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Segmental difficulties in French learners of German

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Abstract. The French Learners Audio Corpus of German Speech (FLACGS) was recorded to study the quantity and nature of French learners' pronunciation difficulties in German on a segmental level across three different tasks: word repetition, reading and picture description. The corpus was transcribed manually. The orthographic transcription was automatically aligned with the MAUS-web service. Among others, the data suggests that French learners of German have difficulties with vowel quantity contrasts as well as presence of /h/ onset on a segmental level. Duration is a valid cue to investigate vowel quantity as well as /h/ onset production. Across the tasks French learners well performed on vowel quantity distinction, except for the contrast /a/-/a:/ in the reading task. French learners of German produce identical durations for /a/-/a:/ that do neither match the usual short vowel or the long vowel duration. French learners of German might only have one /a/-sound they can produce without any auditory input. That could explain why the duration for /a/-/a:/ is not clearly associated to the short-long vowel duration pattern. The quantity contrast between /a/-/a:/ was well performed by the French learners of German in the repetition task. That result suggests that the omitted contrast in the reading task is not due to an erroneous perception. Regarding the /h/ onset, /h/ onset production decreases with higher production complexity of the task. At least three out of four possible /h/ onsets are produced as /h/ onset by French learners. The others are widely replaced by empty onsets, about 15% of the uttered words with /h/ onset, except for the reading task. In reading, French learners prefer a glottal stop to an empty onset. This result could be explained by decoding efforts. In reading and picture describing, French learners of German tend to produce longer /h/ onsets than German natives. The French learners may aim to be unambiguous by insisting on the first segment of the word. Across the tasks, French learners of German behave native-like for the vowel quantity contrast and the /h/ onset in the repetition task. This result suggests that French learners of German well perceive vowel quantity and /h/ onsets. The speech corpus is not a resource that allows us by itself to conclude whether the participants have achieved contrastive perception of the vowel quantity contrast or the /h/ onset.

Keywords: Second language learning, speech corpus, segmental difficulties

Introduction

The pronunciation of a foreign language (L2) is conditioned by the phonological system of the mother tongue (L1). Mastering the phonological system of the L2 improves the communication with native speakers. Flege (1995) highlights that L2 speech production can be erroneous and that the production skills of L2 learners do not only depend on perception skills in the L2.

In the literature, there are very few studies investigating French natives learning English or German. In 2014, Shoemaker investigated syllable boundaries perception in French learners of English. The author shows that in perception, French learners of English are more sensitive to the presence of glottal stops than to aspiration and that, by consequence, glottal stops are a more salient cue to syllable boundaries than aspiration. With respect to L2 productions' intelligibility, native German listeners underwent a perception test of German vowels produced by French native speakers (Zimmerer and Trouvain (2015)). The results showed that French learners' short vowels are less well perceived than their long vowels in minimal pairs by German native speakers. Another study of the

same authors (2015) focussed on /h/ onset production of French learners in German and German native speakers in read speech. The researchers found that German native speakers have voiced and unvoiced /h/. French learners of German produce globally more unvoiced /h/ than the native speakers but they tend to produce only small amounts of empty onsets. Glottal stops, on the other hand, are more frequent especially for the learners who are rated as beginners.

Studying vowel quantity contrast and /h/ onsets in German speech of French learners is part of a larger project in the framework of which we want to investigate whether detailed knowledge, awareness and practice of the segmental and supra-segmental differences between the L1 and the L2 of a speaker help to improve his L2 pronunciation. To that purpose a speech corpus was recorded to identify segmental and suprasegmental challenges for French learners of German in German speech.

Corpus definition, collection and content

Participants

For the *French Learners Audio Corpus of German Speech (FLACGS)*, all participants were recruited in Paris, France. Participation was on a voluntary basis. In return, they received an incentive USB key and pronunciation feedback. The recordings took approximately 45 minutes per participant.

French learners of German (FG)

20 FG (10 women and 10 men) were recorded in Paris (France). The women were aged between 20 and 30 years, the men between 24 and 32. All FG as well as their parents had only French as a first language (L1). They auto-evaluated their German skills based on the Common European Framework of Reference for Languages (CEFR). In both gender groups, all levels were represented: A1/A2 up to C2. Moreover, all participants learned English at school.

