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The Acquisition of Branching Onsets in Simultaneous French–Portuguese Bilingual Children: The Effect of Age, Language, Cluster Type, and Dominance

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Abstract: The literature on bilingual language development often reports cases of cross-linguistic interaction of the two languages being acquired. In this paper, we investigate possible cross-linguistic interaction outputs in the development of branching onsets in the bilingual acquisition of French and Portuguese. Thirty French–Portuguese bilingual children, aged between 3;6 and 6;1, participated in our study. Their elicited productions were collected using two picture naming tasks containing 29 clusters in French and 57 clusters in Portuguese. Almost all the children acquire branching onsets earlier in French than in Portuguese, independently of the quality of cluster type (Consonant + Rhotic (Cr) clusters vs. Consonant + Lateral (Cl) clusters). Epenthesis is more present in Portuguese than in French. Shared structures in both languages are not acquired at the same time. These results show that bilingual children follow separate patterns of development, close to the ones reported for monolinguals, during the acquisition of their two languages. Moreover, the bilingual children show higher rates of development of clusters in Portuguese than the ones reported for monolinguals, suggesting an accelerated acquisition of clusters in Portuguese due to a positive influence of French.

Keywords: phonological acquisition; child bilingualism; clusters; cross-linguistic influence

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1. Introduction

The literature on bilingual language development often reports cases of cross-linguistic interaction (CLI) of the two languages being acquired (Paradis and Genesee 1996). CLI can impact the rate of acquisition, resulting in acceleration or delay of a given structure in comparison with monolinguals. CLI may also impact phonetic inventory and appear as transfer, when a segment absent from the phonetic inventory of a given language but present in the other is produced in the language where it is not attested in adult speech; merging, when bilinguals merge the phonetic properties of two close segments, resulting in the production of the same segment in both languages; and/or deflecting, when bilinguals increase the phonetic space between two close sounds in order to maximize the contrast between their two languages (Kehoe 2015).

In this paper, we investigate possible CLI outputs in the production of branching onsets in the bilingual acquisition of European French and European Portuguese[1]. Branching onsets have different segmental properties in both languages: they are all obstruent + liquid (lateral or rhotic) clusters, but the rhotic is a uvular fricative in French and an alveolar tap in Portuguese. Bilingual French–Portuguese children are thus exposed to a larger set of cluster types than either French or Portuguese monolinguals, which may influence bilinguals' development of clusters. Therefore, the main goals of the present study were: (1) to describe branching onset production in French–Portuguese bilingual children in both languages, and (2) to investigate the occurrence of CLI between their languages. Considering the fact that branching onsets are attested in both languages and that they have different phonological properties, we expect to find CLI in this population.

The following sections describe the properties of branching onsets in French and Portuguese and the acquisition of this structure in monolingual and bilingual settings. Finally, we identify research gaps motivating the current paper.

1.1. Branching Onsets in French and Portuguese

Branching onsets show quite similar distributional properties in French and Portuguese: in both languages, branching onsets are restricted to obstruent + liquid clusters, the liquid being either a lateral or a rhotic. The main difference between these two languages occurs at the phonetic level for the rhotic: it is a uvular fricative in French (/ʁ/) and a tap in Portuguese (/ɾ/), as shown in Table 1.

Table 1. Branching onsets in French and Portuguese [1].

	French	Portuguese	Gloss
Plosive + rhotic	[pʁ]incesse	[pɾ]incesa	princess
Plosive + lateral	[pl]at	[pl]ano	flat
Fricative + rhotic	[fʁ]oid	[fɾ]io	cold
Fricative + lateral	[fl]eur	[fl]or	flower

[1] For the sake of clarity, the examples are cognates (a corresponding lexical item). Note, however, that not all branching onsets have a cognate counterpart.

Branching onsets exhibit some restrictions in both languages. The first element of a branching onset may be a plosive or a fricative. In the former case, its place of articulation can either be labial, coronal, or dorsal, except if the second element is a lateral, in which case the plosive must not be coronal (Dell 1995). Only labial fricatives are allowed as the first member of a branching onset. Finally, all sequences of branching onsets may occur word-medially or word-initially, except from [vɾ] in Portuguese, which can only occur word-medially (Mateus and d'Andrade 2000)[2].

1.2. Acquisition of Branching Onsets

1.2.1. Monolingual Acquisition of Branching Onsets

It is widely accepted that monolingual children go through an initial stage where they delete the second consonant of obstruent + liquid clusters (Barlow 2003; Goad and Rose 2004, among others). Apart from this initial common stage, monolingual French and Portuguese children exhibit different patterns during the acquisition of branching onsets. French monolinguals are reported to acquire obstruent + lateral clusters before obstruent + rhotic clusters (Kehoe et al. 2008), whereas the reverse order is attested in Portuguese (Amorim 2014; Mendes et al. 2013). In addition, Portuguese children tend to produce epenthesis between the two elements of a branching onset, a repair strategy barely attested in French (Freitas 1997, 2003). Finally, children also differ with respect to the age of acquisition of this constituent: monolingual French children are reported to acquire branching onsets quite early (Demuth and Mccullough 2009; MacLeod et al. 2011), whereas Portuguese monolinguals typically acquire them much later, after the ages of 5 or even 6, depending on the study (Amorim 2014; Ramalho and Freitas 2018; Ramalho 2018). We give in (1) some examples from Ramalho (2018) illustrating the lack of branching onsets at ages 5 and 6.

1.	*a.*	*Frigorífico*	'fridge'	[fɾiguˈɾifiku]	→	[fːiuˈɾifiku]	EP27; 72 months
	b.	*Fralda*	'diaper'	[ˈfɾaɫdɐ]	→	[ˈfɨɾɔɫd^{h}ɐ]	EP35; 62 months
	c.	*Claro*	'light'	[ˈklaɾu]	→	[ˈkɨlaɾu]	EP36; 67 months
	d.	*Magro*	'fit'	[ˈmagɾu]	→	[ˈmagɨɾu]	VG9; 68 months
	e.	*Biblioteca*	'library'	[bibliwˈtɛkɐ]	→	[biljuˈtɛkɐ]	EP7; 67 months
	f.	*Quadrado*	'square'	[kwɐˈdɾadu]	→	[kwɐɾˈtat^{h}u]	SCM29; 69 months

Table 2 summarizes the patterns of acquisition attested for monolingual French and Portuguese children.

Table 2. Patterns of acquisition of branching onsets in French and Portuguese.

Pattern	French	Portuguese
Epenthesis	Not attested	Attested
Order of Acquisition	Cl > Cr	Cr > Cl
Age of Acquisition	3	5–6

1.2.2. Bilingual Acquisition of Branching Onsets

As seen in the introduction, bilingual acquisition poses theoretical challenges, in particular with respect to the extent to which the two languages being acquired interact during the acquisition process. Paradis and Genesee (1996) acknowledged that interactions may occur during acquisition and result in different outputs. Several studies have focused on this topic, comparing bilingual children's productions to monolinguals in different linguistic domains (Silva Colaço et al. 2024; Van Dijk et al. 2021).

In the area of phonology, this topic has been investigated focusing on different phonological constituents (vowels, branching onsets, codas) and from different corpora, either looking at few children longitudinally or, more recently, based on cross-sectional studies with more children. The results from these studies are quite diverse, showing different CLI outputs even when looking at a single constituent among different bilingual children. For example, in the case of codas, previous research found an acceleration effect (Keffala et al. 2018), while others found a delay effect (Gildersleeve et al. 2008) and others found no interaction at all between the two languages (Ezeizabarrena and Alegría 2015; see Kehoe 2015 for a summary of CLI outputs in bilingual phonological acquisition).

In this context, the case of the acquisition of branching onsets is particularly interesting; to our knowledge, almost all the studies that have focused on this particular structure have reported the same CLI output (acceleration) in different bilingual populations. The main exception is Kehoe (2018), who reported a delay in the acquisition of clusters with the uvular rhotic in German–Spanish bilinguals in comparison with German monolinguals.

