

PROSODIC AND SYNTACTIC PROPERTIES OF FRENCH INTERROGATIVES: A CORPUS STUDY

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1. INTRODUCTION

There are at least three types of languages when it comes to the formation of *wh*-interrogative sentences (see Cheng, 2003, for a more detailed presentation).

The first type of language is one that exhibits compulsory fronting of the *wh*-element.¹ English is such a language, as shown by the examples in (1). (1a) with a fronted *wh*- is a valid sentence of English, whereas the sentence in (1b) with a *wh-in-situ* cannot be uttered as an information-seeking question (it could be if it were an *echo* question).

- (1) a. Who are you inviting for the fondue tonight?
b. * You are inviting who for the fondue tonight?

Another type of language is one where every *wh*-element appears *in situ*, staying in their canonical A-position. Mandarin Chinese is such a language, as shown by the difference of grammaticality between the sentences in (2). In (2a), moving the *wh*-element results in ungrammaticality, while in (2b) leaving this same element *in situ* is valid.

- (2) a. * Shui ni jin wan yao qing chi zhi shi huo guo?
who you tonight invite eat cheese hot pot
b. Ni jin wan yao qing shui chi zhi shi huo guo?
You tonight invite who eat cheese hot pot
'Who are you inviting for the fondue tonight?'

The third type of language is in some sense a “mixed” language concerning the formation of *wh*-questions, since it displays properties of both English-type and Chinese-type languages. This is the case for the language studied in this paper, namely French.² In French, the interrogative *wh*-element can either be fronted (*wh-ex-situ*) or stay *in situ*, as exemplified

¹ I am only considering simple *wh*-questions, as *in situ* is possible in multiple *wh*-questions in English.

² In the literature on French *wh*-interrogatives, a lot of disagreement on the empirical data can be found, which suggests that different varieties of French might have different properties with regards to this phenomenon. In this paper, I will focus on what has been referred to by Baunaz (2011) as *non-standard colloquial* French, since her description of the data is the one which is most compatible with my own judgments. However, I do not believe that the properties described in this paper are only representing a specific dialect of French, but are common to French spoken in France, Belgium and Switzerland in general.

by (3), with (3a) being a *wh-ex-situ* sentence where the *wh*-element has been fronted, and (3b) being a *wh-in-situ* sentence.^{3,4}

- (3) a. Qui tu vas inviter pour la fondue ce soir ?
 Who you go-2SG invite for the fondue this evening
 ‘Who are you inviting for the fondue tonight?’
 b. Tu vas inviter qui pour la fondue ce soir ?
 you go-2SG invite who for the fondue this evening

French is the most peculiar type of language since it apparently allows *optionality* of *wh*-movement. Optionality has been argued not to be a desirable property in the most recent developments of generative syntax (*the Minimalist Program*, MP, Chomsky, 1995), since narrow syntax is not considered to be the locus of variation (for a competing view, see Biberauer and Richards, 2006). In MP, Optionality should be delegated to external systems (Sensory-Motor and Conceptual-Inferential systems, the outputs of PF and LF, respectively), and to be only apparent. Several scholars have attempted to explain the French paradigm of *wh*-interrogatives by means of optionality in external systems (Chang, 1997; Boeckx, 1999; Cheng & Rooryck, 2000; Bošković, 2000; Mathieu, 2004; Baunaz 2011, 2016; Richards 2010, 2016; a.o.). They all claim that optionality is only apparent since French *wh-in-situ* structures display different syntactic, semantic or phonological properties than its fronted counterpart.

In this paper, I mainly consider the theory presented by Cheng and Rooryck (2000) (henceforth CR). They examine the phenomenon of French optional *wh-in-situ* from the perspective of the syntax-prosody interface. As I show in section 2.1, CR claim that *ex situ wh*-interrogatives have a different prosody from interrogatives in which the *wh*-element stays *in situ*.

The goal of this paper is to test the hypothesis put forth by CR. I discuss their empirical predictions, which appear to generate ungrammatical sentences of French. This contribution will also show that the fact that generalizations about *wh*-interrogatives in French are different and not compatible across studies reveals that there is a strong need for a better empirical understanding of data before theorizing.

In the following sections, I first present the theory developed by CR. Next, I summarize the results obtained by Déprez and her colleagues (Déprez et al., 2012, 2013) which support CR’s original hypothesis. The last section of the paper presents a novel study, similar to the one conducted by Déprez et al. but based on new data extracted from a French spoken corpus. The results of this new study differ from those of Déprez et al., and challenge CR’s original hypothesis that French *wh-in-situ* is licensed by a morpheme realized with a specific prosody.

2. THEORETICAL BACKGROUND

2.1. The syntax-prosody system of Cheng & Rooryck (2000)

CR propose an account for *wh-in-situ* in French that is situated at the syntax-phonology interface. CR claim that “one distinct characteristic of French *in situ wh*-questions is the intonation” (Cheng & Rooryck, 2000:5). They present in their paper how the optionality of

³ It should be noted that (3b) can also be interpreted as an *echo* question. Throughout this paper, I will not consider echo questions, unless mentioned.