German native speakers (GG)

20 GG (10 women and 10 men) were recorded in Paris (France) except for two of them who were recorded in Germany. The women were aged between 22 and 47 years, the men between 30 and 45. All GG as well as their parents had only German as L1. Except for one female and one male participant who had no knowledge of the French language, all GG were high proficient in French (B1/B2 up to C2+ according to the CEFR). They all learned English at school. The great majority lived in France for several years.

Even if the GG were born and raised in different regions of Germany, all spoke in standard German for the recordings.

Tasks

The participants performed three tasks of increasing production complexity:

1. Repetition task:
Participants heard small sentences over headphones they repeated immediately.
2. Reading task:
Participants read aloud the short stories *Nordwind und Sonne* and *Die Buttergeschichte*.
3. Picture description:
The picture description task was the only task without linguistic input.



Figure 1. Picture description task

The repetition task aimed to investigate how FG produce long and short vowel contrasts, consonants and consonant clusters that are unusual or different in the French language as well as lexical stress in different word positions.

Carrier sentences (*Er sagt ... klar und deutlich* and *Ich sage ... klar und deutlich*) including 55 distinct words in central accented position were recorded by a female German native speaker. The participants listened to all the spoken utterances in a randomized order over headphones and repeated them.

The material of the repetition task was composed of words with lexical stress in different positions (word-initial syllable, word-final syllable, penultimate syllable and ante-penultimate syllable), minimal pairs with long and short vowels (e.g. *Hüte* /hy:tə/ and *Hütte* /hʏtə/) minimal pairs with voiced/unvoiced distinction in plosive (eg. *glauben* /glɔʊbən/ and *klauben* /klɔʊbən/). We also included words that are difficult to pronounce because of their phonotactics (for French natives, challenging consonants, clusters and glottal stops between vowels in adjacent syllables) e.g. *Schächtelchen* /'ʃɛçtəlçən/ and *erobernde* /eeʔ'ɔbendɛ/. The aim of the repetition task was to check FGs' reproduction skills of utterances in L2.

The participants had to read two short stories *Nordwind und Sonne* and *Die Buttergeschichte* frequently used in phonetic studies (e.g. in the Kiel corpus Kohler, 1996). Conflicting orthographic conventions between L1 and L2 are possible sources of pronunciation difficulties. For instance the graphic <z> is pronounced /z/ in French but /ts/ in German. Another example is the graphic sequence <au> which is pronounced as the diphthong /ɔʊ/ in German, but /o/ in French. The aim of the reading task is twofold:

- (i) check overall FG pronunciation difficulties, when reading;
- (ii) focus on difficulties which may arise due to conflicting orthographic conventions between German and French.

Both languages, French and German, use the Latin alphabet. But the letters and letter combinations do not necessarily code the same sounds e.g. *Mantel* is produced as ['mantəl] by GG. FG are more likely to pronounce [mã'tɛl] as the letter combination <an> corresponds to a nasal vowel in written French. The reading task also allows us to compare prosodic patterns in different places of the utterance e.g. to compare how word stress is realized in the beginning, the middle and the end of an utterance with respect to prosody.

The description task aims to collect semi-spontaneous speech. All participants described the same picture. We concentrated our analysis on uttered words like *Haus*, *Mädchen*, *Junge* and *Sonne*. The

image description is the only task where the participants did not have any linguistic support (prior written sentences, spoken utterances) to help them with their speech production. Before the participants started the image description, we made sure they knew the names of the items and actions represented on the picture by asking them to name all items.

Name	<i>French Learners Audio Corpus of German Speech (FLACGS)</i>	
Language	German	
Speakers	40 speakers (20 male and 20 female) <ul style="list-style-type: none"> • 20 L1 German • 20 L1 French, L2 German (Level of competence: A2-C2) 	
Volume	ca. 30 h of speech (ca. 15h & ca. 15h)	(35 250 words)
Content	<ul style="list-style-type: none"> • repeated (55 words) • read (347 words) sem • semi-spontaneous speech (49 - 239 words) 	
Transcription	manual using the German orthography	
Alignment	MAUS-webservice (automatic) and manual checking	

Table 1. Summary of the FLACGS-corpus

Methods

Transcription and Alignment

First, manual checking and potential corrections, if necessary, of the orthographical text of both the repeated and read material was carried out. A manual orthographical transcription of the spontaneous speech part (description task) was realized. Transcriptions included spontaneous speech specific events such as hesitations, disfluencies and false starts.

