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Effects of silent letters on the L2 English pronunciation of L1 French learners

Marine Mouquet
Aix Marseille University

Paolo Mairano
University of Lille

This paper investigates the effects of orthography on second language (L2) phonology. We replicate a study by Bassetti and Atkinson (2015) investigating the intrusion of silent consonants in production; while the original study was conducted on L1 Italian learners of L2 English, we focus on L1 French learners of L2 English. We recruited 110 French undergraduate students specialising in English in various French universities and we ran two tests to elicit the production of 7x2 target words containing silent letters. In the first task (reading aloud task) participants saw the spelling of target words, while in the second task (word repetition task), participants initially saw their spelling, but then the spelling vanished before beginning the production. The results show that: 1) participants were significantly affected by spelling in both tasks and produced a high proportion of intrusive consonants prompted by silent letters; and 2) when orthographic input was present, more intrusive consonants corresponding to silent letters were produced. These results extend the findings of the original study on Italian participants to French participants. Furthermore, since French (contrary to Italian) has a relatively opaque spelling system, these results suggest that silent letters can have an effect on L2 pronunciation not only for learners with a transparent L1 orthographic system, but also for those who have an opaque L1 orthographic system.

Keywords: L2 phonology, orthography, silent letters, speech production, second language acquisition



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1 Background

Research in second language (L2) phonology has long focused on the cross-linguistic influence of the native language (L1) on the L2. Among the numerous models formulated to explain the difficulties faced by L2 learners in acquiring L2 phonology through their L1 phonological systems, the most influential are The Perceptual Assimilation Model (Best, 1994) and the Speech Learning Model (Flege, 1995). However, when an L2 is acquired via instructed learning, the acquisition process is achieved not only via spoken input, but also and often mainly via written input (as opposed to L1s, which are acquired through spoken input). It is therefore understandable that many recent studies have turned to the effects of orthography on L2 production and perception.

Research has found that orthography can either be a facilitating or a misleading factor in second language pronunciation, especially at the early stages of language acquisition. Among the beneficial effects of orthography, it has been demonstrated that providing orthographic input to L2 learners enhances the memorisation and retrieval of vocabulary (Bürki et al., 2019) and assists L2 learners in perceiving and distinguishing L2 sounds (Escudero et al., 2008; Escudero et al., 2014). In contrast, among the undesirable effects of orthography, researchers have shown that orthography can negatively affect L2 phonological representations, resulting in non-target-like productions (Bürki et al., 2019), notably segmental additions, omissions and substitutions (Bassetti, 2008). This can even lead to a phonological category from the L1 being imported; notably, Bassetti et al. (2018) reveal that Italian learners produce a singleton-geminate contrast in English reflecting spelling, e.g., *finish* vs. *Finnish*.

L2 learning may vary according to different factors, and the degree of transparency of the orthographic system in the L1 and the L2 is one of them. The orthographic system of some languages can be considered transparent: for instance, Finnish, Dutch, and Italian are acknowledged to have transparent orthographic systems, characterised mostly by one-to-one grapheme-phoneme and phoneme-grapheme correspondences (Aro, 2013). On the contrary, the orthographic systems of English, Irish, and French are considered to be opaque (or deep) since they often deviate from such correspondences (Erdener & Burnham, 2005). Therefore, it seems reasonable to claim that the phonological patterns of L2 languages with a transparent orthography can be easier to predict, because orthographic input can give direct information about the pronunciation of words (Seymour et al., 2003). Furthermore, researchers have suggested that learners whose L1 has a transparent orthographic system may tend to rely more heavily on orthography than learners whose L1 has an opaque orthographic system (Erdener & Burnham, 2005). Clearly, this may then be problematical for learners whose L1 has a transparent orthographic system targeting an L2 with an opaque orthographic system. For instance, Bassetti and Atkinson (2015) investigated the effects of silent letters (i.e., orthographic cues that are never produced) in reading aloud and word repetition tasks, revealing that L1 Italian learners of L2 English tended to pronounce intrusive consonants for silent letters, and more so when orthographic input was directly displayed.