⁴ It does not seem to me that one of the options is more marked than the other, both could be used in the same context in everyday speech.

wh-movement in French can be explained by positing the existence of an intonational morpheme, which licenses *wh-in-situ* as well as yes-no interrogative sentences.

A ‘total’ *wh-in-situ* language like Mandarin Chinese possesses a special *wh*-particle (*ne*) whose goal is to check the Q-feature in C^0 , and thus allows the *wh*-element (*shenme*) to stay *in situ*, as shown by (4).

- (4) Hufei mai-le *shenme* (*ne*) ?
 Hufei buy-PERF what PRT
 ‘What did Hufei buy?’

French apparently lacks this type of *wh*-particle. Consequently, CR’s research question is the following: which element in French checks the Q-feature of C^0 , allowing the *wh*-element to stay *in situ*? This question originates from the Clausal Typing Hypothesis (CTH, proposed by Cheng, 1991), which states that languages must syntactically mark (or “type”) a *wh*-question. This can be done with either *wh*-movement or with the insertion of a question particle.

CR observe that different types of questions in French exhibit different intonational contours. They argue that in French, *wh-ex-situ* questions (with or without “*est-ce que*” or complex inversion) involve a non-rising intonation. On the other hand, yes-no questions can be identical to declarative sentences in their linear-ordering of words, but they are marked phonologically in exhibiting a *final rising intonation*. According to the authors, the questions in (5) should be pronounced with a non-rising intonation, or else they will become ungrammatical. The yes-no question in (6) has to be pronounced with a final rising intonation (indicated with an upward arrow), else it will be perceived as a declarative sentence.

- (5) a. Quel livre est-ce que Jean a acheté ?
 which book EST-CE-QUE Jean has bought
 ‘Which book did John buy?’
 b. Quel livre Jean a-t-il acheté ?
 which book Jean has-T-he bought
 ‘Which book did John buy?’
- (6) Jean a acheté un livre ↗ ?
 Jean has bought a book
 ‘Did John buy a book?’

Concerning *wh-in-situ* sentences, CR claim that a question such as (7) also exhibits a final rising contour, identical to the one in yes-no questions.

- (7) Jean a acheté quoi ↗ ?
 John has bought what
 ‘What did John buy?’

CR are making the following generalization: *wh-in-situ* and yes-no questions pattern together with regards to their final intonation – a rising contour. On the other hand, *wh-ex-situ* questions have another type of final contour (non-rising).

CR claim that the equivalent of the Mandarin Chinese Q-particle for French is a special morpheme of intonation, that appears both with yes-no and *wh-in-situ* questions. This intonational Q-morpheme can be inserted in the structure during the derivation, and will be realized at PF as a final rising contour. This morpheme will also assume the role of checker

for C^0 , while the *wh*-element can stay in situ. In the case of *wh-ex-situ* questions, the checking of C^0 is done by overt movement of the *wh*-element. Therefore, CR assume that the intonation morpheme is not present in *wh-ex-situ* questions. In other words, *wh*-fronting and the presence of the intonational Q-morpheme are in *complementary distribution*.

2.1.1 *Checking and specification of the Q-feature*

In CR's system, two lexical items are capable of checking the strong [+*wh*-] feature on C^0 : the intonational Q-morpheme, and the *wh*-element when it is moved to SpecCP. CR add to their system the idea of specification: the Q-feature in C^0 can be specified or underspecified. When the Q-feature is specified, it is either specified as [Q: yes-no] or as [Q: *wh*-]. At LF, for interpretation purposes the Q-feature must be specified, however it enters the derivation underspecified.

Concerning yes-no questions, nothing will specify the Q-feature during the derivation. The intonational Q-morpheme checks the Q-feature, but does not specify it. However, the underspecification of the Q-feature needs to be resolved, and thus CR propose that at LF, the Q-feature is set by default as [Q: yes-no].

In the case of *wh-ex-situ* questions, the movement of the *wh*-element not only checks the Q-feature, but it also specifies it as [Q: *wh*-]. At LF, the Q-feature signals that the sentence must be interpreted as a *wh*-question. If nothing is added to the system, the derivation will crash when it comes to *wh-in-situ* questions. As a matter of fact, the intonational Q-morpheme present in this type of questions will check the Q-feature in C^0 , yet it does not specify this Q-feature. If nothing is done, the structure is sent to LF where the Q-feature will be set by default as [Q: yes-no]. This would be problematic, since a *wh-in-situ* question cannot be interpreted as a yes-no question. Therefore, CR propose that the underspecification of Q can be resolved by movement of the *wh*-features present on the *wh*-element. Feature movement will specify the value of the Q-feature as [Q: *wh*-], and will happen only at LF. Feature movement is not akin to phrasal movement: in the former the *wh*-element itself is not moved and stays *in situ*, while in the latter this very same element is overtly fronted.

