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AixOx, a multi-layered learners' corpus: automatic annotation

Abstract

This paper presents a multilingual learners corpus, AixOx, collected in the framework of an Alliance project (a partnership between the British Council and The French Ministry of Foreign Affairs). The corpus consists of the recording of 40 1-minute passages in English and French from the Eurom 1 corpus (Chan *et al.*, 1995), read by native speakers and L2 learners. French native speakers reading the French and English passages were recorded in Aix-en-Provence, and English native speakers reading the English and French passages were recorded in Oxford. The AixOx corpus contains about 40 hours of read speech and can be downloaded from the "Speech and Language Data Repository" (http://sldr.org).

This paper also presents the tools used for automatic annotation on several layers using algorithms:

- SPPAS –SPeech Phonetization Alignment and Syllabification– (Bigi, 2012) for a segmentation into utterances, words, syllables and phonemes;

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- MoMel –Modelling Melody– and INTSINT –INternational Transcription System for INTonation– (Hirst, 2007) for the modelling and coding of intonation.

Finally, an example of a pedagogical application of the corpus is given: a pilot-study on the intonation of questions. We show how the AixOx corpus can be used to compare the productions of natives with learners and how it is possible, thanks to the annotation, to understand the prosodic realisations (whether they be positive or negative) and explain them. We conclude that AixOx, with its multi-layered annotation, is a very rich oral database for all kinds of studies on L1 productions, L2 productions, language contact, both at the segmental and supra-segmental levels since it offers a phonemic segmentation and alignment and a prosodic labelling.

Keywords: oral corpus; automatic annotation; MOMEL; INTSINT; SPPAS; intonation; questions; L1; L2; language contact.

1. Introduction

The literature and the growing number of conferences on linguistic corpora confirm the importance of the creation and use of databases in linguistic research. With the development of automatic tools for segmentation and annotation, an increasing number of works in linguistics is based on large corpora. Research as well as courses on corpus linguistics are currently developing everywhere. However, there is still much focus on written corpora, the first well-known collection of texts in English (American English) dating back from the 1960s with the Brown Corpus of American English (Kucera & Francis, 1967). Large oral corpora are much more difficult to collect and annotate and the London Lund Corpus (LLC, Svartvik & Quirk, 1980) was one of the first. It has lately become easy to find corpora of different styles such as historical corpora, corpora for speech recognition or international and multilingual corpora. But despite this growing interest in

corpora, it is noticeable that large oral databases have only been developing recently and that few learners' corpora exist, which are not always readily available to the scientific community. To compensate for this lack, the compilation and annotation of a large database of natives and learners of English and French was essential. Hence the compilation of the AixOx corpus, which is presented in this paper.

We first give an overview of existing oral corpora in English, French and L2 (section 2). The AixOx corpus is then presented and the method used to collect the data detailed (section 3). The next section is devoted to the tools which were applied to the corpus, namely SPPAS, MOMEL and INTSINT, for an annotation at segmental and suprasegmental levels (section 4). Finally, the benefits of learner corpora with a multi-layered annotation are exemplified through the presentation of a pilot-study on the intonation of questions, which is an example of possible research that can be led on such a database (section 5).

2. Literature review

There exist many English learner corpora which focus on written tasks. One major international learner corpus project is that headed by Granger (Granger *et al.* 2009), called ICLE (International Corpus of Learner English). This corpus contains argumentative and literary essays in English by high intermediate and advanced learners of various origins. But it is only written. Oral corpora are currently developing, but they are rare and hardly ever freely or easily available. In what follows, a brief overview of some of the corpora containing native and learner speech in English and French is presented. This review is not exhaustive: its aim is to give examples of different types of corpora and annotations rather than compile a full list of English and French corpora.