In this study, we sought to replicate the two tests carried out by Bassetti and Atkinson (2015) originally on Italian learners, by running similar tasks with L1 French learners of L2 English. Contrary to Italian, the orthographic system of French is opaque and includes many one-to-many and many-to-one correspondences, including many cases of silent letters. This may lead us to expect, based on Erdener and Burnham (2005), that French learners of English may have fewer issues with silent letters in English than Italian learners: since their L1 orthographic system is less transparent and includes silent letters, L1 French learners may rely less than L1 Italian learners on orthography to predict phonological patterns of the L2. However, this prediction contradicts the experience of many teachers of English in France, who regularly witness the challenges posed by silent letters to French learners. Moreover, the impact of such

letters on production is not well-documented. Thus, our study not only replicates the original one, but extends it to a different population (L1 French learners), thereby providing a testbed for the claims of Erdener and Burnham (2005).

2 Research methodology

2.1 Research questions and hypotheses

The study aims to investigate the following research questions:

RQ1: To which degrees will French learners be affected by silent letters resulting in additional segmental units in their output?

RQ2: Do learner variables: a) living abroad and length of stay abroad; b) onset of English acquisition; c) L2 proficiency level; and d) variety comprehension, interact with orthographic effects?

We hypothesise that even though there are many silent letters in French, orthographic forms will still affect French learners' pronunciation of silent letters in English. Following Bassetti and Atkinson (2015), orthographic input is provided in the reading aloud task, but only partially in the word repetition task (i.e., orthographic input is provided briefly but vanishes as soon as the audio starts playing). Thus, we predict that more intrusive consonants will be produced for silent letters in the former task than in the latter. Following Erdener and Burnham (2005), we predict that French learners will be misled by silent letters to a lesser extent than Italian learners, since French is orthographically less transparent than Italian and includes many silent letters.

We also expect some learner variables, such as L2 proficiency, to counterbalance those effects. For instance, second-year undergraduate students at the English Department, University of Lille, are given lectures on grapho-phonemic rules and particularly on silent letters as part of their course in English phonetics in the first semester. In order to evaluate the impact of such lectures, the current study compares the production of first-year vs. second-year and third-year students. It is predicted that second-year students will produce fewer silent letters than the two other groups. This expectation arises from the fact that first-year students have not received any instructions on silent letters and that second-year students have more recently received lectures on silent letters than third-year students. Therefore, third-year students are also expected to produce fewer silent letters than first-year students.

2.2 Participants, task stimuli, and experiment procedure

Due to the COVID-19 lockdown, the two tests were hosted on a website, run remotely, and conducted via computers, without being available on smartphones. Therefore, unlike Bassetti and Atkinson (2015), participants used their own equipment. They were advised to perform the experiment in a quiet room and to use headphones for the repetition task. The website was coded in Javascript/JQuery for the dynamic part and in HTML/CSS for the static part. More precisely, the website also used Bootstrap for the layout. For the recordings, we used the library Recorder.js, published under the MIT licence by Matt Diamond. All the recordings and data were gathered on a MySQL database thanks to PHP.

The tasks were completed by 110 L1 French participants of L2 English with no reported language or reading impairments: 38 first-year, 24 second-year and 48 third-year students. All of them were undergraduate students specialising in English in various French universities ($F = 92$, $M = 18$, a typical gender bias among students in language departments in France). The

median self-reported level of English was B2 and ranged from B1 to C2. Twenty respondents had lived in an English-speaking country (mainly the UK and the US but also Canada, South Africa, Singapore, and New Zealand) with an average duration of 20 months ($MD = 10.5$, $SD = 18.77$). Participation was voluntary and unpaid.