Concerning the marker “*est-ce que*”, CR do not assign it a special role for the licensing of *wh*- or yes-no questions. On the other hand, the authors claim that “*est-ce que*” is merely an instantiation of the Q-feature present in C^0 (Cheng & Rooryck, 2000:10). Its presence will neither check nor specify the Q-feature.

2.1.2 *Wh-in-situ as a root phenomenon*

The last part of CR's system that I will introduce concerns the status of the Q-morpheme. The authors agree with Chang (1997) and Bošković (2000) in that *wh-in-situ* cannot appear in embedded declaratives (8a), or in indirect questions (8b).

- (8) a. * Marie pense que Jean a acheté quoi ?
 Marie thinks that Jean has bought what
 b. * Je me demande (que) Jean a acheté quoi ?
 I CL-1SG wonder that Jean has bought what

According to CR, this is expected considering that the intonational Q-morpheme is a root morpheme, which only appears in matrix clauses and has only matrix scope.

2.1.3 Different strategies of question formation

From the system presented by CR, it can be shown that there are five different grammatical possibilities for the formation of questions in French (from Déprez et al., 2013:7):

1. The strong [+wh-] Q-feature realized at PF as “*est-ce que*”, not specified in C⁰, checked and specified as [Q: wh-] before Spell-Out via wh-movement (cf. (9)).

- (9) Quel élément est-ce qu'elle a mis au milieu ?
 which element EST-CE-QUE-she has put at the middle
 ‘Which element did she put in the middle?’

2. The strong [+wh-] Q-feature realized at PF as “*est-ce que*”, not specified in C⁰, checked before Spell-Out via the insertion of the intonational Q-morpheme to C⁰, and specified at LF by default as [Q: y/n] (cf. (10)).

- (10) Est-ce qu'elle a mis cet élément au milieu ?
 EST-CE-QUE-she has put this element at the middle
 ‘Did she put this element in the middle?’

3. The strong [+wh-] Q-feature in C⁰, checked and specified as [Q: wh-] at Spell-Out via wh-movement (cf. (11)).

- (11) Quel élément elle a mis au milieu ?
 which element she has put at the middle
 ‘Which element did she put in the middle?’

4. The strong [+wh-] Q-feature in C⁰, checked before Spell-Out via the insertion of the intonational Q-morpheme to C⁰, and specified at LF by default as [Q: y/n] (cf. (12)).

- (12) Elle a mis cet élément au milieu ?
 she has put this element at the middle
 ‘Did she put this element in the middle?’

5. The strong [+wh-] Q-feature in C⁰, checked before Spell-Out via the insertion of the intonational Q-morpheme to C⁰, and specified at LF as [Q: wh-] via movement of the features on the wh-element *in situ* (cf. (13)).

- (13) Elle a mis quel élément au milieu ?
 she has put which element at the middle
 ‘Which element did she put in the middle?’

These five possibilities are all attested in CR’s system. However, next section shows that other options that are not actually grammatical in French can be generated by CR’s theory.

2.1.4 Empirical coverage in CR’s system

In this section, I discuss two problems of over-generation created by CR’s system, as well as the status of long-distance questions.

In sentence (14), the wh-element is moved, and inversion takes place between the clitic-subject and the auxiliary.

- (14) Quel livre as-tu lu ?
 which book have-you read

This sentence is a well-formed question in French, and CR's system is able to generate it via *wh*-movement: the movement allows the Q-feature to be both checked and specified as [Q: *wh*-]. Since the Q-feature cannot be checked or specified twice, it can be inferred that subject-auxiliary inversion does not play any role for checking or specifying the Q-feature in CR's theory. However, it is important to notice that the sentence in (15) – with subject-auxiliary inversion and *wh-in-situ* – is completely unacceptable as an information-seeking question in French.⁵

- (15) * As-tu lu quel livre ?
 have-you read which book

Nonetheless, CR's system will generate such a sentence: the intonational Q-morpheme can be adjoined to C^0 to check the Q-feature, and the *wh*-features present on the *wh*-element can move at LF to specify the Q-feature as [Q: *wh*-]. Subject-auxiliary inversion does not play any role in checking or specifying the Q-feature.

The second wrong prediction made by CR's theory concerns the presence of the marker “*est-ce que*”. Consider the ungrammaticality of the sentence in (16).

- (16) * Est-ce que tu as vu qui ?
 EST-CE-QUE you have seen who

The impossibility of having both “*est-ce que*” and a *wh*-element *in situ* is challenging for CR. If “*est-ce que*” is only an instantiation of the Q-feature – as they claim – nothing prevents the adjunction of the intonational Q-morpheme to it. In this case, the Q-feature will be checked by the Q-morpheme, and the Q-feature can also be specified as [Q: *wh*-] by LF-movement of the features on the *wh*-element. In other words: “*est-ce que*” does not participate in the checking or specification of the Q-feature, and should not prevent a *wh*-element to stay *in situ* in CR's system. It would be expected that the question in (16) is a valid sentence of French, but this is not the case.