Keffala et al. (2018) looked at 10 Spanish–English bilinguals aged between 2;1 and 4;8 and compared their performance on a picture naming task with Spanish and English monolingual children. The bilinguals had higher rates of onset clusters in both languages compared to monolinguals, showing acceleration of acquisition of onset clusters in comparison with monolinguals of each language. Likewise Kehoe and Havy (2019) also found higher rates of target productions of clusters in the productions of 23 bilingual French children (with different first languages) in comparison with 17 monolingual French-speaking children, at the age of 2;6. These two studies reveal a common pattern: the authors found a bilingual advantage in the sense that the bilinguals performed better than the monolinguals as a group, i.e., acceleration did not occur from one language to the other. In fact, bilinguals from the former study were advanced in both of their languages, so acceleration was not limited to one language; bilinguals showed acceleration in both of their languages.

One study found an acceleration of branching onsets from one language to the other. To our knowledge, only one longitudinal case study based on spontaneous productions of a bilingual child has been conducted on the acquisition of onset clusters. Almeida et al. (2012) investigated the development of this structure in the productions of a single child aged between 1;0 and 3;10. Comparing the patterns of development of branching onsets of this child with the ones of monolingual French and Portuguese children available in the literature, the authors concluded that the child started to produce branching onsets early in both languages, at 2;4, and acquired this structure by 3;1, an age similar to what is described for French monolingual children but much earlier than monolingual Portuguese children. Therefore, the authors concluded that the child exhibited an accelerated development of branching onsets in Portuguese due to a positive influence of French. In the present study, we want to investigate whether this result is expandable to a larger population of French–Portuguese bilingual children.

Some studies found acceleration in specific consonant clusters only. Tamburelli et al. (2015) focused on 15 Polish–English bilingual children aged 7;01-8-11 and compared their performance on a nonword repetition task with the performance of 15 monolingual controls for each language. The authors showed that some clusters, namely word-initial s+obstruent clusters, showed acceleration for bilinguals, while other clusters, like obstruent + liquid clusters, were unaffected. Montanari et al. (2018) also found acceleration in some clusters only, namely in clusters present in both languages of the children, i.e., obstruent + /l/ clusters. They investigated the productions of 37 Spanish–English children longitudinally, first seeing the children at the age of 3;7 and then a year later, at 4.7. In the current study, we will further test the effect of cluster type on the target production of branching onsets.

Almeida et al. (2012) also focused on the repairs exhibited by the bilingual child during branching onsets' development, namely vowel epenthesis. The authors noticed that, while monolingual Portuguese children are expected to produce epenthesis between the consonants of the clusters when they have not yet acquired this structure (Freitas 2003), French monolinguals are not reported to do so (Rose 2000). One of our goals is to report additional evidence about the repairs used during the development of branching onsets by French–Portuguese bilingual children.

The five studies cited above on simultaneous bilingual development, despite having some discrepancies in the results, all state that the acceleration of the acquisition of clusters is due to complexity. In all cases, the children are exposed to languages with different degrees of complexity for clusters and are exposed to onset clusters in both of their languages. The presence of this complex structure in both languages helps the children acquire this structure. An alternative hypothesis comes from the study of Mayr et al. (2015). The authors looked at 40 Welsh–English bilingual children aged between 2;6 and 5 and divided the children into two groups, 20 Welsh-dominant and 20 English-dominant. The authors found that the Welsh-dominant children showed higher accuracy of word-final clusters in Welsh than the English-dominant children, suggesting that the dominance of the children may impact the acquisition of clusters. Almeida et al. (2012) argued that language dominance could not account for their results because the child analyzed also showed a delay in the acquisition of codas due to an influence from Portuguese into French: in sum, the child showed two CLI outputs: from French into Portuguese (acceleration) and from Portuguese into French (delay) during the same time period. Language dominance cannot explain bidirectional interactions, as it is impossible for the child to be dominant in both languages. Moreover, the child was considered to be balanced, according to her balanced exposure to both languages since birth through her parents (Almeida 2011). Kehoe (2018) also noted that the transfer patterns exhibited by one Spanish–German bilingual child could not be explained by language dominance: the child was dominant in German, but the transfer occurred from Spanish to German. In sum, language dominance as a predictor of CLI has not been widely tested in simultaneous phonological acquisition, and the findings are mixed. We will add evidence concerning the possible accounts of CLI.

1.3. Current Study

The literature review detailed above has shown several research gaps. While most of the studies have reported acceleration in the acquisition of onset clusters, we still do not know to what extent this result is representative: one study reported delay and two studies reported acceleration with specific clusters only, showing that CLI can be restricted to specific structures. The language combinations studied are varied, but more children need to be investigated. In particular, for French–Portuguese, the existing results rely on one case study. We thus need to know whether the acceleration found in this case study is extendable to other children. Finally, we still do not know which factors constrain CLI: complexity seems to play a role for sure, but the role played by language dominance is not clear. This is of particular interest, since other studies conducted on other phonological constituents have revealed that language dominance may explain part of the results (e.g., Paradis (2001), for stress). To address these research gaps, the current study aims to investigate the production of onset clusters in 30 typically developing French–Portuguese bilingual children. The following research questions were investigated, with predictions based on previous literature:

1. Will the children acquire branching onsets earlier in French than in Portuguese? Since the monolingual literature shows that French monolinguals acquire branching onsets earlier than Portuguese monolinguals (Demuth and Mccullough 2009; Ramalho 2018, among others), we expect French–Portuguese bilinguals to acquire branching onsets earlier in French than in Portuguese.
2. Will the acquisition of clusters be influenced by cluster type? The literature on monolingual and bilingual acquisition of clusters reports that cluster type constrains the acquisition of branching onsets, with different orders reported for both languages (Cl > Cr in French and Cr > Cl in Portuguese; Kehoe et al. 2008; Amorim 2014). We thus expect that clusters will be acquired at different rates depending on cluster type in each language.
3. Will the repairs be different between French and Portuguese? The monolingual acquisition of branching onsets differs in French and in Portuguese with respect to the repairs exhibited by the children (Rose 2000; Freitas 2003). Following a previous case study (Almeida et al. 2012), we expect to find CLI from French into Portuguese in the patterns of development of branching onsets, i.e., we expect Portuguese bilinguals not to produce vowel epenthesis.
4. Will children be more advanced in the acquisition of clusters in their dominant language? Some previous studies have shown that language dominance constrains the acquisition of clusters (Mayr et al. 2015), while others have suggested that this factor does not play a role in cluster acquisition (Tamburelli et al. 2015). Following a previous case study on French–Portuguese bilingualism, we do not expect language dominance to constrain the development of clusters.

2. Materials and Methods

2.1. Participants

Thirty French–Portuguese bilingual children aged between 3;6 and 6;1 (twelve boys, eighteen girls) participated in our study. Ten of them attended the first grade, ten attended the second grade, and the remaining ten attended the third grade of a preschool. According to their parents and teachers, the children were typically developing. All the children were simultaneous bilinguals exposed to both languages from birth. Some children had two native French-speaking parents, being exposed to Portuguese through the community, while others had one French-speaking parent and one Portuguese-speaking parent. In all cases, the parents would speak to their child in his/her native language. Children attended a French preschool in Lisbon where French is the dominant language, although Portuguese is also spoken, since the teachers are bilingual and the support staff are Portuguese monolinguals. Thus, the school offers a French-dominant bilingual environment. In order to understand the children's home linguistic environments, the parents filled in a questionnaire about the quantity and quality of language exposure and use at home and the child's language preference. Most of the children were exposed to and used both languages at home as well as outside the home. The parents reported that the children did not tend to code-switch between their languages. The parents' answers allowed us to obtain a more precise picture of the linguistic environments of the children outside school and to establish their dominance profiles: nineteen children appeared to be balanced bilinguals, nine French-dominant, and two Portuguese-dominant. Their dominance was calculated using five criteria: language exposure and use at home, total language exposure and use per day, and the child's preference for using one language. Children were given a score of up to 5 in each language. We then subtracted the score for Portuguese from the score for French. Each child was classified between 5 and −5. The closer to five, the higher the dominance in French. On the contrary, a score close to −5 indicates Portuguese dominance.