Written instructions were given in French before each task. All participants were exposed to 37 stimuli appearing in the same order determined randomly for both tasks (see Table 1): seven target words included the silent letters , <d>, and <l> in different positions, which were the focus of our analysis; 24 fillers (homophones¹); three words including optionally silent letters²; and three filler words. The word *landscape* was included in the list of target words in Bassetti and Atkinson (2015) but it was discarded from our study because the silent <d> is frequently produced by native speakers³.

Table 1

Stimuli Words

Target words	Homophones	Words with optional silent letters	Filler words
climb	aloud	allowed	okay
comb	caught	court	like
debt	flour	flower	um
lamb	higher	hire	
Wednesday	one	won	
salmon	principal	principle	
walk	right	write	
	sauce	source	
	seas	seize	
	son	sun	
	which	witch	
	wood	would	

Homophones were notably included in the stimuli because Bassetti and Atkinson (2015) include four different studies investigating several aspects of orthographic effects. We did not test orthographic effects on the pronunciation of homophones. However, the same stimuli were used in order to: 1) do a valid replication and be able to compare results, and 2) to distract participants from silent letters with different fillers. Stimuli were sorted randomly and presented to participants, although it was impossible to apply the exact same order as this information was not provided in Bassetti and Atkinson (2015).

In the first task, each word appeared on the screen and participants had to click to start recording, and then read the written word aloud within a timeframe of three seconds. No acoustic input was provided in this task. As the experiment was conducted at home and not in a supervised laboratory environment, the test screen displayed a ‘Retry’ button, in case

¹ The homophones were used for a different study by Bassetti and Atkinson (2015).

² These words have letters that are claimed to be pronounced by British English natives and were therefore discarded from the analysis (see Bassetti & Atkinson, 2015).

³ As already shown with *sandwich* and *grandson* in Bassetti and Atkinson (2015).

participants encountered recording issues or other technical problems. However, participants were encouraged to be spontaneous and record each word just once. Only the last version was kept for the analysis. A bar at the top tracked their progress for each task. Once they had recorded the 37 words, they could move on to the second task.

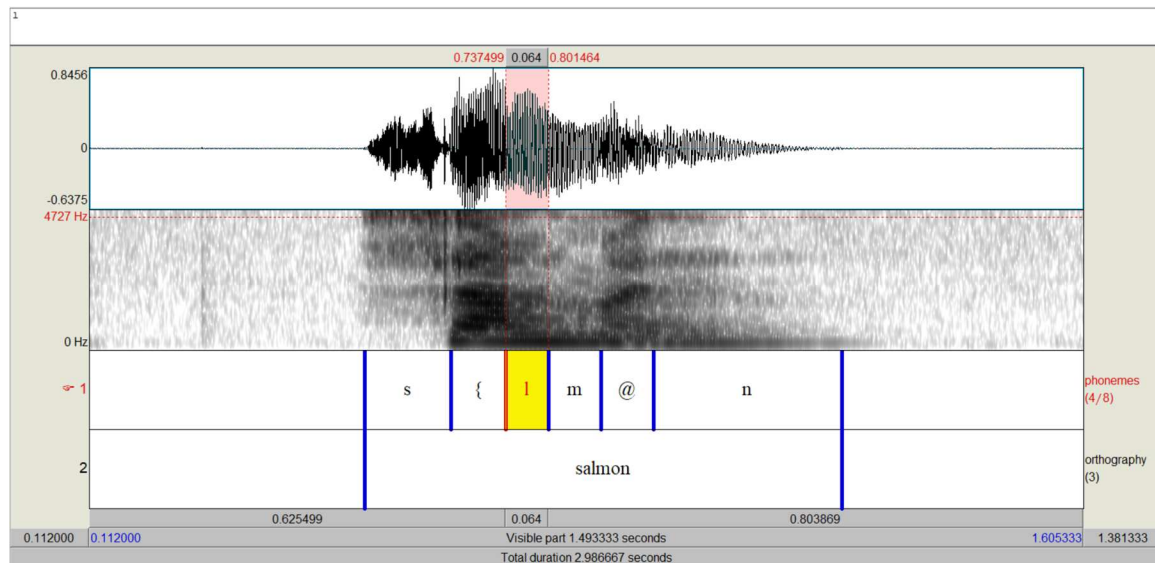
In the word repetition task, participants had to repeat words on the basis of a recording. The orthographic version of each word was initially shown on the screen, but vanished when participants listened to the audio. Only one listening was possible. The audio was extracted from the Cambridge Dictionary⁴ (online version) and was based on Southern British English (SBE). As in the previous task, participants had to record themselves repeating the target stimuli. Participants were advised to record themselves just once, but they could retry if they encountered any technical issues.