Notice that CR are aware that a sentence like the one in (16) is ungrammatical in French. They even claim that “‘*est-ce que*’ triggers overt movement of *wh*-elements while the intonation morpheme does not” and that “nothing prevents *est-ce que* from co-occurring with the intonation morpheme in C^0 ” (Cheng & Rooryck, 2000:8-9). However, I do not picture any way for CR's system to prevent the syntax to be able to generate a sentence such as the one in (16).

From what I've just shown, it seems that in addition to the five grammatical cases presented in section 2.1.3, CR's system is also able to generate two non-grammatical types of sentences:

6. Subject-auxiliary inversion + the strong [+*wh*-] Q-feature in C^0 , checked before Spell-Out via the insertion of the intonational Q-morpheme to C^0 , and specified at LF as [Q: *wh*-] via movement of the features on the *wh*-element *in situ* (cf. (15)).

⁵ Even under an echo interpretation, this type of question does not seem to be acceptable.

7. The strong [+*wh*-] Q-feature realized at PF as “*est-ce que*”, not specified in C⁰, checked before Spell-Out via the insertion of the intonational Q-morpheme to C⁰, and specified at LF as [Q: *wh*-] via movement of the features on the *wh*-element *in situ* (cf. (16)).

Another problem for CR concerns the status of long-distance questions. Let me recall the reader that CR claim that *wh-in-situ* is not licensed in long-distance contexts such as embedded declaratives or indirect questions (see section 2.1.2). This allows them to postulate that the Q-morpheme is a root morpheme only, and that it cannot license *in situ wh*-elements inside an embedded clause. I go against this generalization, and claim that a sentence such as the one in (17a, corresponding to 8a above) is grammatical, but agree with CR saying that an indirect question (17b, 8b above) is ungrammatical.

- (17) a. Marie pense que Jean a acheté quoi ?
 Marie thinks that Jean has bought what
 b. * Je me demande (que) Jean a acheté quoi ?
 I CL-1SG wonder that Jean has bought what

My judgment was confirmed by a web-based acceptability judgment task (Tual, 2017) that showed that sentences corresponding to (17a) are given significantly higher scores by participants than sentences corresponding to (17b). Since both sentences do not have the same grammatical status, it appears that CR’s system is not compatible with this empirical fact. However, I will not go into details of this issue here for reasons of space.

To conclude this first section, I showed that although CR’s system is appealing, it is also problematic for at least two reasons: there is a problem of over-generalization, and the system predicts some grammatical sentences not to be. A more important matter concerns the main part of the system: does the generalization posited by CR about the PF realization of *in situ* and *ex situ wh*-questions hold? In the next section I discuss an experimental study carried out by Déprez et al. (2012, 2013) whose goal was to test CR’s prosodic generalization.

2.2 Syntax and Prosody - Déprez et al. (2012, 2013)

In this second section, I present the experimental findings of Déprez et al. developed in two papers (Déprez et al., 2012, 2013). The researchers’ goal was to test CR’s theoretical hypothesis (reported in section 1.2).

From the discussion of CR in section 1.2, recall that the intonational Q-morpheme and *wh*-fronted elements are in complementary distribution. When the intonational Q-morpheme is present in the structure, the final intonation of the sentence will be rising. On the other hand, when a *wh*-element appears in an *ex situ* position, the final intonation of the sentence will be non-rising. Déprez et al. designed a production experiment to test this specific hypothesis proposed by CR.

Déprez et al. remark that the proposal put forth by CR provides a hypothesis that is easily testable in an experimental study. The obligatory character of the rising contour of French *wh-in-situ* questions has already been questioned in the literature (see Adli (2004, 2006)). However, Déprez et al. claim that these studies did not present a clear picture of the intonation of *wh-in-situ* questions.

2.2.1 Methodology and design

The stimuli chosen by the researchers represented 7 different conditions: declarative sentences as in (18); yes-no questions with “*est-ce que*” (19); yes-no questions without “*est-ce que*” (20); *wh-in-situ* questions without echo interpretation (21); *wh-in-situ* questions with echo interpretation (22); *wh-ex-situ* questions with “*est-ce que*” (23); and *wh-ex-situ* questions with subject-auxiliary inversion (24).

- (18) Elle a mis cet élément au milieu.
she has put this element at the middle
‘She put this element in the middle.’
- (19) Est-ce qu’elle a mis cet élément au milieu ?
EST-CE-QUE-she has put this element at the middle
‘Did she put that element in the middle?’
- (20) Elle a mis cet élément au milieu ?
she has put this element at the middle
‘Did she put that element in the middle?’
- (21) Elle a mis quel élément au milieu ?
she has put which element at the middle
‘Which element did she put in the middle?’
- (22) Elle a mis QUEL élément au milieu ?
she has put which element at the middle
‘She has put WHICH element in the middle?’
- (23) Quel élément est-ce qu’elle a mis au milieu ?
which element EST-CE-QUE-she has put at the middle
‘Which element did she put in the middle?’
- (24) Quel élément a-t-elle mis au milieu ?
which element has-T-she put at the middle
‘Which element did she put in the middle?’