There are several oral corpora of British English as spoken by native speakers, which we shall refer to as ENEN (ENglish native

speakers speaking ENglish). These include the ICE-GB (Greenbaum, 1996, Aarts *et al.*, 2002), the British component of the International Corpus of English (Aarts & Nelson, 1999). The percentage of spoken material in the ICE-GB is 60%, thus being one of the few corpora including both spoken and written material and consisting, at the same time, of more than 50% of spoken material. The ICE-GB has the great advantage of being syntactically parsed, but it is very expensive and the sound quality is insufficient for acoustic analysis. Aix-Marsec (Auran *et al.*, 2004) is another interesting corpus as far as the annotation is concerned. Many tiers (levels of annotation) are available, with the labelling into words, phonemes, syllables, intonation units, various rhythm units, a tier containing tonetic stress marks, another with INTSINT tones (*cf.* 4.2. for details on INTSINT), yet another with fundamental frequency values, etc. Finally, the British National Corpus (BNC, Burnard & Aston, 1998), completed in 1994, only contains 10% of spoken data. It is now available in both written and oral format: the sound files are now published by the Phonetics Laboratory of Oxford together with associated transcription and annotation files created during the 'Mining a Year of Speech' project (Coleman *et al.*, 2011). This corpus is unprecedentedly large, but at the moment there is no prosodic annotation. There are also corpora of regional varieties of British English: PAC (Phonologie de l'Anglais Contemporain, Carr *et al.*, 2004) is currently being developed and annotated, IViE (Intonational Variation in English, Grabe, 2004) is available with the orthographic transcription. Finally, there are corpora devoted to diachronic analyses, like DECTE, the Diachronic Electronic Corpus on Tyneside English (Allen *et al.*, 2007).

There are French oral corpora as well, referred to as FR_FR here (FRench native speakers speaking FRench), such as the Corpus of Interactional Data (CID, Bertrand *et al.*, 2008), which is annotated into many different categories, such as words, phonemes, intonation units, syntactic units, etc. This is spontaneous speech only. ACSYNT (Delais-Roussarie *et al.*, 2004) is syntactically tagged on readings, prepared monologues and guided interviews. Like ACSYNT, PFC (Phonologie du Français Contemporain, Durand *et al.*, 2002) comprises different speech styles and consists of examples of different regional varieties of French. For diachronic investigations, the Corpus

d'Orléans can be mentioned (for a detailed description of this corpus, see Bergounioux, 1996).

Only few oral learner corpora exist. The Barcelona English Language Corpus (BELC; Muñoz, 2006) can be mentioned for its collection of recordings of Spanish and Catalan natives speaking English in oral narratives, interviews and role plays. Also available is the LeAP Corpus (Learning Prosody in a Foreign Language) by Milde & Gut (2002), which consists of recordings of German learners of English with four types of speech styles (nonsense wordlists, readings of a short story, retellings of the story, and free speech in an interview situation). One could also mention VOICE (Breiteneder *et al.*, 2006), but it is more devoted to English as a *lingua franca* than as a second language. The speakers are considered as language users rather than learners. Two corpora focusing on English and French can be cited. The first one is COREIL (Delais-Roussarie & Yoo, 2011), which comprises French and English L2, with data collected in such a way so as to carry research on the acquisition of prosody in second/foreign language. The second one is Longdale (coordinated by F. Meunier at the University of Louvain) and is made-up of recordings of French learners of English (among other L1 nationalities), that is FR_EN here. This project aims at building a large longitudinal database with various types of data recorded from students followed over a period of three years. The collection is therefore a long process and Longdale is still work in progress. Recordings of English learners of French (EN_FR) can also be found, but only of young children. In this respect, it is similar to FLLOC (French Learner Language Oral Corpus, *cf.* Myles & Mitchell, in progress), in which the children are aged 7 to 11, or to CYLIL (The Corpus of Young Learner Interlanguage, *cf.* Housen, 2002), which contains English L2 recordings of school pupils of different European nationalities, French among them. Finally, the Anglish Corpus (Tortel, 2008) is a comparative database of read, repeated and spoken British English in L1 and L2, which provided inspiration for AixOx. It represents more than 5h30 of oral English spoken by both native English and French learners of different levels. Although this corpus is freely available on SLDR (Speech and Language Data Repository, http://sldr.org) and has the advantage of containing spontaneous speech (which is not the case for AixOx), it does

not comprise French L1 and L2 data, which were needed for our study.

The AixOx corpus, which we present in this paper, offers recordings of the 4 types mentioned above: EN_EN, FR_FR, FR_EN and EN_FR. It contains equal amount of native and learners speech which allows for multiway analysis. To our knowledge, it is the only corpus of such a kind. Apart from linguistic analysis, it also offers a number of pedagogical applications as will be exemplified in this paper.