3 Data analysis and results

The recordings containing the seven target words were examined in isolation for each student twice (once for each task). Based on an auditory and spectrographic analysis with Praat (Boersma & Weenink, 2019), each target silent letter was coded by the authors as intrusive or non-intrusive. A sample of the recordings is presented in Figure 1.

Figure 1

Spectrogram Analysis of the Word ‘Salmon’ with a Pronounced /l/ by a First-year Participant

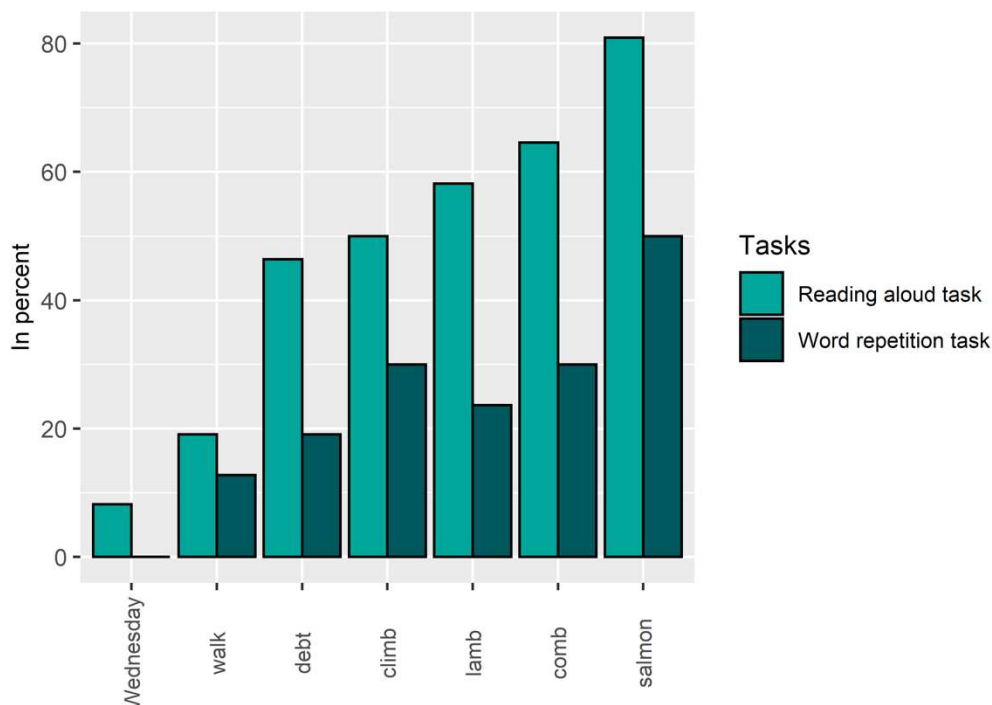


In general, the results show that on average 47% of the target words were produced with an added phone during the reading aloud task vs. 24% during the word repetition task. A paired *t*-test assuming unequal variances confirmed that there were significantly more cases of added silent consonants in the reading aloud task than in the word repetition task ($t(209) = 7.25$, $p < .001$; $M_{RAT} = 3.27$ vs. $M_{WRT} = 1.7$), thus suggesting that acoustic input reduces the intrusion of silent letters.