2.2. Materials and Procedures

All children took part in two picture-naming tasks from the Cross-Linguistic Child Phonology project, namely the Standard French and the European Portuguese versions (Almeida et al. 2015; Ramalho et al. 2014); Available online https://phonodevelopment.sites.olt.ubc.ca/ (accessed on 6 December 2024). In these tasks, children are asked to help the researcher to tell a story shown in the sequencing of the pictures. The global story is different in these two languages, although there are some common pictures and scenarios. Concretely, the researcher reads a sentence and asks the child to fill in the missing word(s). In total, 126 words are elicited in French and 157 in Portuguese. They were chosen to test phonemes across word positions and syllable structure, controlling for word length and stress patterns. In French, there were 18 onset obstruent–rhotic clusters and 11 onset obstruent–lateral clusters (See Appendices A and B). In Portuguese, there were 46 onset obstruent–rhotic clusters and 12 onset obstruent–lateral clusters (See Appendices C and D). The imbalanced number of the targeted clusters is the consequence of the materials used: the tests are designed to test several aspects of phonology and not only clusters.

Data collection took place in a separate quiet room of the preschool. A Portuguese native speaker and a French native speaker conducted the Portuguese and French sessions, respectively, on different days. Half of the children were tested first in French and the other half were tested first in Portuguese. There was a one-week interval between the sessions in each language. The sessions lasted between 11 and 26 minutes. Audio recordings were made using an iPhone (due to lack of other equipment) for later transcription. Most words were produced spontaneously (84% for French, ranging from 53% to 99% per child; 74% for Portuguese, ranging from 45% to 94% per child). If the child was not able to produce a word spontaneously, then he was given a phonological cue (the first syllable of the word). If he/she was still not able to elicit the word, the researcher would say the word and asked the child to repeat it. Although data collection took place in a separate room, some recordings were noisy. We excluded from our analysis all the items containing branching onsets coded as noisy or overlapping speech. This represents 4% of the items with branching onsets in French and 2% in Portuguese.

All the data were transcribed within the Phon computer program (Hedlund and Rose 2020) by a French–Portuguese native research assistant (the second author) and a Portuguese native research assistant (the third author). Twenty-five percent of the corpus was reviewed by the first author, a trained native French–Portuguese bilingual linguist. Transcribers adhered to established guidelines for narrow transcription (Bernhardt and Stemberger 2012) and engaged in a collaborative consensus-building process to achieve 100% agreement for each segment.

2.3. Data Analyses

The production of all target words containing branching onsets was extracted directly from Phon 3.1 and exported to spreadsheets for analysis of individual and group data by language and cluster type, according to the manner of articulation of the second consonant (rhotic or lateral). Children's productions were categorized in a binary way: 1 for target production, when both consonants were produced in a target-like fashion; for rhotics, we considered as acceptable variants all instances of production of a dorsal rhotic in French (velar or uvular, voiced or voiceless) because all these variants are acceptable in adult speech; and 0 for non-target-like production. We also categorized the non-target-like productions in the following way: (i) C2 deletion, when the second consonant of the cluster was deleted; (ii) C2 substitution; (iii) C1 substitution, including voicing errors; (iv) epenthesis, when a vowel was inserted between the two members of the cluster; and (v) others, when two of the preceding repair errors occurred simultaneously, when the C2 was produced as a coda (metathesis), and when the first consonant of the cluster was deleted. The type of non-target-like productions was considered for qualitative analysis only.

Note that here, we used a strict criterion for the classification of branching onsets as target-like, since we relied on both segmental accuracy and prosodic accuracy. There have been two different ways of reporting the accuracy of branching onsets in the literature: as a matter of fact, producing two segments, even in a non-target fashion, is very different from producing only one segment instead of branching onsets. In the former case, children must master the complexity of having two sequencing consonants and, thus, they must have a target-like representation of the prosodic structure of the clusters. For that reason, some authors count C1 and C2 substitutions as correct (Rose 2000, among others). Here, we opted to focus on the segmental accuracy of branching onsets (we used a strict criterion) along with the prosodic accuracy, because the literature available for Portuguese monolinguals (and also some of the literature on French monolinguals, ex: Kehoe et al. 2008; MacLeod et al. 2011) followed this criterion (segmental + prosodic accuracy). As our graphs and tables report all the cases of C1 and C2 substitutions, it is indeed possible to verify whether children master the prosodic structure of branching onsets.

We only selected for analysis the words contained in the elicitation task. When children spontaneously produced a non-target word containing a branching onset, we excluded it from our analysis, because we wanted to control for the effect of specific words across children. However, when a child repeated a target word, we included both productions. For that reason, and also because some children did not produce all the words, the total number of words per child differed slightly. The total number of tokens underlying our analysis is 2302.

Statistical Analyses

We conducted a logistic regression model with mixed effects to test our hypotheses. Words with a branching onset were all coded as 0 when children failed to produce a target-like branching onset, independently of the repair used, and with 1 when they succeeded. We included as independent variables age, language (French or Portuguese), cluster type (Cl or Cr), and dominance. We also included an interaction between language and dominance, since we expected that children would achieve higher productions in their dominant language. We added random slopes for language, but the model failed to converge. After removing the random slopes due to problems of convergence, we ended up with a model containing one interaction (language and dominance), two random effects (children and nonwords), and four fixed effects (language, dominance, cluster type, age). The reference level was French for language and CCl for cluster type. Age and dominance were treated as a continuous variable. This logistic regression model was computed in R (R Development Core Team 2021) using the package lme4 (Bates et al. 2015).

3. Results

This section presents the results of the production of words containing branching onsets by thirty French–Portuguese bilingual children attending the preschool of a French school in Lisbon. Productions were considered target-like when the two members of the clusters were accurate. We considered the structure to be acquired when it reached 80% of target-like production, following previous studies on monolingual and bilingual acquisition (Rose 2000; Almeida et al. 2012; Ramalho 2018, among others).

3.1. General Results

We start by presenting in Table 3 the results of our mixed-effect linear regression model, intended to test the influence of age, cluster type, language, and dominance on children's correct production of branching onsets.

Table 3. Assessment of fixed effects and interactions in the logistic regression model. A *p*-Value with * indicates statistical significance at the 5% level. A *p*-Value with ** indicates statistical significance at the 1% level. A *p*-Value with *** indicates statistical significance at the 0.1% level. A * between two variables indicates interaction.

Variable	Estimate	SE	*p*-Value
Age	0.06150	0.02043	0.00261 **
Cluster Type (Reference Level:CCl)	−0.07573	0.17794	0.67041
Language (Reference Level:French)	−1.87365	0.18942	$<2 \times 10^{-16}$ ***
Dominance	0.10762	0.09635	0.26403
Dominance*Language	−0.11568	0.05512	0.03586 *

We found an effect of two predictors (age and language) and no effect of cluster type nor dominance. We found an effect of the interaction between dominance and language. In order to better visualize the data, we plotted these results into figures, which are shown below.

Figure 1 illustrates that the increase in age favors the correct production of branching onsets. Children below 58 months (4 years and ten months) are unlikely to master branching onsets. The type of cluster does not seem to impact the correct production of branching onsets: there is a great variability around cluster production that is not explained by the quality of the segments. On the contrary, language strongly impacts the production of branching onsets: children are better in French than in Portuguese. Finally, while dominance as a fixed effect has no influence on the production of branching onsets, our model suggests that the interaction between dominance and language impacts the correct repetition of branching onsets. Specifically, the children dominant in French (closer to a value of 5) tend to perform better in French than in Portuguese. Among all the effects found, this one is the least robust ($p = 0.03586$).

