Initial phonological transfer in L3 Brazilian Portuguese and Italian

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This study examines five variables posited to drive(s) initial phonological transfer of (part of) one system over another in an L3: language status (L1/L2), facilitation, global structural similarity, dominance, and bilingual experience. Specifically, we investigate production of intervocalic voiced stops by English/Spanish bilinguals at the initial stages of L3 Brazilian Portuguese (BP) or Italian. These segments surface as [−continuant] in BP, Italian, and English but are realized as [+continuant] in Spanish; English transfer is therefore facilitative while Spanish is non-facilitative. Three groups (English-dominant heritage Spanish speakers, L1 English/L2 Spanish, L1 Spanish/L2 English) enrolled in first semester BP or Italian completed delayed repetition tasks in all three languages. The majority of participants across groups produce Spanish-like [+continuant] segments, suggestive of a primary role for global structural similarity. For the subset of participants across groups that produces English-like/L3-like [−continuant] segments, debrief data indicate a potential relationship between metalinguistic knowledge and [−continuant] production.

Keywords: third language acquisition, transfer, Brazilian Portuguese, Spanish, Italian

1. Introduction

The acknowledgement that the acquisition of a third language (L3) is qualitatively different from that of a chronologically true L2 has given rise to a promising body of research, stemming from a central question: What happens when a language learner has multiple systems available for transfer? Unlike inquiries into second language (L2) acquisition, L3 acquisition must account for the complexity of two or more co-existing and potentially competing grammars. L3 studies are tasked not only with addressing the question of what occurs during acquisition on a

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descriptive level, but also with accounting for what variables might be responsible for determining observed patterns of transfer into a learner's L3/L*n*. Over the past two decades, a foundational body of work in L3 morphosyntax has led to the proposal of a number of variables which could potentially be deterministic in initial transfer (see 'Background' for an overview of these variables). Though the data have begun to shed light on the processes that underlie the onset of L3 acquisition, several key questions remain (see e.g., Rothman, 2015, for discussion), including what drives transfer in the phonological domain. Herein, we operationalize transfer as a type of cross-linguistic influence which consists of the reduplication of linguistic representation, following Rothman, González Alonso, & Puig Mayenco (in press, pp. 14–15).

Of the L3 studies conducted to date, a limited but growing number have tapped into transfer or cross-linguistic influence at the phonological level (see Cabrelli Amaro & Wrembel, 2016, for the most recent state of the science). The subfield of L3 phonology has begun to expand its reach, with deeper inquiries into production of segmental (e.g., Kopečková, 2016) and suprasegmental phenomena (e.g., Lloyd-Smith, Gyllstad, & Kupisch, 2017), speech perception (e.g., Onishi, 2016), and perhaps most notably, the role of early bilingualism in subsequent phonological acquisition (Kopečková, Marecka, Wrembel, & Gut, 2016; Llama & López Morelos, 2016; Lloyd-Smith, Gyllstad, & Kupisch, 2017; Lloyd-Smith, Einfeldt, Kupisch, & Quaglia, 2017). As Cabrelli Amaro and Wrembel (2016) note, however, L3 phonology research will benefit from a wider range of research questions and designs, and the adoption of sounder methodological practices. One methodological issue they highlight is that L3 phonology studies attempting to account for transfer at the true initial stages (i.e., the initial period of exposure to an L3) to date have examined learners at more advanced stages of L3 acquisition, beyond what initial stages models can veritably account for and voiding the possibility of drawing a reliable distinction between facilitative transfer and acquisition. Given that the initial stages offer a fleeting, valuable window into acquisition mechanisms that later L3 time points cannot capture, the addition of true initial stages data to the extant literature is a critical next step for the advancement of research in transfer in L3 phonology. Our primary goal herein is to determine the variable(s) which provide(s) the greatest predictive power for the patterns of L3 phonological transfer observed across the early and late bilingual learners in the present study, and in doing so, contribute to the larger conversation about linguistic representations in the multilingual mind.

Given the dearth of true initial stages data, we examine patterns of transfer of intervocalic stop consonants in first-semester L3 Brazilian Portuguese (BP) and Italian by three groups of English/Spanish bilinguals: L1 English/L2 Spanish, L1 Spanish/L2 English, and early English/Spanish bilinguals (heritage speakers of

Spanish).[1] While underlying intervocalic voiced stop consonants (/b d g/) surface faithfully as [−continuant] in English, BP, and Italian, they critically surface as [+continuant] approximants in Spanish. Data from a delayed repetition task administered in all three of the participants' languages reveal that each group produces proportions of [+continuant] segments in the L3 that fall between English and Spanish proportions and that the three groups do not differ from one another. While this result could be interpreted on the surface as "combined" transfer from English and Spanish at the group level, individual-level analyses show that the majority of participants' production reflects Spanish transfer, while the remainder produce English-like or a combination of English- and Spanish-like segments. We attribute the outcome to a primary role for global structural similarity (i.e., an overlap of underlying lexical or grammatical properties) and discuss the potential role of metalinguistic knowledge and/or acquisition in progress even at this early stage in the production of English-like segments.

2. Background

Investigations into adult multilingualism have underscored the need for explanatory accounts of the mechanisms which drive transfer at the initial stages of L3 acquisition. Though the variables that have been proposed thus far are born out of research into L3 morphosyntactic representations, they may (or may not) extend to the phonological domain. With corroboration of between-domain data, these proposals stand to gain explanatory power regarding initial L3 transfer more generally. While some of these proposals assume that full transfer of one system to the L3 occurs, others posit that transfer is cumulative from either existing system and occurs on a property-by-property basis. The variables that have dominated the discussion are language status (L1 versus L2)/age of acquisition and typological proximity, which are associated with full transfer of one system, and facilitation (i.e., transfer of a property which patterns with the target L3 property), which is associated with property-by-property transfer from either existing system. It is of note that these variables have been tested primarily with adult sequential bilinguals, but recent research acknowledges that L3 transfer in early bilingual populations might be determined by distinct variables (see Section 2.3 for discussion). As will be seen, the juxtaposition of early and late bilinguals allows us to expand our investigation to include the variables of dominance and cumulative bilingual experience. In turn, we consider the role for the different variables in

1. Herein, we use the terms 'early bilingual' and 'heritage speaker' interchangeably, while recognizing that the former subsumes the latter.

light of existing L3 phonology data and posit the predicted outcomes for the current study based on each variable.

2.1 Full transfer

2.1.1 *Language status*

The consideration of age of onset of acquisition (AoA) has given rise to two models which predict full transfer of either the L1 or the L2. The L1 transfer scenario (L1TS, Hermas, 2014) and the L2 Status Factor Model (L2SFM, Bardel & Falk, 2007, 2012; Falk & Bardel, 2010) hinge on the chronologically true nature of a learner's L1 and L2. Though never presented as a formal model, the L1TS assumes a privileged status for a learner's L1 due to its entrenchment and predicts that it will compose the L3 initial state. Authors of a handful of studies examining phonological transfer point to L1 transfer (e.g., García Lecumberri & Gallardo del Puerto, 2003; Llisteri & Poch-Olivé, 1987; Ringbom, 1987). However, in each case, conclusions were based solely on L3 data. Without L2 data, it is not possible to confirm that the learners had acquired the relevant L2 phenomenon. Thus, it cannot be ruled out that the L1 representation was the only option available for transfer. The L2SFM, for its part, posits that transfer is determined by a learner's most recently acquired language. The model stems from early descriptive work by Meisel (1983) noting a 'foreign language effect' in L3 learners, and later studies by Williams and Hammarberg (1998) and Hammarberg (2001) suggesting that full transfer of a learner's L2 occurs at the onset of L3 acquisition due to the more chronologically recent language's blocking of access to the L1. Bardel and Falk's (2012) later proposal incorporates Paradis' (2009) declarative-procedural framing of L3 acquisition processes, regarding the explicit, metalinguistic processes employed in L3 acquisition as more cognitively similar to those used in L2 than those in L1 acquisition (i.e., implicit, automatized). It is important to note that such an approach may render the L2SFM irrelevant for early bilinguals, as many of these speakers acquire both systems under implicit conditions. We return to this issue in 'Modeling early bilinguals' L3 transfer'.

A limited number of studies have been put forth as empirical support for an L2 status from the phonological domain. Kamiyama's (2007) investigation of L1 Japanese/L2 English speakers' perception and production of L3 French close and close-mid rounded vowels revealed non-facilitative influence from L2 orthography. In a study of L3 English fundamental frequency (F0), Wrembel (2009) found a strong correlation between L2 German and L3 English F0 that was absent from a comparison of L1 Polish and L3 English. Tremblay (2007) reports evidence of L2 influence in voice onset time (VOT) transfer in L1 English/L2 French/L3 Japanese learners. Although each case is presented as evidence of L2 transfer, the design of these studies does not allow for the isolation of L2 status as the deterministic variable. Kamiyama (2007) and Tremblay (2007) share a common confound between L2 status and (perceived) facilitation: In the former, the L2 and L3 share a script that the L1 and L3 do not; in the latter, the L2 and L3 VOT values are more similar than L1 and L3 VOT values. In the case of Wrembel (2009), there is a confound between L2 status and typological proximity. These confounds were first addressed methodologically in Llama, Cardoso, and Collins (2010), who observed L1 English/L2 French and L1 French/L2 English speakers' VOT in L3 Spanish. This mirror-image design allowed the authors to tease apart the roles of language status and typological distance, and they found that L3 VOT values patterned more closely with each group's L2 VOT values. That is, the L2 French group produced shorter lag VOT and the L2 English group produced longer lag VOT in L3 Spanish. While the design addresses the need to disentangle the variables of language status, facilitation, and typological proximity, the learners' L1 was not tested. Considering what we know about (a) the development of hybrid L1-L2 phonetic categories (e.g., Flege, 1987; Major, 1992) and (b) L2 effects on L1 speech production which have been documented after as few as six weeks after initial L2 exposure (Chang, 2012), it is possible that L3 learners do not have distinct L1 and L2 representations available for transfer. In this case, L1 transfer cannot be ruled out. In light of the methodological limitations of the existing studies that report evidence of an L1 or L2 effect, there is a lack of concrete support for language status as a deterministic variable in L3 phonological transfer.