⁴ Cambridge Dictionary <https://dictionary.cambridge.org>

Figure 2

Proportion of Pronounced Silent Letters in Target Words: Reading Aloud Task vs. Word Repetition Task



Note. Data is presented in percentage and classified by significance

More detailed results of the tasks for each word are indicated in Figure 2. The <l> in the word *salmon* was the most problematic for French participants in both tasks: they produced 81% of <l> occurrences in the reading aloud task vs. 50% in the word repetition task. In addition, French participants encountered overall difficulties with the in final position in *comb*, *lamb*, and *climb* and in middle position in *debt* (55% of the participants produced them in the word reading task vs. 26% in the word repetition task). Conversely, participants did not seem to face many difficulties with the silent <d> in *Wednesday* as only 8% of them pronounced it during the first task and none of them did during the second one. Most students who produced a /d/ also mispronounced other phonemes and/or stress (e.g., pronouncing it as */wed'nesdeɪ/ and */wed'nezdeɪ/).

In addition, written and spoken frequencies were extracted from the British National Corpus (see Table 2). In order to determine whether spoken and written lexical frequencies affected the percentage of intrusive consonants corresponding to silent letters, we examined their correlation (see Figure 3).

Table 2

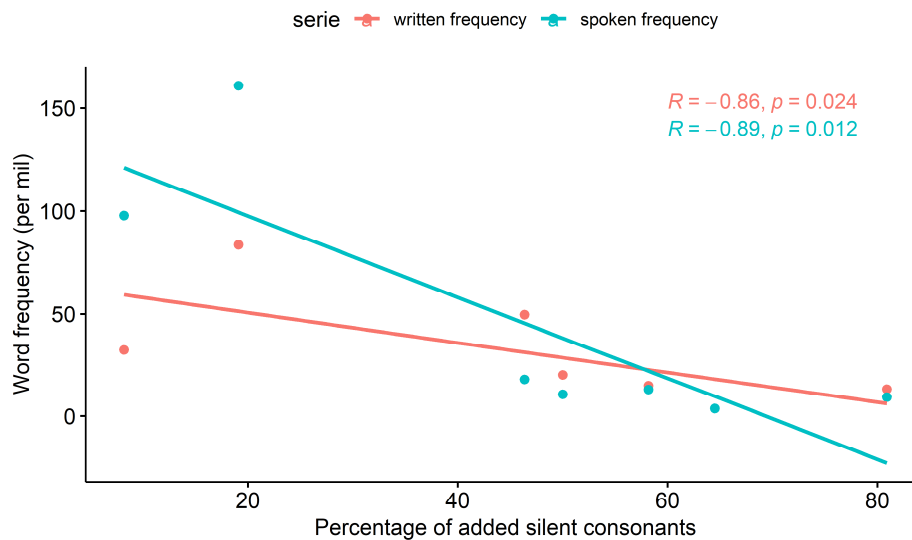
Occurrences of Written and Spoken Target Words in the British National Corpus (in Lemma, per Mil)

Words	Written frequency	Spoken frequency
walk	83.59	160.88
Wednesday	32.54	97.76
debt	49.64	17.97
climb	20.16	10.54
lamb	14.8	12.95
salmon	13.11	9.23
comb	3.62	3.61

Note. Data retrieved from the British National Corpus in May 2021 (Davies, 2004)

Figure 3

Number of Pronounced Silent Letters in the Reading Aloud Task: Spoken-to-written Frequency



Words with lower frequencies were more challenging for participants. A Spearman correlation test was used to check the distribution between the number of intrusive silent consonants for each word and its spoken and written frequencies. The correlation yielded significant results for both spoken ($r = -0.89, p = 0.012$) and written ($r = -0.86, p = 0.024$) frequencies. Spoken frequency correlates even more significantly than the written one; this is of course expected, as it is reasonable to assume that the pronunciation of words more

frequently encountered in speech is better known to learners. However, more samples are needed to confirm the validity of this finding, as only seven words were involved in this task.