All sentences were included in specific discourse contexts created by the experimenters. A discourse context was indeed necessary to distinguish between *in situ* echo questions as in (22) and *in situ* non-echo questions as in (21), since the stimuli for these two types of sentences are completely alike in the experiment. Five different discourse contexts were used, each with the seven conditions for a total of 35 items. 12 participants (5F, 7M) from France and Switzerland participated in the experiment. They were asked to read the sentences appearing on a computer screen, and their utterances were recorded. After the recording procedure, the researchers performed two different analyses:

- Three research assistants were assigned the task of reviewing the final contour they perceived for each sentence; either as falling or as rising.
- An acoustic analysis of the contours was also performed.

2.2.2 Déprez et al.'s predictions

Déprez et al. made the following predictions concerning their experiment whose goal was testing CR's hypothesis:

- Yes-no (with or without “*est-ce que*”) and *wh-in-situ* questions should always be realized with a final rising contour, because of the presence of the intonational Q-morpheme.
- Declarative sentences should not exhibit a final rise, given the absence of the intonational Q-morpheme.
- Concerning *wh-ex-situ* questions, Déprez et al. strongly expected that they will show a falling contour, given the absence of the intonational Q-morpheme in this type of questions (see also the results of Beyssade et al. (2007)).

2.2.3 Déprez et al.'s results

Concerning the perception of sentence-final fall or rise by the research assistants, the researchers found that:

- declarative sentences were almost never perceived with a final rise, as it was expected.
- yes-no questions (with or without “*est-ce que*”) were almost all the time perceived with a final rising intonation, which was also expected.
- *wh-ex-situ* questions were generally associated with a falling contour.

For *wh-in-situ* questions, Déprez et al. found that most of them were pronounced with a final rise, according to what was perceived by the assistants. However, the percentage of *in situ* sentences where a final rise was perceived (around 75%) was significantly lower than the percentage of yes-no questions with a final rising contour (almost 100%). This is not expected under CR's theory: since both yes-no and *wh-in-situ* questions are supposedly licensed by the same morpheme, therefore they should exhibit a similar final contour. Moreover, the researchers remarked that there were actually two groups of speakers when it came to the prosody of *wh-in-situ* question:

- The first group (3 speakers) produced a sentence final rise in *wh-in-situ* sentences only 25% of the time.
- The second group (9 speakers) assigned a final rising contour to *wh-in-situ* questions almost 100% of the time.

According to the researchers, these results provide support for CR's hypothesis, only taking into account the utterances of the second group. However, the fact that 3 speakers realized most of their *wh-in-situ* questions without a final rising intonation might challenge CR's model.

The acoustic analysis of the contours revealed that speakers of the first group assigned a more prominent pitch accent on the *wh*-element *in situ* than the speakers of the second group (see Fig. 1). Moreover, Déprez et al. reported a negative correlation between the height of the pitch accent on the *wh*-element and the presence and height of the final rising contour. The last important finding of Déprez et al. was that the final rises in *wh-in-situ* questions appeared systematically more compressed than those in yes-no questions.

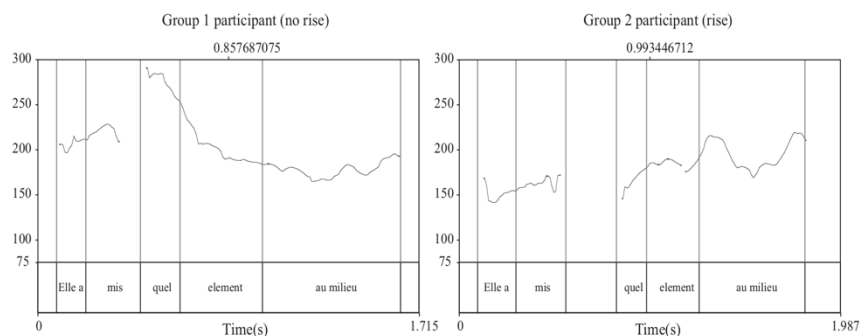


Figure 1: Example of the intonation contour from two participants (one from Group 1 and one from Group 2) for the *wh-in-situ* sentence “Elle a mis quel élément au milieu ?” (‘Which element did she put in the middle?’) (from Déprez et al. 2013:13)

2.2.4 Discussion of Déprez et al. ’s findings

According to Déprez et al., their results globally provide support for the theory developed by CR. They need to propose further explanation with regards to the detailed results. At the end of their study, Déprez et al. provide three possible explanations to account for the two following facts:

- that not all of the speakers produced a final rising intonation contours with *wh-in-situ* questions;
- and that there is a correlation between the amount of rising in the final contour and the presence of a pitch accent on the *wh*-element for the *in situ* interrogative sentences.