3. The AixOx Corpus

3.1.Compilation

The AixOx corpus, as its name suggests, is the fruit of a collaboration between Aix-Marseille University at Aix-en-Provence (France) and the University of Oxford (United Kingdom). It contains a large amount of identical oral data from both English and French native speakers and learners recorded using the same protocol.

The English speakers were recorded in Oxford (except for the learner group C). They were all native speakers of Southern British English. French speakers were recorded in Aix-en-Provence and spoke a Southern or standard variety of French. All speakers were 20 to 35 years old and all grew up in monolingual families.

Non-native speakers were divided into two groups, B and C. These groups correspond to the levels of the Common European Framework of Reference for Languages (CEFR).

- Learners of group B are independent users, B1/B2 in the CEFR: they were selected among speakers who had studied French or English at school but not as their main subject at university level, and who had not spent more than 4 weeks in a French- or English-speaking country. Their level in the L2

language was proof-evaluated by two specialists of French and English as foreign languages.

- Learners of group C are proficient users, C1/C2 according to the CEFR: they were selected among speakers who have spent a considerable amount of time in the L2 country (university instructors and high level students). Their level was also assessed by the two specialists.

All recordings were performed following a common experimental procedure:

- in Aix-en-Provence, the recordings were done in a recording studio equipped with a Shure SM 58 microphone, a TASCAM M512 mixing desk, related to an iMac with a digidesign Mbox 2 sound card. The software Protools LE 7 was used.
- in Oxford, the recordings took place in an anechoic room with a condensed microphone using custom software for stimuli presentation.

We also used questionnaires to collect data about the speakers' exposure to L2 (see appendix 1) and the whole procedure was approved by appropriate ethics committees. A consent form was filled in by each speaker (see appendix 2). The data have been anonymized, each speaker being assigned a code.

The recordings consist of read speech. The passages from the Eurom 1 corpus (Chan *et al.,* 1995) were chosen because they have already been recorded in 11 different European languages (including Danish, Finnish, German, Greek, Polish), and therefore additional comparisons could be done between our corpus and these languages. There are forty passages (T01 to T40 in AixOx), each representing about 1 minute of speech. Each passage describes every-day events and includes a variety of utterance types including questions, exclamations, etc. All speakers were recorded reading these forty passages: the recording took between 30 and 50 minutes per speaker, depending on the speech rate but also on the proficiency level when learners were concerned (the less advanced learners being slower and making more hesitations and repetitions). The speakers were allowed to repeat a word or a sentence in case of hesitation. Here is an example of the same passage in English and in French (T03):

> Please put me through to the complaints department. The repair to the water-main outside my house was unsuccessful, and my cellar's flooded. Your Water Services Department was singularly unsympathetic. All their repair teams are apparently booked out for the next two weeks. Am I supposed to use the cellar as a swimming pool till then?
>
> Passez-moi les réclamations, s'il vous plaît. On est venu réparer le tuyau d'arrivée d'eau, devant chez moi, et ça n'a pas tenu : ma cave est inondée. Quand j'ai téléphoné, on m'a répondu que toutes les équipes de dépannage étaient occupées pendant les deux semaines qui viennent. On peut vraiment pas faire confiance au Service des Eaux. Si j'ai bien compris, en attendant, ma cave va me servir de piscine.

3.2. Corpus size

The corpus contains more than 40 hours of speech obtained from 60 speakers. For each group, 10 speakers (5 females and 5 males) were recorded. The sound file including the 40 passages was cut into 40 sound files, one for each passage, and labelled as explained below.

ENEN_M01_T01, for example, corresponds to a male native English speaker reading passage T01: ENEN stands for English/English: an English speaker reading English. M01 means Male no.1 and T01 stands for passage no 1. FRFR_F02_T39 is therefore the group of French natives. Female no. 2 is reading passage no. 39. For the learners' groups, a letter was added for the level. Thus FRENB stands for French learners of English with a B1/B2 level, and FRENC is the C1/C2 group. The English learners of French are called ENFRB or ENFRC.

Hence the corpus is composed of 6 groups of 10 speakers, with 41 sound files for each speaker (a long sound file comprising the 40 passages and 40 files, one for each individual passage), amounting to 2460 sound files, which are already available for the research community on SLDR (Herment *et al.,* 2012).