Additionally, no significant correlation was found between orthographic effects and learner-level variables: living abroad and length of stay abroad, onset of English acquisition, proficiency level in English, and English variety comprehension. Surprisingly, a *t*-test assuming unequal variance revealed that second-year and third-year participants from the English Department in Lille (who had received grapho-phonemic lectures on silent letters ($n = 16$)) did not significantly diverge from first-year participants ($n = 11$) from the same Department ($t(25) = 1.76$; $p = 0.09$; $M_{\text{FIRST}} = 4.45$ vs. $M_{\text{OTHERS}} = 3.25$) for the reading aloud task and ($t(20) = -0.08$; $p = 0.9$; $M_{\text{FIRST}} = 2.27$ vs. $M_{\text{OTHERS}} = 2.31$) for the word repetition task. This may suggest that lectures on grapho-phonemic rules were not only ineffective, but also that there does not seem to be a change from the first year to the second and third year in terms of pronunciation of silent letters.

4 Discussion

In line with Bassetti and Atkinson's (2015) study, these findings confirm the significant effects of orthography on L2 production: French participants produced intrusive consonants corresponding to silent letters in 47% of words with silent letters in the reading aloud task and 24% in the word repetition task. The effects that we found for French learners of L2 English are smaller than those found by Bassetti and Atkinson (2015) for Italian participants. This result seems to support Erdener and Burnham's (2005) claim that the transparency of L1 orthography has an effect on the extent to which learners rely on spelling to predict pronunciation patterns in an L2. However, this interpretation should be tempered, because comparisons of L2 learners from different L1s may be misleading, and many factors may influence these findings, e.g., our French participants had less L2 instruction than the Italian participants in the original study, having had on average, 10 years vs. 11 years. However, French participants were older and were university students learning English, thus frequently speaking, listening, and writing English for a minimum of 20 hours per week, whereas Italian participants in the original study were high-school students from Rome. In addition, although French participants' self-reported proficiency levels were examined, we did not include a control group with experienced learners who did not receive lectures on grapho-phonemic rules. It may be that more experience with the L2 could lower orthographic effects.

Nonetheless, beyond differences potentially due to the L1 and other factors, the difference in results between the two tasks remains significant: when provided with orthography, participants were decoding graphemes, and therefore the effects of spelling were more noticeable. Yet, when investigating L2 transfer, phonological models such as PAM (Best, 1994) and SLM (Flege, 1995) do not account for orthographic effects, suggesting that more research is needed to attempt to capture learners' difficulties in acquiring a second language.

The impact of cognates was also investigated. In the original study, Italian learners did not encounter any difficulties with the cognate word *salmon* (in Italian *salmone*) even though the <l> is produced in the L1. Conversely, the French *saumon* does not include any <l> but *salmon* was the word with which French learners struggled most (i.e., 80% of them produced an intrusive consonant corresponding to silent letters in the reading aloud task and 50% in the word repetition task). This suggests that cognate words did not have any evident effects on the production of intrusive consonants prompted by silent letters, confirming Bassetti and Atkinson's (2015) findings.

The present study also yielded some unexpected results. The final <-mb> cluster (with silent) seems to be challenging for French learners of L2 English, resulting in /mb/ realisations in 52% of the cases in the reading aloud task and 30% in the word repetition task. Yet, this

consonant cluster does not exist in French, suggesting that the effects of orthography can override L1 phonotactic restrictions. Bassetti et al. (2018) had similar results, with geminate consonants produced by L1 Italian learners and late bilinguals in contexts where they would not be present in the L1. Additionally, we observed an interaction of orthographic and phonotactic effect in the reading aloud task, where many participants had the tendency to nasalise the preceding vowel in *lamb* and *comb* leading to non-target-like realisations such as */'lãb/ (12%) and */'kõb/ (43%). This effect was barely noticeable in the repetition task (1% for the former vs. 8% for the latter), thereby suggesting that phonotactic constraints and orthography interact with one another, resulting in the nasalisation of the vowel (since <-am-> and <-om-> are realised as /ã/ and /õ/ in French) and the realisation of an intrusive consonant prompted by the silent letter.