2.1.2 *Typology*

In contrast to the L1TS and L2SFM, Rothman (e.g., 2015) has proposed that L3 initial stages transfer is selective in nature, and that global structural similarities between languages motivate full transfer from a single linguistic system (see Rothman, González Alonso, & Puig Mayenco, in press, for discussion of why full transfer should be the default assumption).[2] These tenets are formalized in the Typological Primacy Model (TPM, Rothman, 2010, 2011, 2013, 2015; Rothman et al.). Typological similarity between languages, as defined by Rothman (2015), refers to an overlap of underlying lexical or grammatical properties, detected by the linguistic parser and capitalized upon once sufficient information has been provided in the L3 input for the parser to make a determination of global structural similarity. These decisions are made hierarchically and are based on lexical, phonological, morphosyntactic, and semantic levels, in that order.

Wrembel (2012) and Lloyd-Smith, Gyllstad, and Kupisch (2017) posit that their L3 phonological transfer data might be at least partially explained by the

2. Herein, we use the terms 'typological similarity' and 'global structural similarity' interchangeably.

TPM. In a study of L3 foreign accent in L1 Polish/L2 German/L3 English speakers, Wrembel (2010) found evidence of L2 German transfer to L3 English, but the design conflated language status and typological distance (i.e., German is the L2 but is also more similar to L3 English). In a subsequent study, Wrembel (2012) examined L3 foreign accent in L1 Polish/L2 French/L3 English learners and this time found evidence for L1 transfer. Since Polish and English pattern together with respect to suprasegmental phenomena such as stress, Wrembel posited the possibility of phonological similarity as a key variable. Lloyd-Smith, Gyllstad, and Kupisch (2017) examined global English accent in German/heritage Turkish/L3 English speakers and reported that 60% of learners were identified by English accent raters as L1 German speakers (as a point of comparison, 80% of L1 German speakers were identified as L1 German speakers). In contrast, 18% of the L3 learners were identified as L1 Turkish speakers, and a relationship was found between Turkish phonological proficiency and the identified source of the learners' accents. While the finding that the source of the majority of the learners' L3 English accent was the more similar German, it is uncertain what role dominance plays in this case since German was also the majority of the learners' dominant language. We discuss this outcome and its implications in further detail in 'Modeling early bilingual L3 transfer.'

In the current study, we would anticipate under the assumptions made by the TPM that all three groups of learners would demonstrate comparable patterns of Spanish transfer to BP and Italian. This outcome has been attested in a number of studies of syntax-semantics interface and core syntactic properties that examine judgments by English/Spanish bilinguals acquiring L3 BP (Cabrelli Amaro, Amaro, & Rothman, 2015; Giancaspro, Halloran, & Iverson, 2015; Ionin, Grolla, Santos, & Montrul, 2015; Montrul, Dias, & Santos, 2011; Parma, 2017; Rothman, 2010, 2011; Santos, 2013), with further evidence of Romance to L3 Romance (French, Spanish, or Italian) transfer coming from Bruhn de Garavito and Perpiñán (2014), Foote (2009), Borg (2013), and Rothman and Cabrelli Amaro (2010). Considering that the TPM assumes full transfer of a single system, it should follow that phonology should pattern with syntax. However, this is not what is attested in Llama and López-Morelos (2016). In their investigation of L3 French VOT, the authors found that English/heritage Spanish bilinguals produced VOTs consistent with their dominant language, (non-facilitative) English. Although they note that the learners' L3 input might have consisted of English-like VOT, this disparity indicates that the outcome of a scenario of phonological transfer with English/Romance speakers acquiring a Romance L3 might not be as straightforward as what we have found thus far for morphosyntax, at least not for heritage speakers (see Section 2.3 for a discussion of early bilingual L3 transfer).

2.2 Property-by-property transfer

A common thread that the models discussed up to this point share is that they assume that initial transfer consists of a full copy of one of a learner's existing systems (in line with Full Transfer/Full Access, Schwartz & Sprouse, 1996), primarily for reasons of cognitive economy. Other models, however, assume that transfer takes place on a property-by-property basis. In such a case, any existing grammar may serve as a source of transfer, acting cumulatively to construct the L3 grammar. This pathway of acquisition has been represented in the literature predominantly by the Cumulative Enhancement Model (CEM, Flynn, Foley, & Vinnitskaya, 2004; Berkes & Flynn, 2012), whose development stems from empirical support for scaffolding effects in L3 acquisition. The CEM predicts transfer of individual L1/L2 properties into the L3 in the case of a facilitative relationship, or neutrality of the L1/L2 properties in the case of non-facilitation. That is, non-facilitative transfer is predicted to never occur. Although outcomes consistent with the predictions of the CEM have been observed in a number of L3 phonology studies (e.g., Kopečková, 2014; Onishi, 2016; Sypiańska, 2016; Wrembel, 2012), it is of note that the participants in each of these studies were tested at later stages of L3 acquisition. Thus, there is a confound since it is not possible to adjudicate between facilitative transfer and L3 acquisition. Moreover, non-facilitative transfer has been attested in a large body of L3 syntax and phonology research, which casts doubt on the impossibility of non-facilitation that the CEM posits. This evidence of non-facilitative transfer has recently given rise to modified approaches to L3 initial cumulative transfer, including the Linguistic Proximity Model (LPM, Westergaard, Mitrofanova, Mykhaylyk, & Rodina, 2017) and the Scalpel Model (SM, Slabakova, 2017). While both models propose that transfer is cumulative, they predict that non-facilitation can occur for reasons including insufficient input (LPM, SM), misanalysis of input (LPM), and/or differential learnability of properties (SM). Although the LPM and SM do not make strong a priori predictions that are testable in the present study,[3] the LPM predicts a potential stage of transfer during which L3 input passes through a double (L1/L2) filter, which could yield hybrid English/Spanish outcomes (i.e., combined transfer, see e.g., De Angelis, 2007). We return to the LPM in the discussion of our results.

3. To test the predictions of the SM, we would have to examine multiple properties that vary in frequency and type of input available. Moreover, since input quantity is a key factor in both models and a lack of sufficient input could result in transfer from either or both of the existing linguistic systems, these models cannot make concrete predictions for whether English or Spanish will transfer to L3 BP and Italian in the present study.

2.3 Modeling early bilingual L3 transfer

As we note in Section 2.0, L3 transfer has been investigated primarily in late (i.e., sequential) bilingual L3 learners. As acknowledged by Lloyd-Smith, Gyllstad, and Kupisch (2017), however, early bilinguals represent an increasingly common L3 acquisition scenario which does not conform to the traditional L1/L2 distinction that is central to much of the extant literature. Even more problematically, there has been little consensus on what constitutes the distinction between "L1" and "L2"; it has been understood by some as hinging on a critical period or age of acquisition and alternatively by others as a function of type of learning (i.e., naturalistic versus instructed; see, e.g., Bardel & Falk, 2012; Paradis, 2009; for general discussion, see Lloyd-Smith, Gyllstad, & Kupisch, 2017). When applied to many early bilinguals, these two approaches generate conflicting categorizations of learners, and determining which models of L3 transfer are applicable to early bilingual populations becomes unclear. The TPM and cumulative models apply equally to early and late bilingual learners, as their predictions are not age-driven. Whether the L1SF and L2SFM are also relevant for the early bilinguals in the present study, however, is less clear. For instance, what would the L1SF predict for early simultaneous bilinguals, given that they have two L1s available? We avoid this categorization for the L2SFM in the present study in light of the model's assumptions that the L2 relies on declarative memory; in this case, we assume that the heritage speakers' English grammar relies on procedural memory.

2.3.1 *Dominance*

While we are unable to apply the L2SFM to the heritage speaker data in this study, this population will potentially allow us to examine the role of dominance in initial L3 transfer, which has been isolated as a deterministic variable in recent studies of L3 transfer among early bilinguals. In studies of Persian/Mazandarani bilingual adolescents at the initial stages of L3 English, Fallah, Jabbari, and Fazilatfar (2016) and Fallah and Jabbari (2018) have found that learners' English possessives and attributive adjectives, respectively, could be traced to the language of communication, rather than facilitation, global structural similarity, or order of acquisition. Specific to phonology, Llama and López-Morelos (2016) report that English/heritage Spanish bilinguals produce English-like VOT in L3 French, which is indicative of (non-facilitative) transfer from their dominant language (English).

While the L1 Spanish/L2 English participants and heritage Spanish participants in the present study share an early AoA of Spanish, they differ in language dominance: The L1 Spanish group is Spanish dominant, while the heritage Spanish group is English dominant. Thus, if the heritage Spanish group transfers Spanish, this would allow us to rule out dominance as a deterministic variable in this case. However, if the heritage Spanish and L1 English/L2 Spanish groups rely on English while the L1 Spanish/L2 English group relies on Spanish, such an outcome would align with the findings from Fallah et al., Fallah and Jabbari, and Llama and López-Morelos.