They interpret these results in these three possible ways:

1. A phonetic/phonological explanation: the intonational Q-morpheme proposed by CR is realized as a high tone (H), but is underspecified regarding its docking site. It can be realized either as a H* (pitch accent) on the *wh*-element, or as a H% (boundary tone), in this case only the final part of the utterance will be rising.
2. An explanation based on a theory of information structure and the notion of givenness: The authors follow Hamlaoui (2011), who claims that in a *wh-in-situ* question, the *wh*-element receives narrow focus, while the other parts of the sentence are given. For the prosody of the sentence, this can be the case that the *wh*-element will receive a H* because of its “not-given” status, while the given information will be deaccented. The difference between the two groups of speakers can be accounted for by a difference in the height of the H* on the *wh*-element, and the level of deaccenting of the rest of the sentence. Pitch compression would be more effective for participants of group 1, since they produced very prominent pitch accents on *wh*-elements *in situ*. In other words, the realization of the intonational Q-morpheme would be leveled because of the presence of a high pitch accent on the *wh*-element. For participants of group 2, the realization of the intonational Q-morpheme was more “visible” because the pitch accent on the *wh*-element was not very prominent.
3. The third possibility raised by the authors is that the intonational Q-morpheme found in *wh-in-situ* questions and yes-no questions should actually be considered as two different morphemes, with different phonological realizations. However, Déprez et al. reject immediately this hypothesis stating that they “find this possibility to be

unparsimonious and uninteresting from a theoretical perspective, and therefore leave it aside” (Déprez et al., 2012, p.24).

To summarize section 2.2: Déprez et al. claim that the results obtained after their experimental study provide at least partial support for CR’s hypothesis that *wh-in-situ* and yes-no questions are licensed by the same intonational Q-morpheme. However, they had to refine the hypothesis of CR concerning the phonological realization of the Q-morpheme to take into account the variations found in the speakers’ productions.

3. CORPUS STUDY

The third and last section of the paper is devoted to the presentation of a corpus study that I conducted. The goal is to understand better the syntactic and prosodic properties of the different types of interrogative sentences in French, and to test CR’s hypothesis with another type of data than the experimental evidence provided by Déprez et al.

The goal was to set up a large oral corpus of French, for two reasons: (i) to gather empirical data to be able to analyze it from a morphosyntactic point of view, and thus make precise generalizations about French interrogatives; (ii) to analyze the intonation patterns of interrogative sentences of French, with non-experimental data. It indeed seems that to have a clear picture of the properties of these types of sentences, it can be very useful to consider spontaneous data produced by French speakers in a non-controlled context.

In this paper, I focus only on the second goal, namely the phonetic analysis that was carried out to understand better the final intonational contours of different types of interrogative sentences in French. The aim was to compare the hypothesis put forth by CR to natural and spontaneous data, contrarily to what was done by Déprez et al. I will show that the results obtained are different from the ones that were found by Déprez et al., and that these results invalidate CR’s theoretical hypothesis.

3.1 Corpus and Methodology

3.1.1 Corpus data

Concerning the choice of the corpus, the interview part of the ESLO corpus was used (Eshkol-Taravella et al., 2011), a corpus of spoken French collected in the Orléans area (central France). The interview section of the corpus was chosen because it contained a good number of questions, due to the type of interaction. It was also found that audio files from this part of the corpus were of higher quality than in other sections, which was needed to perform phonetic analyses.

Text and audio corresponding to every yes-no and *wh*-questions was extracted from the corpus, as well as some declarative sentences. This task was completed via manual annotation of the data. The extracted audio files were then processed via Praat (Boersma and Weenink, 2017) and automatically segmented with the EasyAlign plugin (Goldman, 2011). Only sentences where the quality of the audio recordings was satisfactory enough to perform a phonetic analysis were selected. At the end, 1212 annotated sentences were selected for the study, including:

- 486 declaratives (40%)
- 362 yes-no questions (30%)
- 201 *wh-in-situ* questions (17%)
- 163 *wh-ex-situ* questions (13%)

3.1.2 Methodology

To test CR's hypothesis and the predictions associated to it, mean values of the fundamental frequency (F0, in semitones, $re=100\text{Hz}$) were taken on the last accented vowel (V_0) and the penultimate one (V_1). This was done for each type of sentences.

The idea behind this study was to control the final contour of each sentence. With these two measurements (F0 values on the last accented vowel, and F0 values on the penultimate one), it was possible to compare the final parts of utterances between each type of sentence (declaratives, yes-no questions, *wh-in-situ* questions and *wh-ex-situ* questions). Single values of F0 for the last accented vowel were compared between sentences, as was the difference between F0 values taken on the last vowel and F0 values from the penultimate accented vowel. The F0 difference between the last two vowels is an indication for the direction of the final contour: rising or falling; as well as the degree of rising or falling.

The statistics were developed with the R program (R Core Team, 2017) using multi-level mixed effect regression models and Helmert coding for contrasts in order to test the relationships between the different sentence types and:

- mean F0 values on the last vowel V_0 ($F0_{V_0}$);
- F0 difference between V_0 and V_1 ($F0_{V_0} - F0_{V_1}$), roughly indicating the direction of the final contour of the sentence.