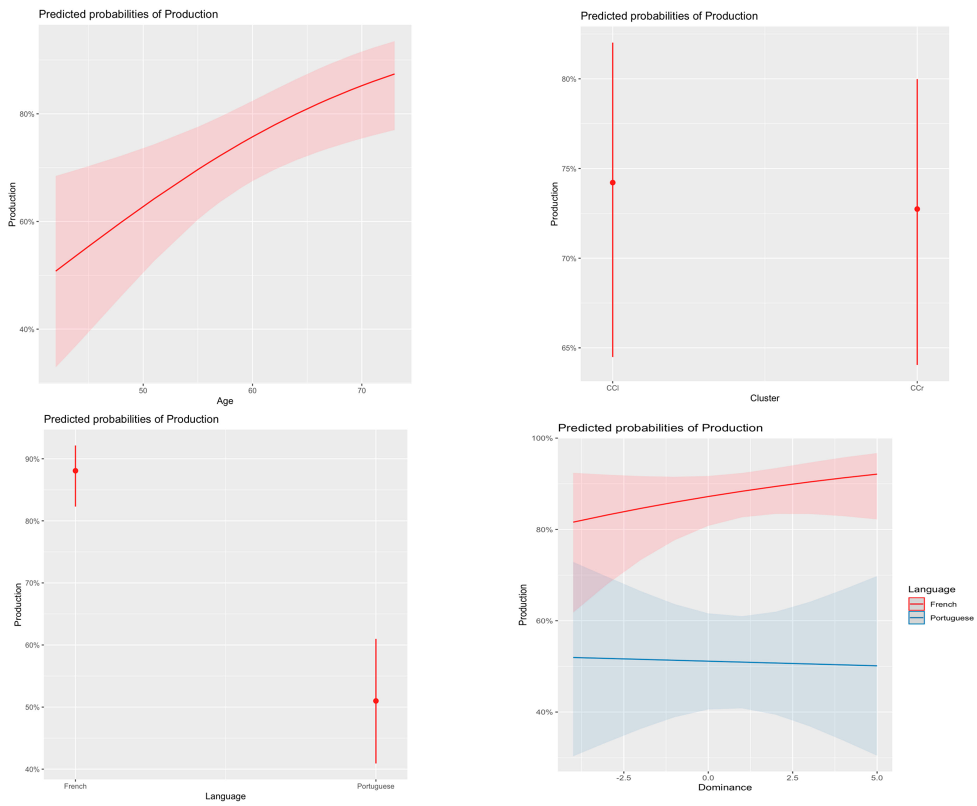

Figure 1. The effect of age, cluster, language, and dominance on branching onsets' production.

We turn now to the presentation of the repair strategies used by the children when they did not produce branching onsets. The results are presented according to the preschool grade of the children, the language, and the quality of the liquid.

3.2. Production of Branching Onsets in French

3.2.1. Production of Obstruent + Lateral Clusters in French

We start by presenting the results of the production of obstruent + lateral sequences. Figure 2 shows the production of these clusters for the thirty children according to their preschool grade. Individual results of the children can be checked in Appendix E.

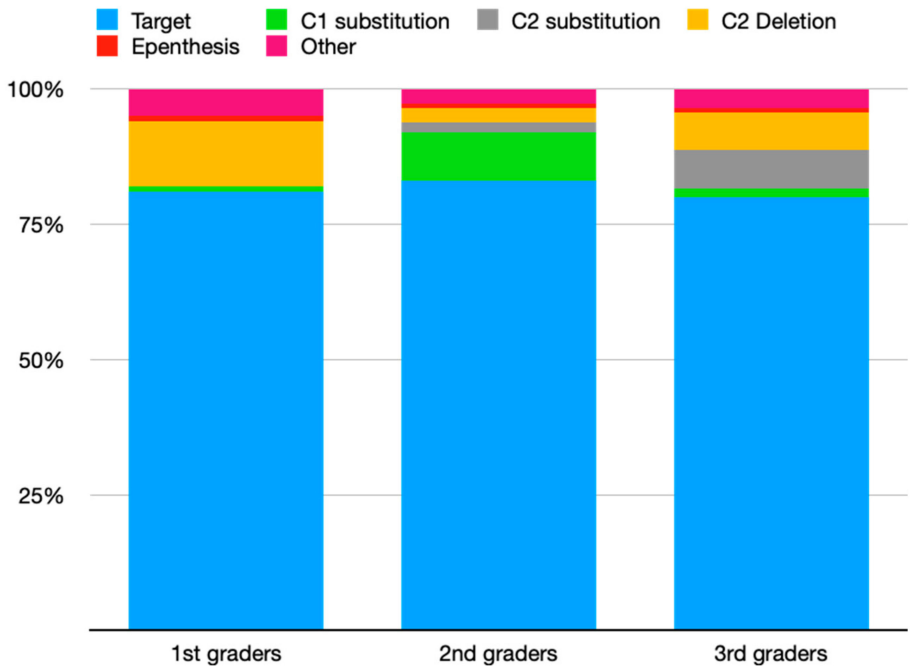

Figure 2. Production of Cl clusters in French.

Most of the children, independently of their grade, produced Cl clusters more than 80% of the time, thus suggesting acquisition of this structure. C2 deletion occurred predominantly in the younger group. C1 substitution was the most common repair for children in the second grade, and C2 substitution was the most common repair for children in the third grade, thus suggesting that, by this time, children have mastered the prosodic structure of branching onsets but are still struggling with their segmental properties. C1 substitution include voicing errors and C2 substitutions include the production of another lateral (absent from the phonetic inventory of the target language; ex: [ɫ] or [ʟ]), a rhotic, a glide, or a vowel, as illustrated in (2).

2.	*a.*	*Cloche*	'Bell'	[klɔʃ]	→	[glɔʃ]	PF11; 5;0 C1 substitution
	b.	*Plage*	'beach'	[plaʒ]	→	[pʟazə]	PF26; 5;9 C2 substitution
	c.	*Blanche*	'white'	[blɑ̃ʃ]	→	[bʁɑ̃s]	PF26; 5;9 C2 substitution
	d.	*Plage*	'beach'	[plaʒ]	→	[pjaʒ]	PF17; 4;7 C2 substitution
	e.	*Glace*	'ice-cream'	[glas]	→	[gəas]	PF26; 5;9 C2 substitution

3.2.2. Production of Obstruent + Rhotic Clusters in French

We move now to the presentation of the global results of production of obstruent + rhotic clusters in French in Figure 3. Individual results underlying the ones exposed here are given in Appendix F.

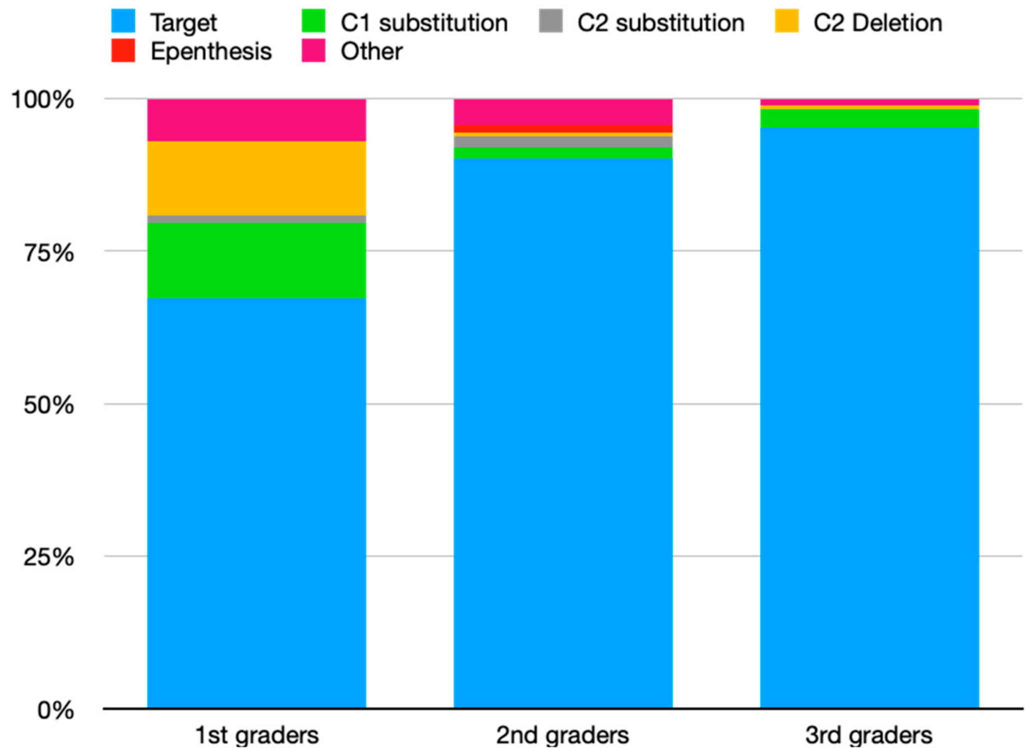

Figure 3. Production of Cr clusters in French.

The younger children did not master rhotic clusters in French, contrary to the children in the two older groups. In the younger group, C2 deletion and C1 substitution coexist. Other strategies include deletion of the first consonant. C1 substitution is mainly due to a devoicing of the entire cluster, like in *dragon* /dʁagɔ̃/ → [tχagɔ̃] 'dragon'. In this specific case, it is possible that, with the rhotic being produced as voiceless, a possible target production in French, the plosive undergoes voicing assimilation, thus being produced as voiceless too. Some other examples of repairs are given in (3).