2.3.2 *Bilingual experience*

In addition to dominance or language of communication, we can examine the possible effect of 'bilingual experience'. Lloyd-Smith, Gyllstad, and Kupisch (2017), following Rothman's (2015) discussion of the implications of heritage speakers' increased inhibitory control resulting from their cumulative bilingual experience, posit that heritage speakers might be able to bypass non-facilitative transfer. That is, if heritage speaker participants are more likely to produce target-like segments at the initial stages than the mirror-image sequential bilinguals, it is possible that such a transfer pattern could be attributed to relative bilingual experience. We return to these more exploratory questions of dominance and bilingual experience in the discussion.

3. Stop realization in English, Spanish, BP, and Italian

To examine transfer patterns in L3 phonological acquisition, intervocalic stop realization was chosen as the phenomenon of interest in this study. The surface realization of underlying voiced stops is faithful in the L3s we test (BP and Italian) as well as in English, but these stops surface as [+continuant] segments in Spanish. We thus have a pair of background languages in which the more similar language to the L3 (Spanish) behaves differently than the L3, while the less similar language to the L3 (English) behaves similarly. This design provides the opportunity to tease apart the variables of language status, typological proximity, and facilitation (and potentially dominance and bilingual experience) in this case of initial L3 transfer.

In Spanish, underlying voiced stops surface systematically as lenited approximant segments in intervocalic position ((1a–c), e.g., Hualde, Simonet, & Nadeu, 2011). In contrast, intervocalic /b d g/ surface as [−continuant] segments in English ((2a–c), see e.g., Hualde, 2005),[4] BP ((3a–c), see e.g., Barbosa & Albano, 2004), and Italian ((4a–c), see e.g., Krämer, 2009).

4. Studies such as those by Bouavichith and Davidson (2013) and Warner and Tucker (2011) indicate that English speakers lenite intervocalic voiced stops in fast speech. However, as will be seen in Section 6, these findings are not reflected in our data set: In English, the L1 English speakers produce [+continuant] segments 2% of the time, the L1 Spanish speakers 13%, and heritage Spanish speakers 3%.

(1)	a.	*lobo*	[ˈlo.**β̞**o]	'wolf'
	b.	*todo*	[ˈto.**ð̞**o]	'everything'
	c.	*mago*	[ˈma.**ɣ̞**o]	'magician'
(2)	a.	*baby*	[ˈbeɪ.**b**i]	
	b.	*buddy*	[ˈbʌ.**d**ɨ] / [ˈbʌɾi]	
	c.	*muggy*	[ˈmʌ**g**ɨ]	
(3)	a.	*cabo*	[ˈka.**b**ʊ]	'cape'
	b.	*nada*	[ˈna.**d**ɐ]	'nothing'
	c.	*saga*	[ˈsa.**g**ɐ]	'saga'
(4)	a.	*cibo*	[ˈtʃi.**b**o]	'food'
	b.	*moda*	[ˈmo.**d̪**a]	'fashion'
	c.	*vago*	[ˈva.**g**o]	'vague'

There is evidence that L1 English/L2 Spanish speakers successfully acquire spirantization in word-medial intervocalic position (see, e.g., Cabrelli Amaro, 2017; Face & Menke, 2009; Rogers & Alvord, 2014),[5] and that L1 Spanish/L2 English speakers can acquire faithful word-medial intervocalic stop production (Zampini, 1996). While heritage speaker intervocalic stop realization is reported to be variable, English-dominant heritage speakers have generally been found to produce [+continuant] segments in word-medial position (see e.g., Knightly, Jun, Oh, & Au, 2003; Rao, 2015). The finding that word-medial stop realization is acquirable in each of the three group's L2 or heritage language makes this an appropriate phenomenon to use as a test case of L3 initial phonological transfer.

4. Research question

In light of the unresolved questions surrounding patterns of L3 transfer and limited evidence from the phonological domain, we ask the following question: Which variable is deterministic in initial stages phonological transfer in L3 BP and Italian by English/Spanish bilinguals: facilitation, language status, global structural similarity, dominance, or bilingual experience? We will answer this question by analyzing the production of English/Spanish bilinguals' intervocalic stops in English, Spanish, and BP or Italian to determine whether learners' L3 Italian or BP stops are more Spanish-like ([+continuant]) or English-like ([−continuant]). The predictions made according to each variable for the present study are outlined in Table 1.

5. Cabrelli Amaro (2017) shows that even beginner-proficiency L2 Spanish speakers produce [+continuant] segments in word-medial position in high-frequency lexical items.

Table 1. Predictions for English/Spanish bilingual transfer into L3 BP and Italian, according to group

	Language status		Facilitation	Typology	Dominance	Bilingual experience
	L1 transfer	**L2 transfer**				
Heritage Spanish	N/A	N/A	English	Spanish	English	English
L1 English/L2 Spanish	English	Spanish	English	Spanish	English	Spanish
L1 Spanish/L2 English	Spanish	English	English	Spanish	Spanish	Spanish

5. Method

5.1 Participants

Forty-one initial stages L3/L*n* learners of Brazilian Portuguese ($n = 23$, $M_{age} = 24.30$, $SD = 5.54$; 15 females) and Italian ($n = 18$, $M_{age} = 19.72$, $SD = 1.49$; 15 females) were recruited from first-semester, university-level courses (three contact hours per week) for participation in the present study, which took place starting in week 5 of the semester, after approximately 12–15 hours of instruction. Initial eligibility was determined by language background experience, and included a total pool of 66 early and late English/Spanish bilinguals (HS, L1 English/L2 Spanish, and L1 Spanish/L2 English) who completed all experimental tasks and computer-based background assessments. Sixteen participants were removed from the sample for having an additional background language (in these cases, Basque, French, Italian, or Valencian), as their inclusion could confound our analyses of transfer source. From the remaining 50 participants, only those who demonstrated a significantly greater proportion of [+continuant] segments in Spanish than in English during the delayed repetition tasks, as determined by a series of McNemar tests, were included in further analyses. In a McNemar test, the null hypothesis states that the two marginal probabilities for each outcome ([+continuant], [−continuant]) are the same; a result of $p < .05$ thus indicates that the marginal proportions are significantly different.[6] The test outcomes resulted in the exclusion of seven participants from the reported data set who did not demonstrate distinct English/Spanish underlying stop realization patterns available for transfer. Following Rothman (2015), we take demonstration of two distinct grammars to be sufficient for study inclusion, regardless of L2 proficiency:

6. In the case that there were < 25 discordants (in which case χ^2 is not well approximated by the chi-squared probability distribution), a mid-p McNemar test was used.

> The mind does not know of or much care about so-called completeness or relative proficiency level; these are shorthand descriptions and theoretical constructs that we have invented for theory internal purposes. From the mind's perspective, at the onset of exposure to L3/L*n*, the bilingual mind has whatever systems it has, whether the L2 is at a fossilized state or still in the process of modification. (p. 188)

In fact, the inclusion of learners based on objective proficiency measures alone is unadvisable, since advanced oral proficiency (much less written proficiency) does not guarantee that a learner has acquired the phonological phenomenon under investigation. We see this firsthand in our sample; several excluded participants that are highly proficient in the L2 according to the written proficiency measure[7] were not more likely to produce [+continuant] segments in Spanish than in English. Since this inclusion criterion resulted in a sample with varying degrees of L2 proficiency, we included proficiency as a covariate in our analysis (see Section 5.4.2 for details).

Participant information on language dominance, use, and background was gathered using an appended version of the self-reporting Bilingual Language Profile (BLP, Birdsong, Gertken, & Amengual, 2012). Dominance scores calculated by the BLP have a possible range of −218 to +218, with negative values indicating Spanish dominance and positive values indicating English dominance. Higher absolute value of a score corresponds to stronger dominance, and values closer to zero indicate greater 'balance' of the two languages. As noted in Appendix A (online supplement), all L1 English/L2 Spanish were English dominant and all L1 Spanish/L2 English speakers were Spanish dominant. Twenty-two of 24 HSs were English-dominant; for the sake of homogeneity in our group-level analysis, we excluded the two Spanish-dominant HSs from analysis.In all, our final data set consisted of 22 heritage speakers (HS, 18 simultaneous, four early L2 English),[8] 14 L1 English/L2 Spanish speakers (L1EN), and five L1 Spanish/L2 English speakers (L1SP).

L2 proficiency, though not treated as an inclusion criterion in this study, was assessed via foreign accent ratings and a written assessment. The English-dominant participants (i.e., HS and L1EN groups) completed a 50-item Spanish proficiency assessment that has been widely used in L2 Spanish and Heritage Spanish research (e.g., Montrul, 2008) comprised of portions of the Modern Language Association (MLA) and Diploma of Spanish as a Foreign Language (DELE) proficiency exams. The Spanish-dominant participants (L1SP group) completed a 50-item English

7. Since these participants were excluded from the study, we did not include their speech samples in the global accent rating and thus only have written proficiency scores from them.