Type of sentences, sex of the speaker and number of syllables were included as fixed-effects, with by-subject random intercepts and slopes.

3.2. Results

3.2.1. Final contours

Among *wh*-questions, there was no significant difference w.r.t. F0 values on V_0 between *in situ* and *ex situ wh*-questions ($p > .05$). F0 values on declarative sentences were not significantly different from those on *wh*-questions either ($p > .05$). Yes-no questions showed significantly higher F0 value on V_0 than *wh*-questions and declaratives altogether ($p < .0001$).

The results are even clearer when it comes to the difference of pitch height between the last two accented vowels ($F0_{V_0} - F0_{V_1}$, see Fig 2). No significant variation was found between *ex situ* and *in situ wh*-questions for the difference between mean F0 values on V_0 and V_1 ($p > .05$). Declarative sentences patterned with *wh*-questions ($p > .05$). Yes-no questions showed a significant increase of F0 on the last vowels w.r.t. the other types of sentences ($p < .0001$).

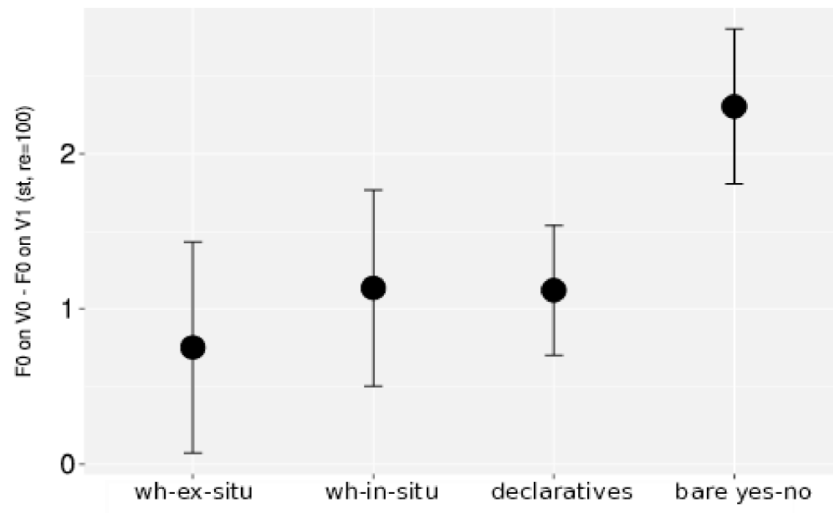


Figure 2: F0 differences between V₀ and V₁ across sentence types.

3.2.2. Correlation

Recall that Déprez et al. reported a negative correlation between the peak on the *in situ wh*-element and the presence and height of the final rising contour. Therefore, I calculated whether a similar correlation could be found in the data. 67 *wh-in-situ* questions where the *wh*-element was non-final were analyzed, and the highest F0 value in the *wh*-region (that will be referred as F0_{wh}) was extracted for each of these sentences. This value was then compared to the F0 difference between the last two vowels (F0_{V0} - F0_{V1}, an indication of the final contour of the sentence).

The results of this second analysis can be found in Fig. 3. No positive nor negative correlation was found between the F0 height on the *wh*-element and the F0 difference between the two last vowels ($p > .05$, $\beta = .12$).

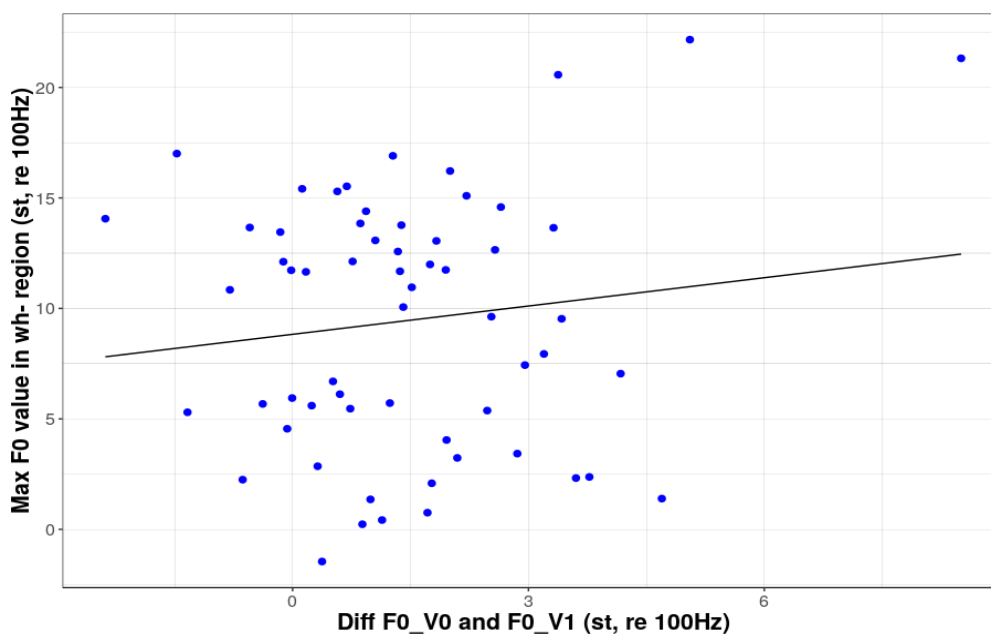


Figure 3: No correlation between F0_{wh} and F0 difference between V₀ and V₁.

