carísima y flores preciosas.

En el museo de Bellas Artes, unos ladrones roban un cuadro. Se trata de la imagen de un ángel. La cogen y la venden en una plataforma de internet.

A la mujer de mi compañero Rafael le gusta mucho practicar deporte. Cuando está de vacaciones, siempre quiere correr alrededor del mar.

Los constructores salen del túnel y miden el ancho de la acera que está al margen de la carretera. Luego siguen dedicándose a su trabajo: suben a una montaña en su coche de diésel en el que caben cinco personas.