Second, the MAUS-webservice (Munich AUtomatic Segmentation - web service, Schiel, (1999); Kisler, Schiel, Sloetjes (2012); <https://clarin.phonetik.uni-muenchen.de/BASWebServices/#/services>) performed the alignment of the speech signal with its transcription. The MAUS aligner generates a TextGrid-file that can be opened with Praat (Boersma, Weenink 2001). Transcription checking is almost real-time whereas the manual transcription of the spontaneous speech took about 3 minutes for 1 minute of recordings. MAUS needs these orthographic transcriptions to segment the speech signal.

Third the TextGrid files generated by MAUS were checked. They comprise three tiers corresponding to three segmentation or annotation levels: the orthographic word, the canonical pronunciation of the word (phonemic level) and the aligned phones (phonetic level). The automatic alignment of each sound-file was checked manually for boundaries and labelling. Phone boundaries of targeted words were manually corrected if necessary. We also checked some pronunciations, for instance when MAUS had to perform a grapheme-to-phoneme conversion for words that were not included in its dictionary. Performing those adjustments took about 2min for 1min of automatically aligned speech.

Acoustic analysis

Acoustic parameters were measured using Praat scripts. The first four formants, energy, intensity

and voicing rate were extracted from the sound files for each phoneme. The TextGrid file provides information about segmental durations.

The short and long vowel contrast as well as the presence of /h/ onsets only required information on segment duration that could be extracted from the TextGrids.

Results

Short and long vowels

German natives produce the phonologically short and long vowels in minimal pairs by acoustic duration (and vocalic timbre, i.e. formants differences). In French, this duration contrast is absent. We want to investigate whether GG speaker make duration distinctions for all vowel pairs and whether duration distinction is better for some vowel pairs than others. We also are interested in knowing whether FG speakers are able to make duration distinctions and what the impact of the different tasks would be.

Duration contrast of vowels across tasks

In figure 2, mean vowel duration in milliseconds for the short-long vowel pairs /ɪ/-/i:/, /ʏ/-/y:/, /a/-/a:/ and /ɔ/-/o:/ for both participants groups are plotted.

In the repetition task, the FG are quite successful in imitating GG speakers' duration oppositions. FG produce vowels with in general longer durations compared to the GG vowels. The central open long vowel /a:/ and the half-open back vowel /ɔ/ are an exceptions to that observation. In both participants groups, GG and FG, statistical significant duration differences are made for all short-long vowel pairs that occurred during the repetition task.