3.	*a.*	*Grand*	'big'	[gʁɑ̃]	→	[kχɑ̃]	PF21; 5;7 C1 substitution
	b.	*Bras*	'arm'	[bʁa]	→	[bua]	PF14; 5;4 C2 substitution
	c.	*Tracteur*	'tractor'	[tʁaktœʁ]	→	[taktœʁ]	PF06; 3;6 C2 deletion
	d.	*Crocodile*	'crocodile'	[kʁokodil]	→	[toɹ.todiʎə]	PF05; 3;9 Metathesis

All the third-graders showed acquisition and stabilization of Cr clusters, since they all showed rates above 80%. Repair errors were residual and consisted mainly of the substitution of the first member of the cluster due to a regressive assimilation of the voicing of the rhotic, like the younger children.

3.3. Production of Branching Onsets in Portuguese

3.3.1. Production of Obstruent + Lateral Clusters in Portuguese

We turn now to the production of obstruent + lateral sequences in Portuguese. As in the preceding section, the results are presented according to cluster type and preschool grade, and individual results can be seen in Appendix G. Figure 4 shows the production of Cl clusters by the thirty children, organized by their grade. As for French, productions were considered target-like when the two members of the clusters were produced accurately.

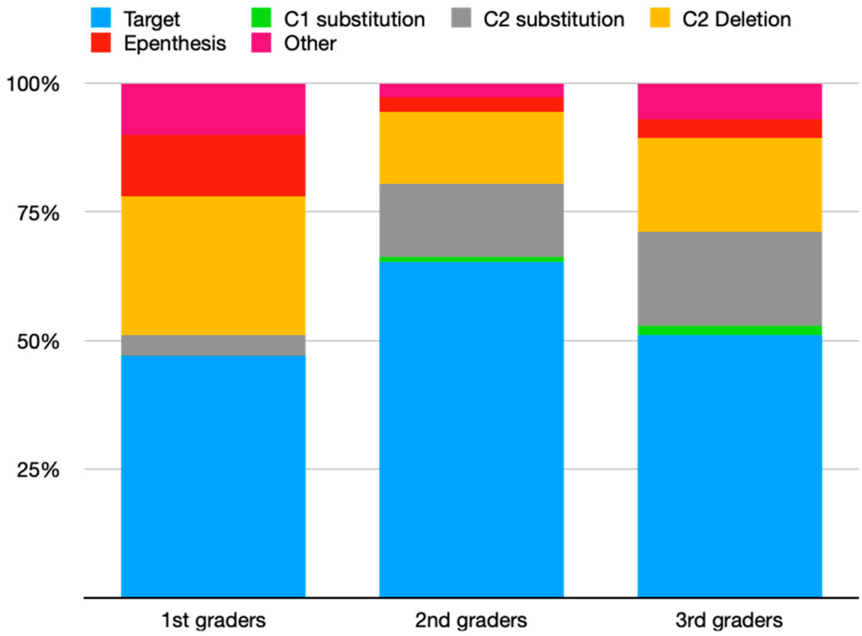

Figure 4. Production of Cl clusters in Portuguese by the second graders.

None of the groups has mastered Cl clusters in Portuguese, unlike in French. C2 deletion and C2 substitution were the most common repairs, the latter being more prominent in the two older groups. Once again, this suggests that older children are more advanced in the acquisition of the prosodic structure of branching onsets. Note, however, that even if C2 substitution were considered as a correct production of branching onsets, children would not reach the previously established threshold of acquisition. C2 substitutions consist mainly of the substitution of the lateral by a rhotic, either a tap or a dorsal, as exemplified in (4). These substitutions can also consist of the production of another lateral or the approximant [w].

4.	*a.*	*Flor*	'flower'	[ˈflor]	→	[ˈfrør]	PF06; 3;6 C2 substitution
	b.	*Bicicleta*	'bicycle'	[bisiˈklɛtɐ]	→	[bisiˈkʁɛtɐ]	PF26; 5;9 C2 substitution
	c.	*Flauta*	'flute'	[ˈflawtɐ]	→	[ˈfaw]	PF05; 3;9 C2 deletion
	d.	*Planeta*	'planet'	[plɐˈnetɐ]	→	[piliˈnɛti]	PF27; 5;11 Epenthesis

Figure 4 highlights that epenthesis also occurred, especially in the younger group, although this repair was almost never attested in French. If we compare the children's productions for Cl clusters in French and in Portuguese, Cl clusters were generally more successful in French than in Portuguese.

3.3.2. Production of Obstruent + Rhotic Clusters in Portuguese

The results of the production of obstruent + rhotic clusters in Portuguese are summarized in Figure 5. Once again, individual results are available in Appendix H.

None of the children exhibited acquisition of rhotic clusters in Portuguese, independently of their age/grade. C2 deletion and epenthesis were two productive repairs. C2 substitutions consisted of the production of a non-target rhotic, either coronal or dorsal, like in *bruxa* /ˈbɾuʃɐ/ → [ˈbɹuʃɐ] 'witch', or of the lateral /l/, as exemplified in (5). All these children exhibited higher rates of production of Cr clusters in French than in Portuguese. Here, again, note that even if we had classified C2 substitutions as correct, the children would not have been considered to have mastered branching onsets.

5.	*a.*	*Brinquedos*	‘toys’	[bɾĩˈkeduʃ]	→	[blĩˈkɛduʃ]	PF04; 3;8 C2 substitution
	b.	*Braços*	‘arms’	[ˈbɾasuʃ]	→	[ˈbrasuʃ]	PF16; 4;9 C2 substitution
	c.	*Livros*	‘books’	[ˈlivɾuʃ]	→	[ˈlivuʃ]	PF18; 4;9 C2 deletion
	d.	*Creme*	’cream’	[ˈkɾɛmɨ]	→	[ˈkɨɾɛm]	PF07; 3;6 Epenthesis
	e.	*Pedra*	’stone’	[ˈpɛdɾɐ]	→	[ˈpɛðɐɾɐ]	PF19; 4;7 Epenthesis
	f.	*Estrelas*	’stars’	[ʃˈtɾelɐʃ]	→	[ʃtɨˈɾelɐʃ]	PF21; 5;7 Epenthesis

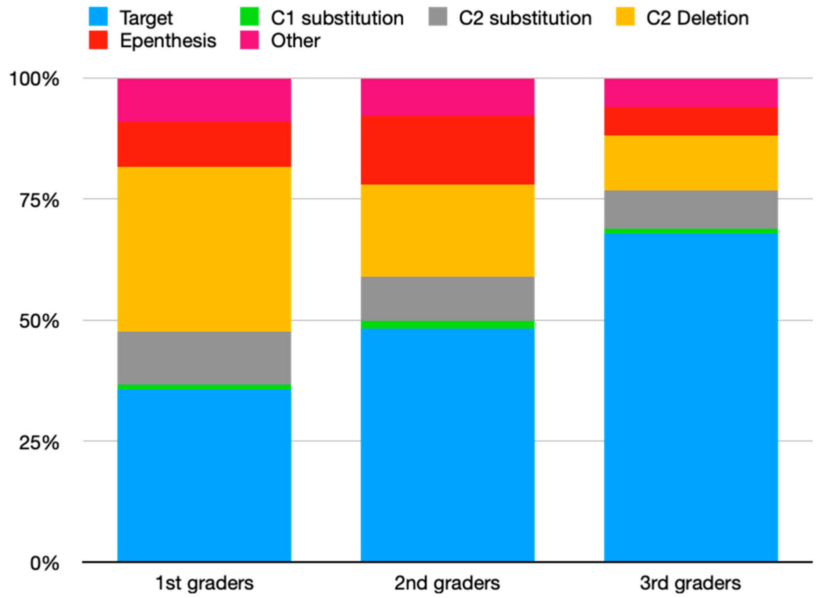

Figure 5. Production of Cr clusters in Portuguese.

4. Discussion

4.1. Age of Acquisition of Branching Onsets

Our statistical analysis found an effect of age and language on the production of branching onsets. The increase in age favors the correct production of branching onsets. In other words, as children grow older, they tend to better produce branching onsets. There is also a strong effect of language: overall, children are better at producing branching onsets correctly in French than in Portuguese. The visualization of the results according to the grades of the children showed that branching onsets are acquired in French from age 4 (second grade), although they are still not acquired in Portuguese. These results show that, overall, French–Portuguese bilingual children acquire branching onsets earlier in French than in Portuguese. This pattern is in line with the patterns attested in the literature on monolingual acquisition of French and Portuguese, which show that French monolingual children acquire branching onsets around three years old, whereas Portuguese monolinguals are reported to acquire branching onsets after five years old (Demuth and Mccullough 2009; Ramalho 2018, among others).