8. We categorize these heritage speakers as simultaneous (onset of English acquisition at 0–3 years) or early sequential bilinguals (onset of English acquisition at 4–6 years) following Montrul (2008, p. 18).

proficiency test that is adapted from the Cambridge Placement Test and has been used in L2 English research (e.g., Leal, Slabakova, Ivanov, & Tryzna, 2016; Slabakova, Cabrelli Amaro, & Kang, 2016). Oral proficiency in the non-dominant language was assessed via accent ratings of 10–15 second speech excerpts extracted from interview audio files (see 'Procedure)'. Spanish samples were evaluated by 23 L1 Spanish/L2 English speakers and English samples were evaluated by 29 L1 English/L2 Spanish speakers. Raters were graduate students or faculty members in Spanish or Linguistics departments in US universities with extensive experience with English-accented Spanish and Spanish-accented English. The ratings task was administered via Qualtrics online survey platform, and raters were asked to provide ratings on a Likert scale of 1 (very strong foreign accent) to 9 (no foreign accent). Ratings for each participant were then z-score transformed and inter-rater reliability was assessed via intraclass correlation. The intraclass correlation coefficient for English was .994 and for Spanish was .980, both of which indicate very high interrater reliability. A correlation between written and oral proficiency measures yielded only a moderate relationship ($r = .586$, $p < .001$). Given the lack of a strong correlation (likely due to lower variability in the written proficiency scores as compared to the oral proficiency scores) and considering that our focus is on phonological production, we incorporated the z-score transformed accent ratings into our statistical analysis to account for any potential effect of proficiency, and report the written proficiency scores as supplemental information. The participants' relevant background information, including proficiency and dominance scores, is summarized in Table 2.

Table 2. Age of acquisition, proficiency, and dominance scores by participant group

Group	n		AoA non-dominant language		AoA L3		Written proficiency non-dominant language (0–50)		Phonological proficiency non-dominant language (z-score)		Dominance (−218 to 218)	
	Total	Italian	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
HS	22	13	2.14	1.81	20.73	2.39	33.77	9.58	0.25	0.63	57.54	27.84
L1 EN	14	4	13.71	2.49	23.14	6.43	30.93	8.96	−0.70	0.61	95.16	22.00
L1 SP	5	1	14.00	3.54	26.80	5.02	42.80	4.49	−0.19	0.70	−67.34	32.96

5.2 Tasks

A delayed repetition task was administered in all three languages. All items were nonce words presented aurally within a carrier phrase ('I say ___ for you' and its Spanish, BP, and Italian equivalents; see Table 3). For each trial, participants were asked to repeat the entire phrase after a 1000 ms delay and repetition cue ('Can you repeat that, please?' or its equivalent). The intermediate cue served to impede direct imitation and storage of the original carrier phrase in participants' phonological short-term memory. In spite of the articulatory and processing effects associated with any production task, we would argue that this particular task, which forces the participant to rely on stored representation, offers the best chance at yielding a reliable approximation of learners' representational grammars via production. We return to considerations of production tasks in L3 initial transfer research in greater depth in our discussion. The nonce repetition stimuli in all languages consisted of 30 disyllabic, CV.CV critical tokens: two repetitions of 15 critical items containing /b d g/ (n = 5 per phoneme) and 30 (Italian) or 124 (BP) total distractor items (see Appendix B (online supplement) for a list of critical stimuli).[9,10] The selected stimuli were phonotactically legal in all of the languages, and stimuli were recorded in English, Spanish, Italian, or BP by phonetically trained L1 speakers of the relevant language.[11] Visual inspection of spectrograms and waveforms for each of the stimuli confirmed that the intervocalic English, BP, and Italian /b d g/ segments were produced as stops and the Spanish segments were produced as continuants (see Section 5.4.1 for the categorization criteria used).

Table 3. Auditory prompts and expected responses in delayed repetition tasks

	English	**Spanish**	**BP**	**Italian**
Prompt	I say *faba* for you.	Digo *faba* para ti.	Digo *faba* para você.	Dico *faba* per te.
Repetition cue	Can you repeat that, please?	Repite, por favor.	Repete, por favor.	Ripeti, per favore.
Expected response	I say *faba* for you.	Digo *faba* para ti.	Digo *faba* para você.	Dico *faba* per te.

9. A subset of the BP participants (n = 10) completed the first block only and have 15 data points per language.

10. The additional BP distractor items are part of a separate phase of this project.

11. An anonymous reviewer correctly points out that words with a C(C)V.CV structure are more common in the Romance languages than in English and brings up the question of whether this pattern could arguably 'trigger' Spanish versus English transfer. We minimized this potential outcome by creating items across languages exclusively with disyllabic stress (the most common pattern across languages) and with the low vowel; this vowel, produced as [ə] in English in unstressed position, is the only permissible short word-final vowel. We prioritized maximal comparability across languages in our design; doing so also allowed us to include by-item random intercepts in our statistical models.

5.3 Procedure

Data collection took place across three sessions during weeks 5–7 of the semester. The L3 (BP or Italian) session was always conducted first and consisted of informed consent, the delayed repetition task, and completion of the BLP. English and Spanish session order was counterbalanced across participants, and both sessions followed the same format: a 10–15 minute informal oral interview which served to move them into the relevant language mode and obtain speech samples for foreign accent ratings, followed by the delayed repetition task. During the non-dominant language session (Spanish in the case of L1EN and HS participants; English for L1SP participants), participants completed a written proficiency measurement in that language.[12] All recordings were completed in a sound-attenuated booth (delayed repetition tasks) or quiet space (interviews) using a Marantz PMD661 MKII solid state recorder and a Shure SM10A head-mounted dynamic microphone at a sampling rate of 44.1 kHz. Total participation time lasted three to four hours for all sessions, and participants were compensated upon completion.

5.4 Data analysis

5.4.1 *Acoustic analysis*

Data from the delayed repetition tasks were segmented and analyzed in Praat (Boersma & Weenink, 2017). Critical segments (intervocalic /b d g/) were coded binarily: Productions were determined to be [−continuant] in the presence of occlusion (i.e., interruption of energy in the spectrogram and absence of amplitude in the waveform), and as [+continuant] otherwise.[13] Presence of a release burst in the spectrogram has traditionally been an acoustic index associated with stop production, though bursts are not always visible for occluded segments. Therefore, we treat release bursts not as a necessary condition for occluded segments, but rather as an additional indicator of [−continuant] production. Figure 1 shows production of a [+continuant] segment by an L1 Spanish speaker; Figures 2–4 show production of a [−continuant] segment by L1 English, BP, and Italian speakers in their respective L1. Each production is for the critical nonce stimulus /taba/.

12. Eleven L3 BP participants gave informed consent and completed the background interviews and proficiency assessments in a session prior to the delayed repetition tasks.

13. While a substantial body of acoustic research of spirantization implements measurements of relative intensity, we use a binary categorization here. Our research question is not concerned with *degree* of lenition, but rather with whether learners transfer the representation which yields English-like [−continuant] [b d g] outputs or Spanish-like [+continuant] approximant outputs. Therefore, it is necessary to categorize productions as [+/− continuant], and there is not a principled way to do so using a continuous measure such as relative intensity.

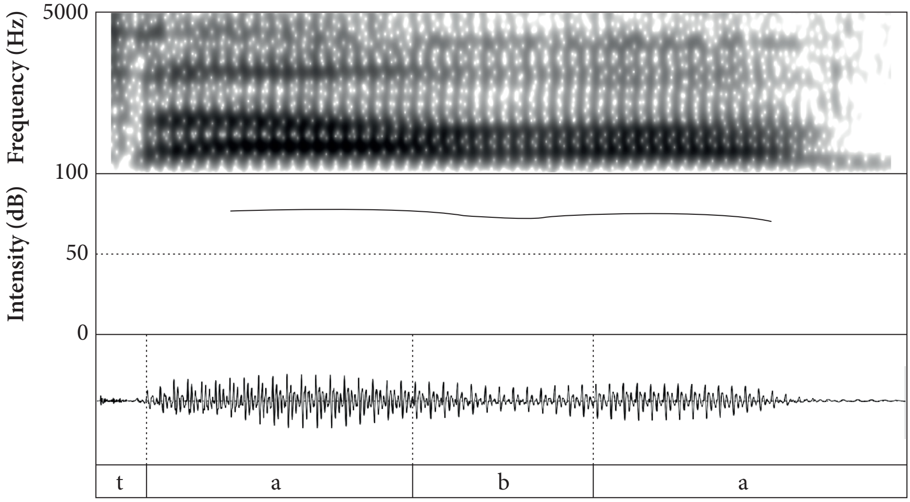

Figure 1. [+continuant] production of /b/ in Spanish 'taba' by an L1 Spanish speaker

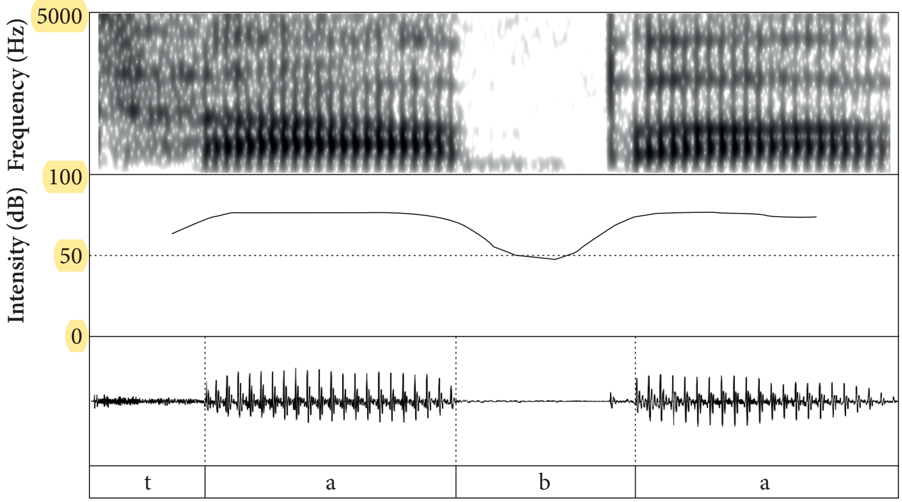

Figure 2. [−continuant] production of /b/ in English 'taba' by an L1 English speaker