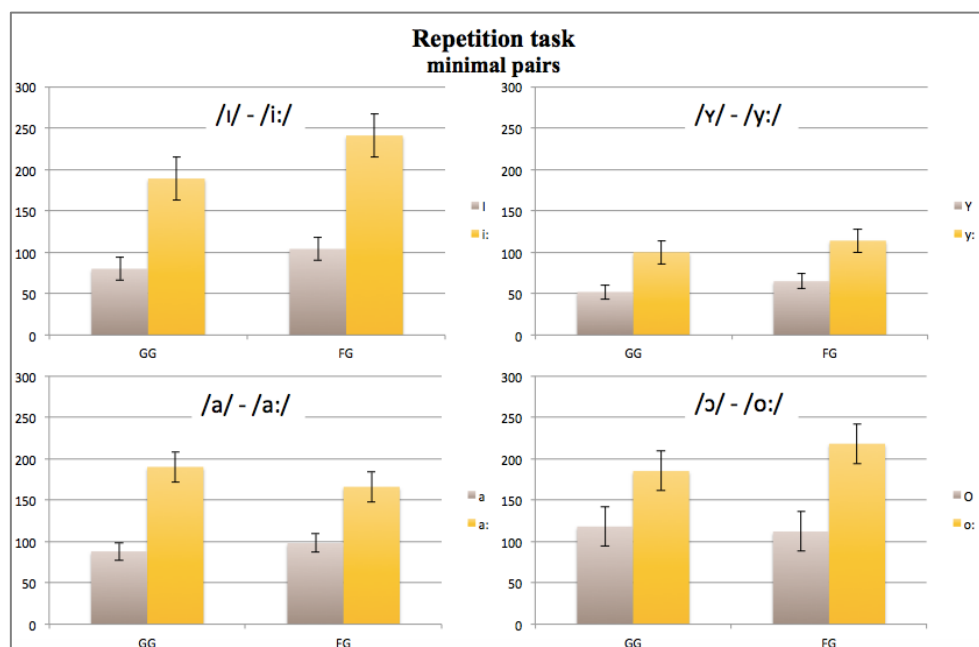


Figure 2. Vowel duration in stressed word positions in milliseconds, repetition task

In the reading task (e.g. figure 3), statistical significant differences are made by the FG for all long-short vowel pairs except the /a/-/a:/ contrast. The /ɔ/-/o:/ contrast regarding the duration pattern is better performed by the FG during reading.

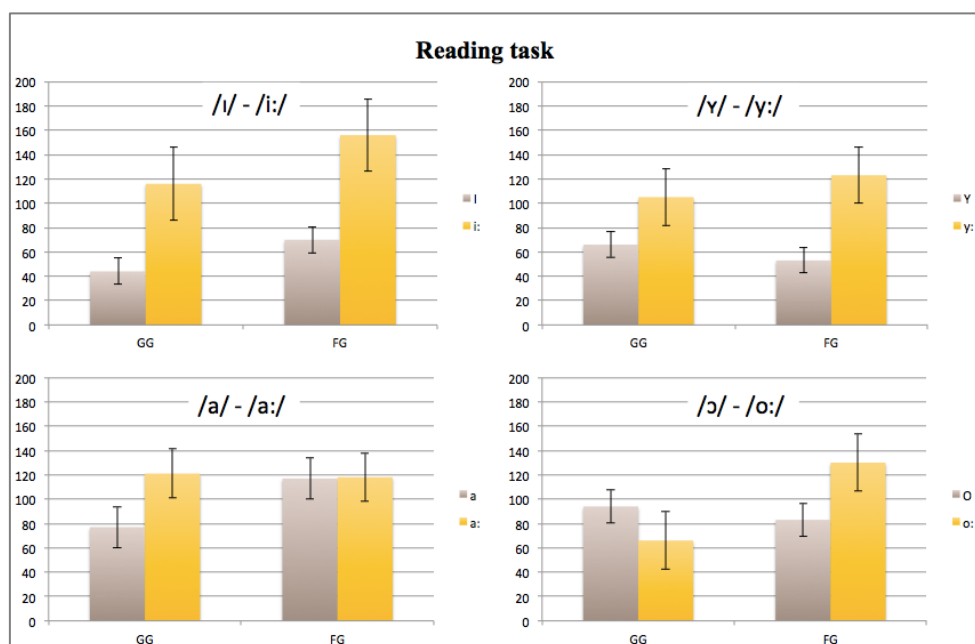


Figure 3. Vowel duration in stressed word positions in milliseconds, reading task

/h/ onset

In German, /h/ onsets exist frequently and minimal pairs between /h/ onsets and /ʔ/ onsets exist: *Haus* /haʊs/ versus *aus* /ʔaʊs/. The French language does not have a phonological /h/. That is why they tend to omit /h/-onsets in foreign languages they might learn.

We predict that FG will replace /h/ onsets with empty onsets or with /ʔ/ onsets. We also think that /h/ onsets produced by the FG should have a shorter duration than those produced by GG. And finally, global /h/ onset production should decrease as the production tasks gets more complex.

/h/-onset across tasks

Table 2 recapitulates all possible /h/ onsets and their realization by FG. First, we observe that /h/ onset production decreases with increasing complexity of the production task. Still, a surprisingly high number of /h/ onsets are actually produced by FG: at least three out of four for the most complex task, the picture description.

Furthermore, Table 2 confirms that /h/ onsets are more likely to be replaced by empty onsets than glottal stops except for the reading task where FG produced one out of five /h/ onsets as a glottal stop.