3.3 Discussion

The results obtained in this study are not similar to those found in Déprez et al.'s experiment. Moreover, these results invalidate CR's hypothesis:

- There is no difference between *wh-in-situ* and *wh-ex-situ* questions concerning their final contours. *Wh*-questions pattern with declarative sentences, and show:
 - similar mean F0 values on the last vowel;
 - similar values for the difference between F0 on V₀ and F0 on V₁.
- There is a significant difference between yes-no questions, and other type of sentences concerning their final contours. On average, the F0 difference between the last two vowels was greater in yes-no questions than in other sentence types, signaling the presence of a more rising final contour.
- I did not find any correlation between the maximum F0 value in the *wh*-element area and the final contour.

According to CR, *wh-in-situ* should have patterned with yes-no questions, and *wh-ex-situ* questions with declaratives. On the contrary of Déprez et al., in this experimental study no distinct groups of speakers were created to explain a difference between the expected realizations of *wh-in-situ* questions and the actual findings.

The fact that *wh-in-situ* and *wh-ex-situ* questions pattern together does not support CR's claim that the intonational Q-morpheme present in the former is in complementary distribution with the latter type of sentence. Moreover, CR's proposal that *wh-in-situ* and yes-no questions are licensed by the same intonational Q-morpheme is also challenged, since the final contours of these two types of sentences are significantly different in my results.

As for *wh-in-situ* questions only, since there was no negative correlation found between a potential Pitch Accent on the *wh*-element and the presence and height of the final rising contour, my results cannot be explained by one of the solutions proposed by Déprez et al. to reconcile their data with CR's hypothesis. In other words, there is no support in favour of Déprez et al.'s claim that the Q-morpheme can be realized either on the *in situ wh*-element; or as a final rising contour, nor there is support to their solution in terms of givenness and pitch compression (see section 2.2.5).

Concerning the status of declarative sentences, which show a similar final contour than those of *in situ* and *ex situ wh*-questions, this result was not expected. It is possible that the declarative sentences extracted from the corpus show a typical continuation intonation: when the speakers uttered these sentences, they were not finished with what they had to say, and indicate that to their listeners by means of a slightly rising final intonation.

As Déprez et al. considered (point 3 in section 2.2.5), it could be possible to imagine that in the results of the present experiment, speaker do not produce the intonational Q-morpheme in *wh-in-situ* and yes-no questions in the same manner. However, this does seem to be an *ad hoc* solution to the problem, and it seems preferable to say that the obtained results do not support the presence of an intonational Q-morpheme in *wh-in-situ* questions in French.

4. CONCLUSIONS

In this paper, I presented the analysis of French *wh-in-situ* proposed by CR, and the experimental results of Déprez et al. (2012, 2013) that confirmed CR's hypothesis. However, the current study that was carried out provided different results than those of Déprez et al. Moreover, these results do not go in line with CR's proposal.

CR's proposal seems to be on the right track at least in one sense: trying to explain the difference between French *in situ* and *ex situ* *wh*-elements in syntactic terms only is not a viable option. It seems clear that variation can be found at the interfaces with PF and/or LF, and from this point of view the idea of the intonational Q-morpheme is elegant. However, the theory of CR has some problem concerning the empirical coverage of the French data (as for long-distance *in situ* *wh*-questions, cf. Section 2.1.4).

How to explain that Déprez et al.'s results are different from the ones from the experiment discussed in this paper, and that their results validate CR's proposal, while the ones from the present experiment do not? It could be the case that the experimental setting in their study made speakers produce sentences with some particular intonation, but that this type of intonation is not the only possible one. In this case, my corpus study showed that there are several types of intonational contour for *wh*-sentences, and the ones found by Déprez et al. could also be found in a subset of my data. This does not save CR's theory, because this would mean that the intonational Q-morpheme is in fact optional. If it is the case, the original research question of CR is again at issue: what *does* license *wh-in-situ* questions when the Q-morpheme is not present?

Another way to explain the difference between Déprez et al.'s results and ours could be in terms of variation. It is possible that groups of speakers in my study do not speak the exact same variety of French than those of Déprez et al. The variation could be diaphasic (different register of French requires different patterns of intonation for *wh*-sentences), or diatopic (regional variation). Even if this explanation is valid, it is still not sufficient to keep the theory of CR: what does license *wh-in-situ* for speakers who do not seem to use the Q-morpheme?

To have a better understanding of how French speakers produce several types of interrogative sentences, it seems mandatory to continue designing experiments to have access to the intonational contours produced by the speakers. It is necessary to obtain more fine-grained data to be able to find robust generalizations that will allow us to develop precise theories.

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