A previous case study on the acquisition of branching onsets by a French–Portuguese bilingual child showed that, once the child was able to produce branching onsets in French, she would also produce them in Portuguese, leading to an accelerated acquisition of branching onsets in Portuguese in comparison with monolinguals. We did not find this systematic positive influence of French in our data, as most of the children had not mastered branching onsets in Portuguese yet. However, if we compare the rates of acquisition of our bilingual children with the ones reported for Portuguese monolinguals using the same task, we observe that the bilingual children exhibit more accuracy of branching onsets in Portuguese. Ramalho (2018) reports that Portuguese monolinguals, by age 5, have an average production of Cl clusters of only 36%, and of 69% of Cr clusters. Most of the bilingual children in the present study produced higher rates of target production, especially for Cl clusters. Thus, even if they had not fully mastered these clusters, they seemed more advanced in their acquisition than monolingual Portuguese children. In that sense, the data suggest a positive influence from French to Portuguese, leading to an earlier development of branching onsets in Portuguese in comparison with monolinguals. In other words, we did find a CLI from French into Portuguese, leading to an acceleration of the development of branching onsets in Portuguese in comparison with monolingual Portuguese children. The present study thus adds evidence of acceleration in the acquisition of branching onsets, a CLI output that has been reported almost systematically in the literature, at least when the two languages have clusters. This is an important finding, as it suggests that the same CLI output can be found systematically in bilingual children independently of the language combination.

In our data, we did not observe the stabilization of branching onsets in the bilinguals, nor did Ramalho (2018) for Portuguese monolinguals attending preschool, because some clusters were still in the process of being acquired. In order to fully account for an acceleration, future research needs to focus on older children. Also, in order to better compare the rate of acquisition of the bilinguals with French monolinguals, future research should evaluate French monolinguals with the tasks used in the current study.

Keffala et al. (2018) and Kehoe and Havy (2019) found a positive effect of bilingualism, in the sense that bilinguals outperformed monolinguals. In order to evaluate this, we would need to focus on younger children and evaluate whether the bilinguals acquire this structure before monolinguals in French.

This would also be of particular interest in order to compare our results to the results of Spanish–German bilinguals reported by Kehoe (2018). This linguistic pair is of particular interest for us because the distribution of rhotic clusters is comparable in Spanish–German bilingualism and in French–Portuguese bilingualism. In German and in French, the rhotic in clusters is dorsal, whereas the rhotic in clusters in Portuguese and Spanish is coronal. Spanish–German bilinguals showed a delayed acquisition of Cr clusters in German in comparison with German monolinguals. Looking at younger children would allow us to compare the rate of development of rhotic clusters in French between bilinguals and monolinguals and, thus, to investigate a possible delay effect in French.

4.2. The Influence of Cluster Type on the Acquisition of Branching Onsets

Previous literature has shown that Cl clusters tend to be acquired earlier than Cr clusters in French, while the reverse order is attested for Portuguese. In our data, we did not find evidence for an effect of cluster type, as shown by our regression analysis. Once again, it would be interesting to test monolingual French children with the same tasks used in the current study in order to closely compare patterns of development. We need more data from French monolinguals in order to investigate the CLI effects affecting cluster type preference in monolinguals and bilinguals.

Our results diverge from the findings reported in Montanari et al. (2018), where the authors found that clusters shared in both languages (Cl) were acquired earlier. In the present study, Cl clusters are shared in both languages and have the same phonetic format, contrary to Cr clusters, for which the rhotic is different. Nevertheless, we did not find a preference for Cl clusters, as would be expected if children preferred the clusters shared in both languages. In other words, in our data, Cl clusters, present in both languages, are not the first to be acquired. This result indicates that the presence of a structure in both languages does not imply faster acquisition of it.

4.3. Repair Strategies

Another pattern of development that is different in monolingual French and Portuguese children is the presence of epenthesis between the two members of the clusters during acquisition. While Portuguese monolinguals are reported to produce an epenthetical vowel, this repair is barely mentioned in French monolingual development. Here, we found almost no case of epenthesis in French, while this repair is attested in Portuguese. This suggests that bilinguals differentiate their two phonological systems and follow different paths of acquisition for both of them, exhibiting repairs that are characteristic of monolinguals of each language. In line with this, it is important to note that we indeed observed this in the repair strategies present in each language. In French, when a rhotic was produced in Cr clusters, the first consonant could undergo a regressive assimilation of voicing, a pattern attested in French (Rose 2000). In Portuguese, when the rhotic underwent substitution, it could be replaced by [w], by the lateral [l], or by another coronal rhotic. These patterns are all attested in Portuguese monolingual acquisition of branching onsets (Ramalho 2018). To sum up, we did not find any instance of cross-linguistic influence between one language and the other concerning patterns of development: epenthesis did not occur in French and was attested in Portuguese only.

4.4. The Effect of Language Dominance

Mayr et al. (2015) found that language dominance played a role in the production of clusters for Welsh–English bilinguals. Welsh-dominant children produced more clusters in Welsh than English-dominant children. In our data, it could be the case that children dominant in French produce more clusters in French than children dominant in Portuguese, and vice versa.

One should remember that we focused on a quite homogeneous group of children: all of them are simultaneous bilinguals raised in Portugal and attending a French preschool. The differences in language exposure and use we captured were subtle: they were related to the fact of having either one or two caregivers speaking French and to the quantity of exposure outside school. In other words, some children were more exposed to French outside school than others. Gathering this information confirmed that most of the children shared similar profiles because they appeared to be balanced, which is not surprising for children raised in one country and attending school in a foreign language. Despite this quite homogeneous group of children, we found a small effect of language dominance on the production of clusters: there was more disparity between the target production of clusters between the two languages of a bilingual child if he/she was French-dominant; in other words, French-dominant children tend to have even higher levels of accuracy for branching onsets in French and similar levels of accuracy of branching onsets in Portuguese compared to Portuguese-dominant children. This indeed suggests that children are better in their dominant language than in their non-dominant language. We still need to interpret this result with caution: we did not find that Portuguese-dominant children were better with branching onsets in Portuguese than in French. On the contrary, all the children were better with branching onsets in French, independently of their dominance. There was less overlap between the rates of production of branching onsets in French-dominant children than in the remaining children. Moreover, language dominance itself was not a significant predictor in our regression analysis. Finally, this result was not as robust as the effect of language or age. It is difficult to know whether this result would hold with a larger number of children or with children who have more varied language dominance profiles. One should keep in mind that we had an unbalanced number of bilinguals dominant in French and in Portuguese: most of the children were either balanced or French-dominant. This could have affected the results of the statistical model, since it may not have detected an influence of dominance for Portuguese due to an insufficient number of Portuguese-dominant children.

In order to further evaluate the impact of language dominance, future research should compare bilinguals with very different dominance profiles, for example, by testing bilingual children living in two different countries. We should compare these bilingual children raised in Portugal with bilingual children raised in France. Unlike other areas of language, like vocabulary, which has been reported to be influenced by language dominance, cross-linguistic influence attested in phonological acquisition is better captured by the linguistic properties of the two languages than by dominance (see Paradis (2001) for a counter example). In the case of French–Portuguese bilingual children, we claim that this is also the case. Children are exposed to a more diverse inventory of clusters since Cr clusters have two phonetic formats in each language. Moreover, branching onsets are a complex structure present in both languages. This seems to positively influence their development of branching onsets in Portuguese.

5. Conclusions

This study has shown that French–Portuguese bilinguals are more advanced in their acquisition of branching onsets in French than in Portuguese. This result is in line with what is reported for French and Portuguese monolinguals. Bilinguals also use different repairs in each of their languages (for example, epenthesis is present in Portuguese but barely attested in French). Despite these different patterns of acquisition in each of their languages, we argue that there is a CLI effect between the two languages, leading to a faster development of branching onsets in Portuguese in comparison with monolinguals. We also found an effect of language dominance on the production of clusters, since the more French-dominant a child is, the more accurate they are with French clusters.