	Repetition task	Reading task	Picture description
[h] onset	85%	78%	75%
[ʔ] onset	1%	20%	9%
Empty onset	14%	2%	16%
Tokens	77	104	71

Table 2. /h/ onset realisations ([h], [ʔ], empty) across the three different tasks in FG speakers

The figures 4, 5 and 6 present the produced /h/ onsets by the FG and their duration in milliseconds. For the repetition task again, FG behave like GG when they produce the /h/ onset. There is no statistical difference of /h/ onset duration between GG and FG (e.g. figure 4).

In the reading task, represented in figure 5, FG produce significant longer /h/ onsets for most vowel contexts except in the right context of rounded vowels.

Regarding the picture description, /h/ onsets produced by FG are globally longer than those produced by GG. The word *Hunden* is an exception to that trend. *Hunden* presents a complex morphology: stem+plural+dative. FG who use such complex words are very proficient in German. They are more likely to adjust their production to the native model.

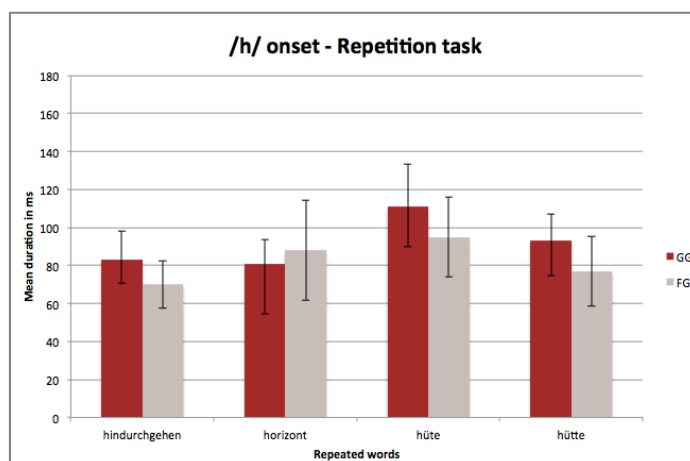


Figure 4. Duration (in ms) of /h/ onset, repetition task

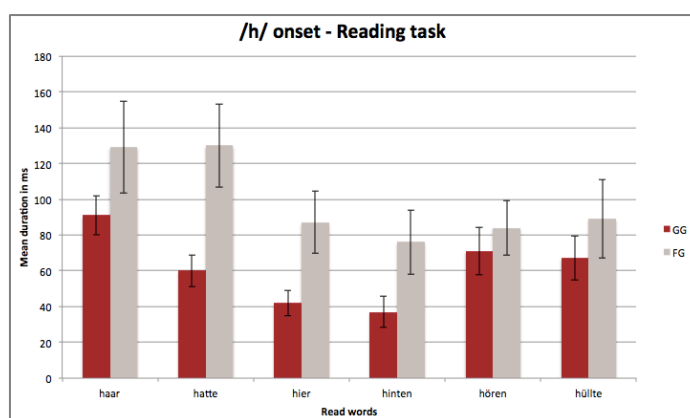


Figure 5. Duration (in ms) of /h/ onset, reading task

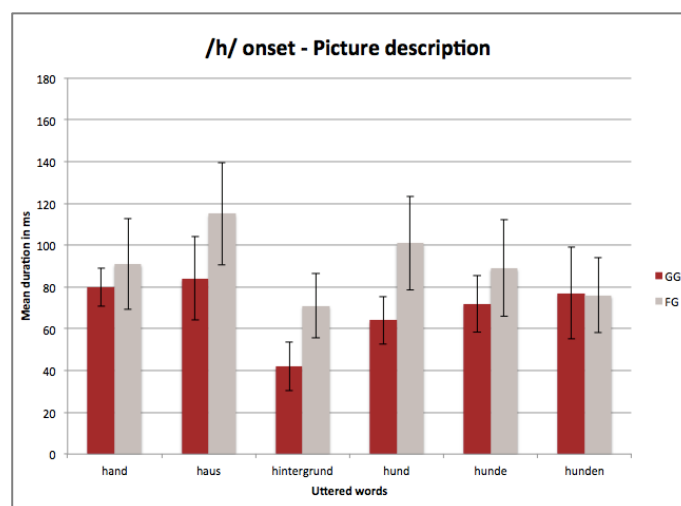


Figure 6. Duration (in ms) of /h/ onset, picture description

Discussion

Short and long vowels

For the short and long vowel opposition, GG and FG make a duration opposition in both repetition and reading task. The picture description was not included in the analysis because not enough words with long and short vowels in stressed positions were produced. This result shows that FG are sensitive to duration variations in vowels even if this contrast has no phonological value in French.