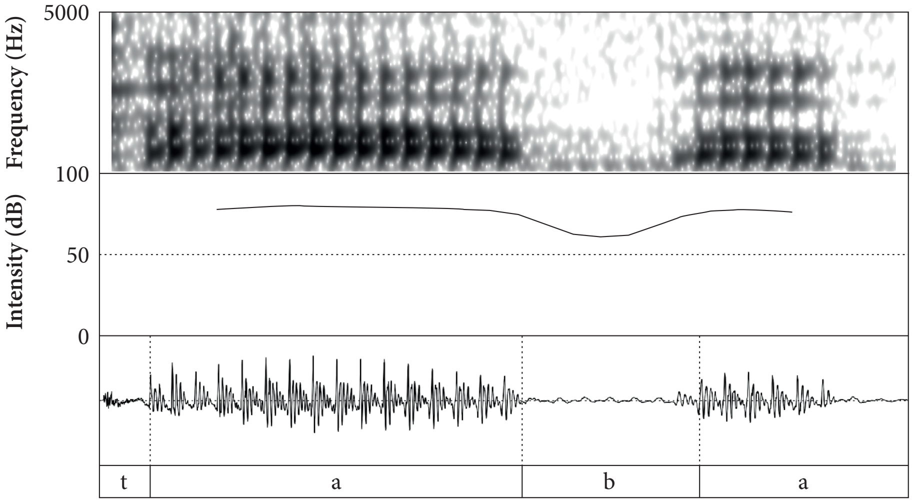

Figure 3. [−continuant] production of /b/ in BP 'taba' by an L1 BP speaker

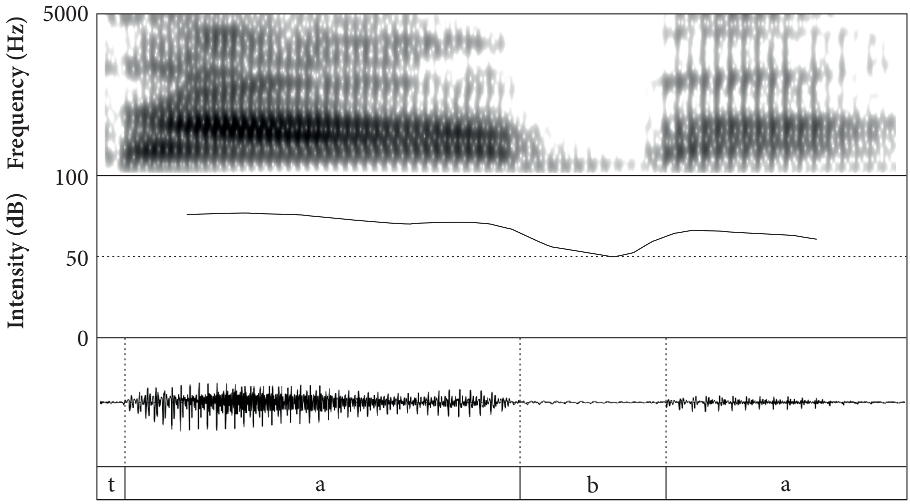

Figure 4. [−continuant] production of /b/ in Italian 'taba' by an L1 Italian speaker

5.4.2 *Statistical analysis*

To evaluate transfer at the group level, the binary data (2,941 tokens) were entered into a mixed-effects logistic regression model using the GENLINMIXED procedure in SPSS 24, with fixed effects of Group (L1 English/L2 Spanish, L1 Spanish/L2 English, heritage Spanish), Language (English, Spanish, BP/Italian), and the control variable of Phoneme (/b/, /d/, /g/), with Phonological Proficiency (z-scores) as a covariate. We did not include L3 (i.e., whether the participant's L3 was BP or Italian) as a fixed effect for two reasons. First, there is no principled reason to predict divergent patterns, as (a) these two Romance languages pattern together with respect to the phonetic realization of intervocalic underlying stops and (b) the participants' classroom exposure to the L3 was the same whether they were enrolled in BP or Italian. With that said, while we exclude the variable from our statistical modeling, we will consider it in our discussion on a descriptive level.

We included the maximal random effects structure supported by the data (see e.g., Barr, Levy, Scheepers, & Tily, 2013), which consisted of random by-subjects intercepts and slopes across Language, Phoneme, and Language*Phoneme, and random by-item intercepts. Effect sizes are reported via odds ratios (ORs) calculated from the Estimated Marginal Means and are interpreted here as the odds of a participant producing a [+continuant] segment in one language (e.g., Italian) over another (e.g., English). Accounting for multiple comparisons, the resulting p values of the pre-planned contrasts were adjusted with the False Discovery Rate (FDR) adjustment (Benjamini & Hochberg, 1995), with the rate set at .05.

To assess transfer at the individual level, we again used a series of McNemar tests to determine the homogeneity of the proportions of spirantized segments in BP/Italian versus English and BP/Italian versus Spanish, the outcomes of which were corrected together with the English versus Spanish comparison with the FDR adjustment, and calculated odds ratios for each language pair. Where zero cells were present in the data set, a constant of 0.5 was added to all cell counts in odds ratios calculations to avoid computation errors (Deeks & Higgins, 2010; Pagano & Gavreau, 2000), an amendment supported particularly in the case of small cell counts (Agresti, 1996).

6. Results

The model yielded a significant interaction for Group*Language*Phoneme ($F(8, 151) = 2.48$, $p = .02$). No other main effect or interaction was significant; the main effect of Language was likely not significant due to the variance in the English and Spanish data; odds ratios for all three pairwise comparisons are very large (Spanish-English $OR = 63.91$, L3-English $OR = 12.46$, Spanish-L3 $OR = 5.13$) and the comparisons with the L3 favor Spanish transfer. The significant three-way interaction is attributable to the production of /b/ and /d/ in the L3 by the L1 Spanish/L2 English group, as visible in Figure 5.

Descriptively, the group's proportion of L3 [+continuant] segments patterns with their English proportion (/b/ $p = .07$, $OR = 3.85$, /d/ $p = .21$, $OR = 2.97$) and is higher than that of the HS and L1 English/L2 Spanish groups' L3 proportions. With that said, the corrected p values for the between-group comparisons were not significant (vs. HS /b/ $p = .81$, $OR = 11.40$ and /d/ $p = .11$, $OR = 496.71$, vs.

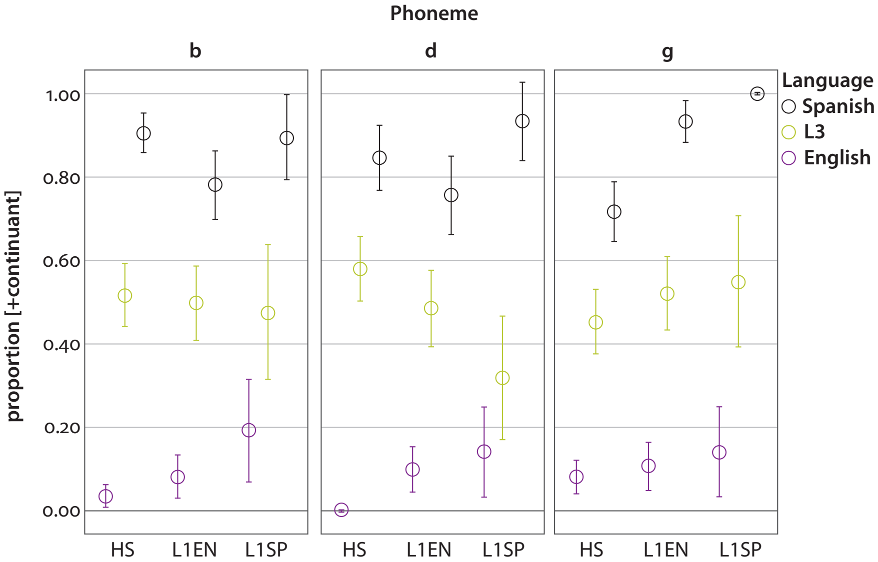

Figure 5. Proportions of [+continuant] productions in each language by group and phoneme. Error bars are 95% confidence intervals

L1 English/L2 Spanish /b/ $p = .77$, $OR = 11.40$ and /d/ $p = .21$, $OR = 7.82$, respectively) and the odds ratios are in line with that of the L1 Spanish L3-English comparison. With the exception of the L1 Spanish group's /b/ and /d/, across the three phonemes, each of the three groups produced significantly different proportions of [+continuant] segments in each language. In each case, learners were more likely to produce [+continuant] segments (a) in Spanish than in English, (b) in the L3 than in English, and (c) in Spanish than the L3 ($ps < .03$). That is, the overall L3 rate of [+continuant] production fell between that of English and Spanish, as evident in Figure 6.