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Institutional Review Board Statement: This research and all its procedures were approved by the Ethics Committee of the School of Arts and Humanities at the University of Lisbon (Lisbon, Portugal) (reference number 10_CEI2023).

Informed Consent Statement: Informed consent was obtained from all the parents of the subjects involved in the study.

Data Availability Statement: The data that support the findings will be available in PhonBank within the next 3 months after the publication of this article.

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Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A

Table A1. Words containing obstruent + /ʁ/ clusters in French.

Cluster	Orthography	Gloss
[pʁ]	princesse	'princess'
[bʁ]	bras	'arm'
[bʁ]	bruit	'noise'
[tʁ]	triste	'sad'
[tʁ]	trois	'three'
[tʁ]	train	'train'
[tʁ]	tracteur	'tractor'
[tʁ]	citrouille	'pumpkin'
[dʁ]	drapeau	'flag'
[dʁ]	dragon	'dragon'
[kʁ]	crayon	'pencil'
[kʁ]	crocodile	'crocodile'
[gʁ]	grand	'big'
[gʁ]	grenouille	'frog'
[fʁ]	fraise	'strawberry'
[fʁ]	froid	'cold'
[fʁ]	fruit	'fruit'
[fʁ]	dentifrice	'toothpaste'

Appendix B

Table A2. Words containing obstruent + /l/ clusters in French.

Cluster	Orthography	Gloss
[bl]	blanc	'white'
[bl]	bleu	'blue'
[pl]	plage	'beach'
[pl]	plonger	'to dive'
[pl]	plumes	'feathers'
[pl]	parapluie	'umbrella'
[kl]	cloches	'bells'
[kl]	clown	'clown'
[gl]	glace	'ice cream'
[fl]	fleur	'flower'
[fl]	flûte	'flute'

Appendix C

Table A3. Words containing obstruent + /ɾ/ clusters in Portuguese.

Cluster	Orthography	Gloss
[pɾ]	prenda	'gift'
[pɾ]	presunto	'Smoked ham'
[pɾ]	professor	'teacher'
[pɾ]	primavera	'Spring'
[pɾ]	pretas	'black'
[pɾ]	compras	'shopping'
[pɾ]	princesa	'princess'
[bɾ]	braços	'arms'
[bɾ]	zebras	'zebras'
[bɾ]	cobra	'snake'
[bɾ]	bruxa	'witch'
[bɾ]	brinquedos	'toys'
[bɾ]	fiambre	'ham'
[bɾ]	obrigado	'Thank you'
[tɾ]	triciclo	'tricycle'
[tɾ]	trotineta	'scooter'
[tɾ]	triângulo	'triangle'
[tɾ]	três	'three'
[tɾ]	letras	'letters'
[tɾ]	trela	'leash'
[tɾ]	trator	'tractor'
[dɾ]	quadrado	'square'
[dɾ]	dragão	'dragon'
[dɾ]	vidro	'glass'
[dɾ]	pedra	'rock, stone'
[kɾ]	creme	'cream'
[kɾ]	cravo	'carnation'
[kɾ]	cruz	'cross'
[kɾ]	crocodilo	'crocodile'
[kɾ]	croquetes	'croquette"
[kɾ]	micro-ondas	'microwave'
[kɾ]	recreio	'playground'
[gɾ]	gruta	'cave'
[gɾ]	grandes	'big'
[gɾ]	fotografia	'photography'
[gɾ]	tigres	'tiger'
[gɾ]	magro	'slim'
[gɾ]	gravata	'necktie'
[fɾ]	frango	'chicken'

Table A3. *Cont.*

Cluster	Orthography	Gloss
[fɾ]	fralda	'diaper'
[fɾ]	frigorífico	'refrigerator'
[vɾ]	livros	'books'
[vɾ]	palavras	'words'

Appendix D

Table A4. Words containing obstruent + /l/ clusters in Portuguese.

Cluster	Orthography	Gloss
[bl]	biblioteca	'library'
[pl]	plasticina	'plasticine'
[pl]	planta	'plant'
[pl]	planeta	'planet'
[kl]	claro	'light'
[kl]	clube	'club'
[kl]	bicicleta	'bicycle'
[kl]	ciclista	'cyclist'
[kl]	triciclo	'tricycle'
[fl]	flor	'flower'
[fl]	flauta	'flute'
[fl]	floresta	'forest'

Appendix E

Production of Cl clusters in French.

Table A5. Production of Cl clusters in French by the first-graders.

Child	PF01	PF02	PF03	PF04	PF05	PF06	PF07	PF08	PF09	PF10
Dominance	4	−3	−1	0	0	5	1	3	3	3
Age	04;03.20	04;03.22	04;03.29	03;08.29	03;09.15	03;06.26	03;07.11	04;00.02	04;03.07	04;00.02
Target	100% (13/13)	92% (11/12)	100% (10/10)	85% (11/13)	9% (1/11)	78% (7/9)	80% (8/10)	82% (9/11)	80% (8/10)	100% (10/10)
C2 Deletion	-	8%	-	8%	64%	11%	10%	9%	10%	-
C1 substitution	-	-	-	-	-	11%	-	-	-	-
C2 substitution	-	-	-	-	-	-	-	-	-	-
Epenthesis	-	-	-	-	-	-	-	9%	-	-
Other	-	-	-	8%	27%	-	10%	-	10%	-

Table A6. Production of Cl clusters in French by the second-graders.

Child	PF11	PF12	PF13	PF14	PF15	PF16	PF17	PF18	PF19	PF20
Dominance	−4	2	0	0	5	0	0	2	2	−2
Age	05;00.06	05;00.05	04;08.27	05;04.09	04;11.20	04;09.30	04;07.02	04;09.02	04;07.10	05;02.12
Target	60% (6/10)	89% (8/9)	80% (8/10)	67% (8/12)	86% (12/14)	91% (10/11)	75% (9/12)	100% (12/12)	91% (10/11)	90% (9/10)
C2 Deletion	-	-	-	8%	7%	-	8%	-	-	-
C1 substitution	40%	-	20%	17%	7%	9%	-	-	-	-
C2 substitution	-	11%	-	-	-	-	8%	-	-	-

Table A6. *Cont.*

Child	PF11	PF12	PF13	PF14	PF15	PF16	PF17	PF18	PF19	PF20
Epenthesis	-	-	-	-	-	-	-	-	-	10%
Other	-	-	-	8%	-	-	8%	-	9%	-

Table A7. Production of Cl clusters in French by the third-graders.

Child	PF21	PF22	PF23	PF24	PF25	PF26	PF27	PF28	PF29	PF30
Dominance	0	3	−1	−1	1	1	3	0	−2	−1
Age	05;07.07	05;09.22	05;09.30	05;06.27	06;01.13	05;09.07	05;11.03	05;10.17	05;09.19	04;09.30
Target	100% (11/11)	80% (8/10)	91% (10/11)	91% (10/11)	92% (12/13)	8% (1/12)	90% (9/10)	73% (8/11)	83% (10/12)	92% (12/13)
C2 Deletion	-	10%	9%	-	8%	17%	10%	9%	8%	-
C1 substitution	-	-	-	9%	-	-	-	9%	-	-
C2 substitution	-	-	-	-	-	67%	-	-	-	-
Epenthesis	-	10%	-	-	-	-	-	-	-	-
Other	-	-	-	-	-	8%	-	9%	8%	8%

Appendix F

Production of Cr clusters in French.

Table A8. Production of Cr clusters in French by the first-graders.

Child	PF01	PF02	PF03	PF04	PF05	PF06	PF07	PF08	PF09	PF10
Dominance	4	−3	−1	0	0	5	1	3	3	3
Age	04;03.20	04;03.22	04;03.29	03;08.29	03;09.15	03;06.26	03;07.11	04;00.02	04;03.07	04;00.02
Target	94% (17/18)	44% (8/18)	65% (11/17)	74% (14/19)	7% (1/14)	83% (15/18)	88% (15/17)	78% (14/18)	75% (12/16)	56% (10/18)
C2 Deletion	-	11%	-	11%	79%	11%	6%	-	6%	-
C1 substitution	-	17%	29%	5%	-	6%	-	17%	6%	44%
C2 substitution	-	-	6%	-	7%	-	-	-	-	-
Epenthesis	-	0%	-	-	-	-	-	-	-	-
Other	6%	28%	-	11%	7%	-	6%	6%	13%	-

Table A9. Production of Cr clusters in French by the second-graders.