In the repetition task, FG behave native-like in contrasting minimal pairs. This result suggests that FG can perceive vowel duration and can repeat the pattern in their oral production. However, being able to reproduce vowel quantity patterns does not automatically mean that FG have contrastive perception of vowel quantity. Especially for minimal pair production, a great number of participants thought they produced the same word twice.

Regarding the reading task, FG realized vowel quantity surprisingly well. That could be due to orthographic cues. In German orthography short vowels are often followed by a double consonant e.g. *sollte* and long vowels are often followed by a graphic <h> (Dehnungs-h) e.g. *früh*. On one hand, the /ɔ/ - /o:/ contrast regarding the duration pattern is better performed by the FG than the GG. This vowel contrast does exist in French, which could explain the better performance of the FG. It is also possible that FG overgeneralized the short-long vowel pattern, as lax vowels tend to be shorter than tense vowels. Vowel duration can be influenced by the words' sentence position. This criterion could explain why the production of GGs' short vowel /ɔ/ is longer than their production of the long vowel /o:/. On the other hand, FG do not produce any difference in vowel quantity for the vowel pair /a/ - /a:/. Both vowels match the mean duration of GGs' /a:/. Compared to the other three vowel pairs, in the reading task, FG produced the /a/ - /a:/ pair shorter than the other long vowels but longer than the other short vowels. French learners of German might only have one /a/-sound they can produce without any auditory input. That could explain why the duration for /a/ - /a:/ is not clearly associated to the short-long vowel duration pattern.

/h/ onset

At least three out of four /h/ onsets are produced by FG. If /h/ onsets are not produced, they are mostly replaced by empty onsets except in reading. In reading, almost all unrealized /h/ onsets are replaced by glottal stops rather than empty onsets. The glottal stop can be due to cognitive efforts towards orthographic decoding. First, the graphic representation <h> could trigger an onset production instead of leaving it empty. Second, as the /h/ phoneme does not exist in French. FG

speakers may put a lot of effort to produce this glottal fricative. The production effort, if not successful, could result in a glottal stop. Both explanations relate to the conflicting orthographic conventions with respect to <h>, which is known to be pronounced /h/ in German but not in French.

Empty onsets that are produced in the repetition task and during the picture description concern about 15% of the uttered words with an expected /h/ onset. This result suggests that the production of empty onsets instead of /h/ onsets is not linked to the orthography. Both, the repetition task and the picture description furnished no written input at all.

When producing /h/ onsets, FG speakers tend to emphasize their durations as compared to those produced by GG in both the reading and the picture description tasks.

Conclusions

A corpus of non-native German speech by French natives was recorded. Participants had to perform three different tasks of increasing production complexity. Our results show that segmental difficulties are task related.

FG are able to produce duration contrasts that are not phonological in French in the repetition and the reading task except for the /a-/a:/ pair in reading. The picture description was not taken into account for the vowel quantity contrast because of its limited number of tokens with short and long vowels. FGs' ability of vowel production does not allow us to conclude about their contrastive vowel perception. To investigate whether FG contrastively distinguish between short and long vowels a perception test has to be performed.

Regarding /h/ onsets, a surprisingly high number of /h/ onsets is produced as actual [h] onsets across all three tasks. Except in the reading task, /h/ onsets are more likely to be replaced by empty onsets than by glottal stops. FG tend to exaggerate /h/ onset durations. These information indicate that FG are well aware of the difficulties they have in producing /h/ onsets.

Across the tasks, French learners of German behave native-like for the vowel quantity contrast and the /h/ onset in the repetition task. This result suggests that French learners of German perceive well vowel quantity and /h/ onsets. The *French Learners Audio Corpus of German Speech* is not a resource that allows us by itself to conclude whether the participants have achieved contrastive perception of the vowel quantity contrast or the /h/ onset.

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