The wide 95% confidence intervals around each group's L3 proportions are indicative of substantial variation, which necessitates consideration of individual data. We used McNemar tests corrected for multiple comparisons to compare the proportion of [+continuant] segments produced by each learner in (a) the L3 and English, and (b) in the L3 and Spanish, and categorized each outcome as follows: If the L3-English comparison was significant and the L3-Spanish comparison was not, the outcome was labeled as Spanish transfer. If the L3-Spanish comparison was significant and the L3-English comparison was not, the outcome was labeled as English transfer. If both comparisons were significant, the outcome was labeled as 'combined' transfer since these were cases in which the L3 proportion fell in the middle of English and Spanish. If neither comparison was significant (i.e., the tests were statistically inconclusive), we excluded them from further individual-level

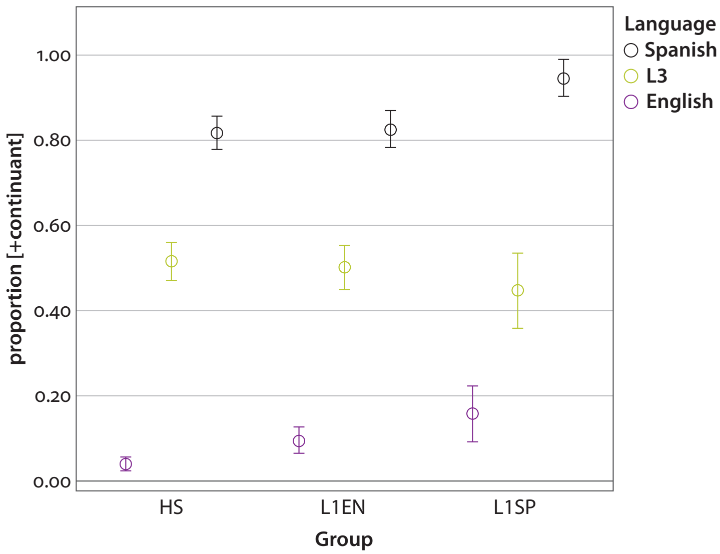

Figure 6. Proportions of [+continuant] productions in each language by group

analysis. This resulted in exclusion of one L1 English/L2 Spanish participant and one HS participant; we focus on the remaining 39 participants herein. All outcomes are detailed in Table 4; see Appendix C (online supplement) for individual McNemar outcomes and odds ratios for all participants, the latter of which largely pattern with the McNemar results.[14]

Table 4. Individual outcomes for between-language McNemar tests

	English transfer		Spanish transfer		Combined transfer	
	n		*n*		*n*	
L1 English/L2 Spanish (*n* = 13)	3	(.23)	7	(.54)	3	(.23)
L1 Spanish/L2 English (*n* = 5)	2	(.40)	1	(.20)	2	(.40)
Heritage Spanish (*n* = 21)	6	(.28)	13	(.62)	2	(.10)
Total (/39)	**11**	**(.28)**	**21**	**(.54)**	**7**	**(.18)**

Although there is a trend towards Spanish transfer, the trend is more clear in the L1 English and HS groups, while only one of the L1 Spanish/L2 English participants shows a clear pattern of Spanish transfer. English-like production patterns account for 28% of the sample, although we are cautious in our categorization

14. While there were four participants whose transfer pattern changed based on odds ratio significance, the overall distribution among the three patterns remains virtually unaltered: Spanish (*n* = 20), English (*n* = 12), combined (*n* = 11).

of these patterns as English-like: The L3 versus English McNemar result for four of these 11 participants (three HS and one L1 Spanish) approached significance (HS all $p = .06$; L1 Spanish $p = .07$)[15] and a significant difference between the L3 and English and L3 and Spanish would move them to the Combined category. Moreover, three of the participants' L3 versus Spanish McNemar is .059,[16] which indicates their pattern of transfer patterns are not as clear-cut as the remainder of the participants in this category. A look at the proportions in each language for these participants supports this assessment (see Appendix C). Eighteen percent of the participants produce proportions of [+continuant] segments that fall between their English and Spanish proportions; this pattern holds across phonemes for two (HS) participants but is phoneme dependent for the remaining five participants (three L1 English/L2 Spanish and two L1 Spanish/L2 English) (see Appendix C). In this second case, there is no clear pattern that favors [+continuant] production of one phoneme over another.

7. Discussion

The majority of the sample across groups transferred Spanish, an outcome which echoes a substantial body of research in L3 morphosyntax with English/Spanish bilinguals acquiring a Romance L3 and is most consistent with predictions based on global structural similarity. However, the fact that the remaining nearly half of the sample produces either English-like segments (28%) or a combination of English- and Spanish-like segments (18%) in the L3 does not align with the predictions of any of the models that we explicitly tested in this study. We begin this section with some consideration of several of the variables that we can rule out as explanatory, including dominance, proficiency, and bilingual experience, and then venture to account for the attested patterns of productions consistent with Spanish, English, and combined transfer.

7.1 Dominance, proficiency, and bilingual experience

One pattern that stood out was that 20 of the 21 learners that produce Spanish-like segments in the L3 belong to the L1 English/L2 Spanish and HS groups, while four of the five L1 Spanish/L2 English learners produce English-like productions

15. No other corrected McNemar results approach significance.

16. We report p values with two decimal places following APA style, but treated any p value $< .06$ as significant. Since the p value in these cases was .059, we report them as such since reporting two decimals would require rounding up to .06.

or productions that fall between English and Spanish. The first two groups are English dominant while the latter group is Spanish dominant, which might lead one to consider that dominance could contribute to transfer patterns (i.e., that the less dominant language transfers). However, two of five L1 Spanish/L2 English participants produce intermediate proportions of [+continuant] segments, an outcome which cannot likely be explained via initial English transfer. That is, there is no principled reason to predict that learners would originally transfer (L3 target-like) English and then reanalyze the original hypothesis, resulting in (non-target) Spanish-like productions in the L3. Another detail that leads us to posit that dominance is not deterministic in this data set is that the ranges in dominance scores within each transfer pattern are substantial (Table 5), and these ranges hold across the three groups (Appendix A). Similarly wide ranges are observed for oral proficiency (Table 5 and Appendix A), which, in conjunction with the non-significant effect of proficiency in the statistical model, indicate that proficiency in the non-dominant language does not explain the observed production patterns, either.

Table 5. Proficiency and dominance ranges for each transfer pattern

Transfer pattern	**Proficiency**		**Dominance**
	Oral (*z*-score)	**Written (/50)**	**(−218–218)**
Spanish	−1.35–.99	18–47	−46–112
English	−1.26–.85	15–46	−78–133
Combined	−1.52–.86	18–49	−106–110

The exclusion of dominance and proficiency as explanatory factors is particularly relevant for the HS data. The finding that the majority of the HS participants produce segments that pattern with their non-dominant Spanish contradicts findings from Llama and López Morelos (2016), whose HS data were indicative of L3 VOT production driven by the dominant language (English). Moreover, we did not find the relationship between transfer and proficiency in the non-dominant language that was reported in Lloyd-Smith, Gyllstad, and Kupisch (2017), which indicates that proficiency in the non-dominant language of these HS participants does not seem to override transfer driven by similarity. Also related to the HS data, we do not find strong evidence of (facilitative) English transfer in comparison to the two sequential bilingual groups. In fact, the HS group has the largest proportion of Spanish-like behavior.[17] Thus, it does not appear that their temporal bilingual experience distinguishes them from the two sequential bilingual groups, contra

17. We did not find any patterns that distinguished between the simultaneous and sequential HS participants.

predictions provided in Rothman (2015). Having established that dominance, proficiency, and bilingual experience are not likely responsible for the attested patterns in the data set, which variable(s) might be responsible for the observed outcomes? In what follows, we posit explanations for the cases of Spanish transfer, and then turn to the cases of English and combined transfer.

7.2 Spanish transfer

For those learners that are producing Spanish-like [+continuant] segments in L3 Italian or BP, there are two possible conclusions. One is that they have transferred their Spanish representation and are still at the L3 initial stages; they have not begun to overcome non-facilitative transfer. This outcome would be consistent with the TPM. Another possible explanation of this pattern comes from Westergaard et al. (2017), who hypothesize that there could be an initial stage at which the learner has not received sufficient input to parse L3 input, and during which time the learner would rely on what the authors refer to as "superficial heuristics" such as comparison at the lexical or phonological levels (p. 12). This reliance would then result in data that reflect stronger influence of the language with greater "surface resemblance" to the L3, in this case, Spanish.[18] The difference between these two accounts is that the first assumes full transfer of the Spanish system, while the second posits that Spanish-like L3 data is a surface phenomenon that acts as a placeholder until L3 input can be parsed, at which point influence from abstract structural similarities (in this case, English transfer) should increase and the role of across-the-board (superficial) Spanish influence should decrease. Westergaard et al. suggest that this surface-level influence can explain the extensive L3 morphosyntactic data that reflect transfer from the globally structurally more similar language. With data from one study that tests a single phenomenon, it is not possible to determine whether the data reflect transfer (of representation) or surface-level influence. However, we would argue that evidence of non-facilitative structures in the L3 which are infrequent in the input and not explicitly taught in the source language or the L3, such as subject-to-subject raising across a dative experiencer (Cabrelli Amaro et al., 2015), cannot be explained via an account of superficial reliance on the globally structurally more similar language.

18. The SM (Slabakova, 2017) predicts non-facilitative (in this case, Spanish) transfer in the absence of sufficient evidence in the L3 input. Given the high frequency of intervocalic /b d g/, we posit that this prediction should not hold for this particular phenomenon.