Child	PF11	PF12	PF13	PF14	PF15	PF16	PF17	PF18	PF19	PF20
Dominance	−4	2	0	0	5	0	0	2	2	−2
Age	05;00.06	05;00.05	04;08.27	05;04.09	04;11.20	04;09.30	04;07.02	04;09.02	04;07.10	05;02.12
Target	93% (13/14)	100% (15/15)	100% (17/17)	92% (12/13)	82% (14/17)	95% (18/19)	75% (12/16)	89% (16/18)	94% (16/17)	81% (13/16)
C2 Deletion	-	-	-	-	-	5%	-	-	-	-
C1 substitution	-	-	-	-	-	-	-	6%	-	13%
C2 substitution	-	-	-	8%	-	-	13%	-	-	-

Table A9. *Cont.*

Child	PF11	PF12	PF13	PF14	PF15	PF16	PF17	PF18	PF19	PF20
Epenthesis	-	-	-	-	-	-	6%	-	-	6%
Other	7%	-	-	-	18%	-	6%	6%	6%	-

Table A10. Production of Cr clusters in French by the third-graders.

Child	PF21	PF22	PF23	PF24	PF25	PF26	PF27	PF28	PF29	PF30
Dominance	0	3	−1	−1	1	1	3	0	−2	−1
Age	05;07.07	05;09.22	05;09.30	05;06.27	06;01.13	05;09.07	05;11.03	05;10.17	05;09.19	04;09.30
Target	89% (17/19)	81% (13/16)	93% (14/15)	95% (18/19)	94% (16/17)	100% (18/18)	100% (19/19)	100% (16/16)	100% (14/14)	100% (15/15)
C2 Deletion	5%	-	-	-	-	-	-	-	-	-
C1 substitution	5%	6%	7%	5%	6%	-	-	-	-	-
C2 substitution	-	-	-	-	-	-	-	-	-	-
Epenthesis	-	-	-	-	-	-	-	-	-	-
Other	-	12%	-	-	-	-	-	-	-	-

Appendix G

Production of Cl clusters in Portuguese.

Table A11. Production of Cl clusters in Portuguese by the first-graders.

Child	PF01	PF02	PF03	PF04	PF05	PF06	PF07	PF08	PF09	PF10
Dominance	4	−3	−1	0	0	5	1	3	3	3
Age	04;03.20	04;03.22	04;03.29	03;08.29	03;09.15	03;06.26	03;07.11	04;00.02	04;03.07	04;00.02
Target	45% (5/11)	45% (5/11)	92% (12/13)	71% (5/7)	0% (0/5)	40% (4/10)	55% (6/11)	33% (3/9)	43% (3/7)	44% (4/9)
C2 Deletion	27%	9%	-	-	60%	50%	27%	44%	14%	33%
C1 substitution	-	-	-	-	-	-	-	-	-	-
C2 substitution	-	-	-	-	-	10%	18%	-	-	11%
Epenthesis	27%	18%	8%	14%	-	-	-	11%	43%	-
Other	-	27%	-	14%	40%	-	-	11%	-	11%

Table A12. Production of Cl clusters in Portuguese by the second-graders.

Child	PF11	PF12	PF13	PF14	PF15	PF16	PF17	PF18	PF19	PF20
Dominance	−4	2	0	0	5	0	0	2	2	−2
Age	05;00.06	05;00.05	04;08.27	05;04.09	04;11.20	04;09.30	04;07.02	04;09.02	04;07.10	05;02.12
Target	75% (9/12)	83% (10/12)	25% (3/12)	63% (5/8)	70% (7/10)	89% (8/9)	80% (8/10)	70% (7/10)	30% (3/10)	73% (8/11)
C2 Deletion	8%	-	8%	25%	30%	-	10%	20%	20%	18%
C1 substitution	-	8%	-	-	-	-	-	-	-	-
C2 substitution	-	8%	67%	13%	-	11%	-	10%	30%	-
Epenthesis	8%	-	-	-	-	-	-	-	10%	9%
Other	8%	-	-	-	-	-	10%	-	10%	-

Table A13. Production of Cl clusters in Portuguese by the third-graders.

Child	PF21	PF22	PF23	PF24	PF25	PF26	PF27	PF28	PF29	PF30
Dominance	0	3	−1	−1	1	1	3	0	−2	−1
Age	05;07.07	05;09.22	05;09.30	05;06.27	06;01.13	05;09.07	05;11.03	05;10.17	05;09.19	04;09.30
Target	75% (9/12)	55% (6/11)	64% (7/11)	50% (6/12)	67% (6/9)	13% (1/8)	58% (7/12)	58% (7/12)	0% (0/12)	73% (8/11)
C2 Deletion	8%	27%	9%	17%	22%	13%	17%	25%	33%	9%
C1 substitution	-	-	-	-	-	-	8%	8%	-	-
C2 substitution	8%	18%	18%	8%	-	38%	8%	-	67%	9%
Epenthesis	8%	-	-	8%	-	-	8%	8%	-	9%
Other	-	-	9%	17%	11%	38%	-	-	-	-

Appendix H

Production of Cr clusters in Portuguese.

Table A14. Production of Cr clusters in Portuguese by the first-graders.

Child	PF01	PF02	PF03	PF04	PF05	PF06	PF07	PF08	PF09	PF10
Dominance	4	−3	−1	0	0	5	1	3	3	3
Age	04;03.20	04;03.22	04;03.29	03;08.29	03;09.15	03;06.26	03;07.11	04;00.02	04;03.07	04;00.02
Target	0% (0/44)	2% (1/45)	76% (35/46)	33% (10/30)	0% (0/27)	33% (13/39)	69% (25/36)	50% (20/40)	47% (18/38)	39% (17/44)
C2 Deletion	16%	89%	15%	30%	89%	31%	11%	23%	11%	27%
C1 substitution	2%	-	2%	-	-	-	3%	-	-	7%
C2 substitution	73%	4%	4%	10%	-	-	8%	8%	3%	5%
Epenthesis	-	-	2%	10%	-	28%	6%	13%	21%	14%
Other	9%	4%	-	17%	11%	8%	3%	8%	18%	9%

Table A15. Production of Cr clusters in Portuguese by the second-graders.

Child	PF11	PF12	PF13	PF14	PF15	PF16	PF17	PF18	PF19	PF20
Dominance	−4	2	0	0	5	0	0	2	2	−2
Age	05;00.06	05;00.05	04;08.27	05;04.09	04;11.20	04;09.30	04;07.02	04;09.02	04;07.10	05;02.12
C2 Deletion	11%	17%	2%	23%	12%	10%	30%	45%	28%	10%
C1 substitution	2%	2%	2%	-	5%	-	3%	-	-	-
C2 substitution	2%	11%	26%	3%	12%	5%	20%	-	6%	3%
Epenthesis	24%	2%	39%	10%	2%	24%	5%	13%	19%	5%
Other	4%	7%	9%	8%	5%	12%	10%	3%	22%	5%

Table A16. Production of Cr clusters in Portuguese by the third-graders.

Child	PF21	PF22	PF23	PF24	PF25	PF26	PF27	PF28	PF29	PF30
Dominance	0	3	−1	−1	1	1	3	0	−2	−1
Age	05;07.07	05;09.22	05;09.30	05;06.27	06;01.13	05;09.07	05;11.03	05;10.17	05;09.19	04;09.30
Target	70% (32/46)	81% (30/37)	61% (25/41)	91% (41/45)	85% (29/34)	5% (2/44)	60% (27/45)	76% (34/45)	71% (32/45)	75% (33/44)

Table A16. *Cont.*

Child	PF21	PF22	PF23	PF24	PF25	PF26	PF27	PF28	PF29	PF30
C2 Deletion	7%	5%	17%	2%	15%	25%	7%	7%	16%	11%
C1 substitution	-	-	2%	-	-	-	7%	2%	-	-
C2 substitution	2%	3%	7%	2%	-	55%	7%	4%	4%	-
Epenthesis	17%	5%	2%	4%	-	-	16%	4%	2%	2%
Other	4%	5%	10%	-	-	16%	4%	7%	7%	11%

Notes

1 Henceforth, French and Portuguese.

2 As an anonymous reviewer noted, in French, even if [vʁ] can occur in both positions, it is not very frequent in the language.

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