5 Conclusion and perspectives

To the best of our knowledge, our study is the first to analyse the effects of English silent letters on French learners of English. The results replicated those found by the original study (Bassetti & Atkinson, 2015): orthographic forms can affect production, even for experienced learners, all of whom produced at least some intrusive consonants for silent letters. Particularly, the effect was stronger in the reading aloud task than in the word repetition task, as in the original study. This confirms that providing orthographic input to learners can increase orthographic effects, even in a language with a phonologically opaque orthography.

From a teaching perspective, one solution involves withholding written input. Winitz and Yanes (2002) suggested that at the early ages of acquisition of second language learning, L2 learners should not be provided with written input until they acquire a correct pronunciation of these words; yet, preventing access to written material in an L2 is obviously very impractical for many reasons, if at all possible. Thornbury (1999, p. 86) attempted to delay students' exposure to the orthographic forms until the correct pronunciation of silent-letter words was completely acquired; however, results were not conclusive, as learners tended to revert to orthographic input once exposed to it.

However, it is important to stress that orthography should not be banished from L2 learning. Another way to minimise the influence of spelling-pronunciation habits is to encourage the learning of phonetic notation (Mompeán & Fouz-González, 2021). Not only can phonetic symbols provide all learners with the correct pronunciation of vocabulary, but as they are based on visual displays, they can also facilitate learners' categorisation, and conceptualisation of mental representations for target sounds – and might even correct fossilised mispronunciations.

An extension of this study (Mouquet & Mairano, 2023) will expand the limits of the present study, which in itself does not address all the effects of silent letters. Particularly, the limited number of target words, the limited variety of silent letters (five items for and merely two for <d> and <l>), as well as the limited number of contexts (three items for <-mb>, one for <-lb>, one for <-lk>, one for <-lm>, and one for <-dn->) do not give us a full picture. Therefore our findings do not provide an adequate basis for drawing generalisable conclusions. This study will therefore be expanded through an alternative design incorporating a greater number of letters, balanced contexts, and a larger set of items. Additionally, by conducting two tasks, a picture naming task and an ABX task in which a phoneme was added or deleted to the recording of each stimulus (e.g., */'sælmən/ for *salmon*) via Mbrola resynthesis, direct orthographic exposure may be discarded. This will be the opportunity to investigate whether L2 orthography, and more particularly silent letters, is entrenched in memory. Future research will attempt to provide further evidence for orthographic effects on L2 phonology.

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About the authors

Marine Mouquet is currently a PhD student at the University of Aix-Marseille, France, in the LPL research group (*Laboratoire Parole et Langage*, UMR 7309) under the supervision of Sophie Herment (LPL) and Paolo Mairano (STL). She received a Master's degree of English Linguistics and Didactics at the University of Lille, France during which she wrote two MA theses supervised by Paolo Mairano investigating the effects of L2 English silent letters on L1 French learners' pronunciation and perception and its impact on the mental lexicon. Her main

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research interests lie in English phonetics and phonology, second language acquisition, the effects of orthography and psycholinguistics.

Email: marine.mouquet@univ-amu.fr

Paolo Mairano is currently Associate Professor in English Linguistics at the University of Lille, and has previously worked in various academic and industrial institutions (University of Warwick, University of Rouen, University of Turin, Nuance Inc.). His research focus lies in the acquisition of L2 sounds as well as other areas of phonetics, and his studies adopt a quantitative approach.

Email: paolo.mairano@univ-lille.fr