7.3 English and combined transfer

For the cases where the learner is more likely to produce [−continuant] L3 segments, or where she is producing a proportion of [+continuant] L3 segments that falls between her English and Spanish proportions, the source of these productions is not as clear as with Spanish-like production patterns. We designed the study to test learners at a point at which we did not predict acquisition to have already occurred (following previous L3 Romance morphosyntax studies which happened to yield categorical results of Spanish transfer, see Rothman et al., in press, for a review), with the expectation that we would be able to more conclusively adjudicate between transfer from English and acquisition of the L3 target, which happens to pattern with English. We also selected a phenomenon that is typically not taught in the first semester of L3 Italian or BP and that is thought to not be salient in the input since it is allophonic rather than phonemically contrastive. While we do not discount the possibility that a subset of the learners in each group have transferred (facilitative) English, an outcome that could potentially be explained via models of selective transfer, we posit that it is unlikely for a number of reasons. First, the only existing evidence of selective facilitative phonological transfer comes from studies where the learners had had substantial exposure to the L3, therefore impeding the ability to distinguish facilitative transfer from acquisition. To further avoid this potential confound in future studies, we plan to test phenomena that pattern differently in each of the three languages; pairing phenomena where there is a facilitative option in one of the languages with one that is different in each language will allow us to tease apart facilitative transfer and acquisition. Second, the overwhelming majority of cases of English/Romance bilinguals acquiring a Romance L3 do not show English transfer, with the lone exception to our knowledge being Llama and López-Morelos (2016), albeit with the caveat that the L3 French input may have had English-like VOT. In fact, Spanish transfer is attested for 11 domains of L3 BP morphosyntax alone (Rothman et al., in press). Third, the cases of combined transfer cast doubt on the source of initial transfer in L3 [−continuant] productions (see Section 7.1). In turn, we discuss three variables that have the potential to contribute to what looks like combined transfer (at least on the surface), with the caveats that these are (a) largely empirical questions and serve as conjecture, and (b) not mutually exclusive: Acquisition in progress, input quality, and the role of metalinguistic knowledge.

The learners were tested around week five of the semester, after approximately 12–15 hours of instruction. While previous L3 morphosyntax research does not point to acquisition (or acquisition in progress) at this time point, it is not impossible that this amount of exposure could have been sufficient for (partial) convergence on the L3 target, and we recognize this potential confound as a limitation of the study's design. In fact, recent results from Cabrelli Amaro (2017) indicate that low-proficiency L1 English learners of L2 Spanish produce target [+continuant] segments in postvocalic position in Spanish in a way that patterns with L1 Spanish speakers. Thus, if target L2 [+continuant] production is attested at low levels of L2 proficiency, it is reasonable to hypothesize that the opposite could be true since the L3 learning task is the inverse of the L2 learning task. In the cases of what looks like combined transfer, it is possible that this pattern reflects acquisition in progress, which can be modeled via two distinct mechanisms. Following the TPM, the assumption would be that full transfer of Spanish occurred at an earlier point in acquisition and that reanalysis of the learner's L3 representation is in progress. A second possibility is based on the tenets of the LPM, which assumes that L3 learners have a double grammaticality filter. Early in the acquisition process, the L3 grammar is in flux and input will pass through both filters (here, Spanish and English). If the input passes through the Spanish filter, this could lead the learner to (incorrectly) produce a [+continuant] segment; in other cases in which input passes through the English filter, the learner would produce an accurate [−continuant] segment.

The individual-level analysis revealed a pattern in which there is an appreciable difference in the proportion of L3 Italian participants that produce English-like segments (or a combination of English-like [−cont] and Spanish-like [+cont]) compared with the proportion of L3 BP participants that follow these trends (Table 6).[19]

Table 6. Transfer outcomes for L3 BP versus L3 Italian

	English transfer		**Spanish transfer**		**Combined transfer**	
	n		*n*		*n*	
L3 BP ($n = 22$)	2	(.09)	15	(.68)	5	(.23)
L3 Italian ($n = 17$)	9	(.53)	6	(.35)	2	(.12)

This outcome leads us to consider why more L3 Italian participants produce these patterns than L3 BP participants. One possibility has to do with input: In addition to singleton intervocalic /b d g/, the Italian participants are receiving input

19. In light of the individual-level analysis, we went back and fit separate models for the L3 Italian and L3 BP data. The models yielded parallel results: There was only a significant main effect of Language (L3 Italian: $F(2, 1335) = 78.36$, $p < .001$; L3 BP: $F(2, 52) = 113.14$, $p < .001$) with the same pattern as the collapsed groups' data (English < L3 < Spanish). Additionally, the effect size patterns were similar. In the BP model, the English-BP odds ratio is 33.48 while the Spanish-BP odds ratio is 4.96. In the Italian model, the English-Italian odds ratio is 43.24 and the Spanish-Italian odds ratio is 9.22. With that said, the probabilities of producing a [+ continuant] in Italian descriptively contrasts with that of BP, which is clear in the individual-level analysis.

containing intervocalic geminate /b d g/. The increased frequency of intervocalic [−continuant] voiced segments coupled with the arguably greater salience of the geminate consonants could yield parsing failures and drive revision of the grammar earlier than L3 BP input (R. Sprouse, personal communication, September 29, 2018). This analysis aligns with one of the tenets of the Speech Learning Model (Flege, 1987, 1995), which is that dissimilar (and thus assumedly more salient) sounds are acquired faster than similar sounds.

It is also possible that the [−continuant] productions are (at least in part) the result of the application of explicit knowledge. As mentioned, we selected a phenomenon that we hypothesized would not be as salient in the input as phonemically contrastive sounds. However, it is possible that metalinguistic knowledge compensates for a lack of salience in this case, and what looks like English or combined transfer could be the influence of an explicit rule. We recognize that, although we confirmed that the pronunciation pattern was not presented in the BP or Italian textbooks, learners may have had access to this explicit rule elsewhere. We followed up with the instructors and found that the Italian instructor had informally taught the rule, while the BP instructor had not. This finding aligns with the distribution of transfer outcomes between Italian and BP (Table 6).

To assess metalinguistic awareness more systematically, we sent a brief survey to participants after the conclusion of the study (Appendix D); 20 of 41 participants responded. One of the 20 had inconclusive individual results, and so we report findings from 19 participants in Table 7. Explicit knowledge was categorized as accurate if they answered question 1 of the survey "<u>When you participated in the study</u>, were you familiar with the rule that the letters *b*, *d*, and *g* are pronounced more 'softly' in Spanish when they are between vowels than in English?" affirmatively, and question 2a "<u>When you participated in the study</u>, did you know how these letters (*b*, *d*, and *g*) are pronounced between vowels in the third language we tested you in (either Italian or Portuguese)?" with the option 'Like in English'.

Table 7. Transfer patterns for learners who reported (a) accurate explicit knowledge of stop realization in the L3, (b) inaccurate explicit knowledge, (c) no explicit knowledge

	Accurate	Pattern			Inaccurate	Pattern			None	Pattern		
		SP	EN	C		SP	EN	C		SP	EN	C
L1 EN/L2 SP	3	1	1	1	3	2	1	0	3	1	0	2
L1 SP/L2 EN	1	0	1	0	0	0	0	0	2	1	1	0
HS	1	0	1	0	2	2	0	0	4	3	1	0
All groups	5	1	3	1	5	4	1	0	9	5	2	2

While the numbers per participant group are generally too small to detect a pattern, the overall trend when collapsing the groups indicates a role for explicit knowledge. That is, inaccurate or a lack of explicit knowledge appears to correlate with Spanish transfer for those participants that responded. Interestingly, the HS group is the one group where we see an appreciable difference between the number of participants with accurate explicit knowledge ($n = 1$) and the number without ($n = 6$). If we were to posit that these numbers are representative of the full sample of HS and the fact that they are the group with the largest proportion of participants that transfer Spanish, it would not be unreasonable to assume that we could predict a stronger tendency towards Spanish transfer among the three groups in the absence of the intervening variable of explicit knowledge. With that said, we recognize that only half of the participants responded and thus these data should be interpreted with caution. To better control for explicit knowledge going forward, we plan to examine phenomena that go beyond the segmental level and are less likely to be addressed in language instruction, such as phonotactic well-formedness.

Continuing the line of discussion regarding limitations and future considerations, it is possible that the variability evidenced in the data set is partially an artifact of production, whereby variability in articulatory planning and coordination can yield variability in output forms. It is also possible that the nature of the task could lead to more target-like L3 forms than other tasks that do not rely on repetition of stimuli. In a delayed repetition task, the time that lapses between the offset of the stimulus and the offset of the response prompt is posited to be long enough for fine-grained phonetic information to disintegrate, forcing learners to rely on abstract representation. However, it is not impossible that there is inter-learner variation, such that some learners may be able to maintain the fine-grained representation of the initial stimulus for longer and thus produce an imitation of the stimulus. Research going forward will therefore include a variety of task types and extend to perception measures in addition to production.

8. Conclusion

While a number of variables have been proposed to be deterministic in L3 phonological transfer at the initial stages, the results of the present study point to a primary role for relative system-wide similarity between a learner's background languages and the L3. In this specific case, we did not find strong evidence for transfer driven by facilitation, order of acquisition (language status), dominance, proficiency in the non-dominant language, or relative bilingual experience. Instead, we found an overall trend towards (non-facilitative) transfer of Spanish-like [+continuant] segments, with a minority of learners producing (a) [−continuant] segments consistent with English and the L3 or (b) intermediate proportions of [+cont] and [−cont] segments. While we do not fully discount the possibility that these patterns that are inconsistent with Spanish transfer might reflect English transfer or L3 acquisition in progress, debrief data suggest that (lack of) explicit knowledge might at least partially account for these cases. These data lead us to consider the possibility that a more dominant pattern of Spanish transfer would be evident in the absence of this intervening variable, and further research conducted at earlier stages of exposure and with stricter control of access to explicit knowledge will confirm the extent of the effect of explicit knowledge.

The results of this study strengthen the existing body of evidence from other domains of grammar that points to transfer determined by global similarity between the L3 and the source languages, at least in a language triad in which there is a clear similarity between the L3 and one of the source languages compared to the L3 and the other source language. This outcome best aligns with the predictions of the TPM, which assumes transfer driven by global structural similarity. While we recognize that our conclusion is based on a single phenomenon in a single domain of grammar, couching our results within the growing body of research across domains that points to similarity-driven transfer moves the scale a point further in the direction of supporting a model in which similarity is deterministic in initial transfer.

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Appendix A. Individual participant information

	Gender	L3	AoA L3	AoA Spanish	AoA English	L2 written proficiency (0–50)	L2 oral proficiency (z-score)	Dominance (−218 to +218)
Heritage speakers								
HS 1	M	BP	21	0	0	36	0.04	71.70
HS 2	F	BP	21	0	3	44	0.86	25.16
HS 3	M	BP	21	0	0	41	0.75	80.46
HS 4	F	BP	20	0	3	36	0.70	56.12
HS 5	F	BP	30	0	3	18	−1.14	88.55
HS 6	F	IT	18	0	5	40	0.50	64.94
HS 7	F	IT	21	0	2	39	0.52	49.13
HS 8	F	IT	20	0	3	39	0.22	23.62
HS 9	M	IT	19	0	4	31	−0.54	88.99
HS 10	M	IT	19	0	0	27	0.49	44.68
HS 11	F	IT	20	0	0	28	0.52	56.67
HS 12	F	IT	22	0	5	34	0.17	66.21
HS 13	F	IT	22	0	4	42	0.86	27.52
HS 14	F	IT	18	0	0	27	0.15	94.27
HS 15	F	IT	22	0	0	19	0.56	70.30
HS 16	F	IT	19	0	0	20	−1.05	90.09
HS 17	M	IT	21	0	2	25	−0.61	54.31
HS 18	F	IT	19	0	3	39	0.85	26.43
HS 19	F	BP	20	0	3	46	0.99	29.61
HS 20	F	BP	21	0	3	49	0.31	8.72
HS 21	F	BP	21	0	4	44	0.73	36.42
HS 22	M	BP	21	0	0	19	−0.49	112.06

(*continued*)

	Gender	L3	AoA L3	AoA Spanish	AoA English	L2 written proficiency (0–50)	L2 oral proficiency (z-score)	Dominance (−218 to +218)
L1 English / L2 Spanish								
L1EN 1	F	BP	28	15	N/A	26	−1.26	132.90
L1EN 2	M	BP	21	16	N/A	30	−0.87	110.97
L1EN 3	F	BP	19	20	N/A	37	−0.66	111.52
L1EN 4	M	BP	23	12	N/A	37	0.42	52.58
L1EN 5	F	IT	18	14	N/A	21	−1.20	86.64
L1EN 6	F	IT	21	13	N/A	28	−1.12	96.26
L1EN 7	F	IT	18	10	N/A	18	−1.52	110.07
L1EN 8	F	IT	20	12	N/A	15	−1.07	121.32
L1EN 9	M	BP	22	12	N/A	42	0.15	85.18
L1EN 10	F	BP	27	12	N/A	38	−1.35	110.70
L1EN 11	F	BP	21	14	N/A	36	−0.20	75.10
L1EN 12	F	BP	24	14	N/A	37	−0.44	71.56
L1EN 13	F	BP	43	12	N/A	43	0.07	82.82
L1EN 14	F	BP	20	14	N/A	25	−0.60	85.73
L1 Spanish / L2 English								
L1SP 2	F	BP	30	N/A	12	47	0.20	−45.86
L1SP 3	F	IT	18	N/A	11	46	0.84	−21.97
L1SP 4	F	BP	28	N/A	13	39	−0.50	−87.44
L1SP 5	M	BP	28	N/A	14	37	−0.56	−103.52
L1SP 6	M	BP	30	N/A	20	45	−0.92	−77.91

Appendix B. List of delayed repetition task critical items by phoneme (all languages)

/b/	/d/	/g/
faba	flada	faga
maba	klada	flaga
naba	lada	kraga
plaba	mada	laga
taba	plada	naga

Appendix C. Individual McNemar and odds ratio outcomes

	McNemar sig.				Probability lenition			Odds ratio	
	EN-SP	EN-L3	SP-L3	Transfer type	EN	SP	L3	L3:EN	SP:L3
Heritage speakers									
HS 1	*†	*†	†	Spanish	0.20	1.00	0.83	20.00	5.00
HS 2	*†	*	†	Spanish	0.13	1.00	1.00	145.80	0.63
HS 3	*†	*	†	Spanish	0.13	1.00	1.00	145.80	0.63
HS 4	*	*		Spanish	0.10	0.96	0.88	63.00	3.57
HS 5	*	*	†	Spanish	0.03	1.00	0.56	36.25	25.10
HS 6	*	*		Spanish	0.00	0.55	0.42	39.32	1.64
HS 7	*		*	English	0.03	0.73	0.19	6.59	11.94
HS 8	*	*	†	Spanish	0.00	0.73	0.42	42.72	3.85
HS 9	*†		*	English	0.00	0.89	0.31	16.22	18.89
HS 10	*		*	English	0.00	0.67	0.20	15.83	8.00
HS 11	*†	*	†	Spanish	0.00	0.67	0.76	165.00	0.62
HS 12	*			Combined 2	0.03	0.48	0.18	6.44	4.13
HS 13	*	*	*	Combined 1	0.00	0.89	0.30	25.72	20.19
HS 14	*		*	English	0.07	0.95	0.19	3.29	76.50
HS 15	*	*		Spanish	0.03	0.88	0.76	88.00	2.33
HS 16	*	*		Spanish	0.00	0.95	0.76	177.00	6.05
HS 17	*		*	English	0.03	0.88	0.25	9.67	21.00
HS 18	*		*	English	0.03	0.75	0.22	7.78	10.80
HS 19	*	*		Spanish	0.00	0.74	0.70	129.80	1.24
HS 20	*	*	*	Combined 1	0.00	0.95	0.68	104.68	9.00
HS 21	*†	*†		Spanish	0.08	0.79	0.86	66.00	0.61
HS 22	*†	*†	†	Spanish	0.14	0.90	0.77	20.00	2.70
L1 English / L2 Spanish									
L1EN 1	*†		*†	English	0.00	0.67	0.27	12.13	5.50
L1EN 2	*			Combined 2	0.27	0.79	0.50	2.75	3.67
L1EN 3	*†	*	†	Spanish	0.00	0.75	0.54	35.77	2.57
L1EN 4	*	*		Spanish	0.60	0.92	0.87	4.33	1.77
L1EN 5	*	*		Spanish	0.00	0.43	0.22	18.44	2.69
L1EN 6	*		*	English	0.03	0.83	0.07	2.23	61.75
L1EN 7	*	*	*	Combined 1	0.00	0.78	0.52	63.72	3.32

(*continued*)

	McNemar sig.				Probability lenition			Odds ratio	
	EN-SP	EN-L3	SP-L3	Transfer type	EN	SP	L3	L3:EN	SP:L3
L1EN 8	*		*	English	0.00	0.92	0.00	1.00	549.00
L1EN 9	*	*	*	Combined 1	0.00	0.83	0.30	29.95	11.67
L1EN 10	*	*		Spanish	0.00	0.63	0.55	74.56	1.40
L1EN 11	*	*	*	Combined 1	0.07	0.95	0.50	13.50	21.00
L1EN 12	*	*		Spanish	0.07	1.00	0.93	175.50	5.38
L1EN 13	*	*		Spanish	0.25	1.00	0.96	81.00	3.11
L1EN 14	*	*†	†	Spanish	0.13	0.93	0.92	71.50	1.18
L1 Spanish / L2 English									
L1SP 2	*	*†	†	Spanish	0.00	0.86	0.50	29.00	6.00
L1SP 3	*		*	English	0.10	1.00	0.13	1.33	276.78
L1SP 4	*	*	*	Combined 1	0.03	0.90	0.48	27.07	9.64
L1SP 5	*	*	*	Combined 1	0.21	1.00	0.60	5.50	35.90
L1SP 6	*		*	English	0.37	0.93	0.61	2.63	8.09

*Significant at the $p < .05$ level
† Calculated with mid-p McNemar test (< 25 discordants)

Appendix D. Debrief questionnaire

1. <u>When you participated in the study</u>, were you familiar with the rule that the letters *b*, *d*, and *g* are pronounced more 'softly' in Spanish when they are between vowels than in English? For example, did you know that the 'b' in 'lobo' is softer than the 'b' in 'robot'?
   a. If you answered yes, can you tell us where (in a class, a book, friends, etc.) and when you learned this?
   b. Did you actively practice the difference, or just learn about it? Please explain.
2. a. <u>When you participated in the study</u>, did you know how these letters (*b*, *d*, and *g*) are pronounced between vowels in the third language we tested you in (either Italian or Portuguese)?
      i. Like in Spanish
      ii. Like in English
      iii. I had no idea
   b. If you answered 'like in Spanish' or 'like in English', where did you get that information from, and when?
   c. If you answered 'I had no idea', do you know now?
      i. Like in Spanish
      ii. Like in English
      iii. I still have no idea

3. When you participated in the study, how often were you exposed to the language you were studying outside of class? You might recall that you had been in class for about a month at that point.
   a. Not at all
   b. Less than an hour a day
   c. More than an hour a day
4. If you DID have exposure outside of class at that time, what form did it take? Choose all that apply.
   a. Conversations with friends and/or family
      i. With whom and in what context would you usually practice conversation? Please describe.
   b. TV/Movies, music, books
      i. Please describe.
   c. Other (Please describe)
5. Why did you decide to take Portuguese or Italian? Please explain.

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