Table 1 below shows each category in AixOx (5 males and 5 females in each group):

Language of recording	Native speakers	L2 learners B1/B2	L2 learners C1/C2
English	ENEN	FRENB	FRENC
French	FRFR	ENFRB	ENFRC

Table 1. Speaker groups in AixOx

4. Annotation

The orthographic transcriptions were manually adjusted to reflect possible repairs and other errors. From these orthographic transcriptions, the corpus was automatically annotated on several layers and this section is devoted to the description of the various tools used to do so. Figure 1 below shows a PRAAT window (Boersma & Weenink, 2001) with 9 tiers, all obtained thanks to the automatic annotation of the following elements: interpausal units (with the initial orthographic transcription), words (tier named *tokens* here), syllables, classes of phonemes, syllable structures, phonemes, F0 values with Momel, Intsint tones, and F0 values recalculated according to the Intsint Momel mapping (see 4.2. below).

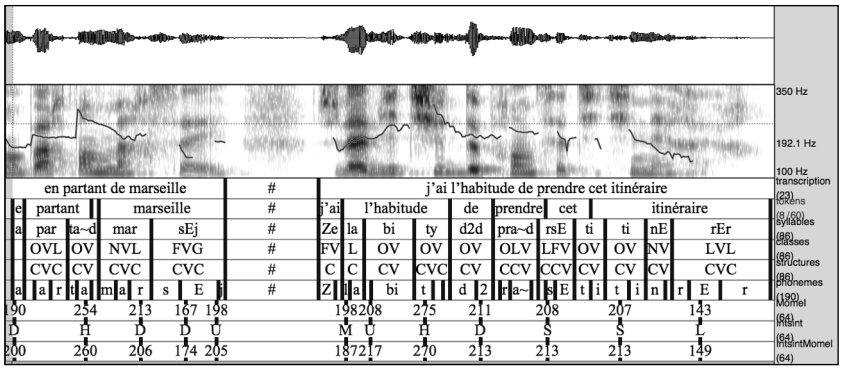

Figure 1. 9 tiers of automatic annotation for AixOx (extract from FRFR_F02_T15)

4.1. SPPAS

The analysis of the phonetic entities of speech nearly always requires the alignment of the speech recording with a phonetic transcription of the speech. This task is extremely labour-intensive. It may require several hours even for an experienced phonetician to transcribe and align a single minute of speech manually. It is consequently obvious that transcribing and aligning several hours of speech manually could not be envisaged. We therefore used the tool called SPPAS (Bigi, 2012) for our alignment.

SPPAS is a tool producing automatic annotations at several levels: utterance, word, syllabic and phonemic segmentations (tiers 1, 2, 3 and 6 respectively in figure 1); it also gives a syllabification for French (tiers 4 & 5 in figure 1), from a recorded speech sound and its transcription. The whole procedure is a succession of 4 automatic steps and the resulting alignments are a set of TextGrid files, as shown in figure 1 (TextGrid is the native file format of the Praat software, which has become one of the most common tools among phoneticians). SPPAS is currently designed for Chinese, English, French and Italian, and other languages can easily be added to the list. This is one of the reasons why we chose this tool, because we had English and French in AixOx, and also because we thought it could be efficient on L2 speech. This tool and all the required resources are distributed under the terms of the GNU Public License, which was another very strong argument for choosing SPPAS. The different steps SPPAS performs are described below.

4.1.1. Inter-pausal unit segmentation

The very first step when using SPPAS is inter-pausal unit (IPU) segmentation. This is an open research problem. It consists in aligning macro-units of a document with the corresponding sound. The algorithm currently implemented in SPPAS identifies silent pauses in the signal and attempts to align them with the inter-pausal units proposed in the transcription, under the assumption that each such unit is separated by a silent pause.

SPPAS was used to segment the FRFR part of AixOx, depending on the utterance marks of the script (*i.e.* written text). SPPAS failed to align about 10% of the files and 40% of the sentence boundaries had to be manually corrected. Errors were only due to the fact that, for some reason, silences were not placed as expected, that is, at the end of sentences. Despite these errors, the use of SPPAS saved a lot of time when performing IPU-segmentation.

4.1.2. Word and phoneme segmentations

Input transcriptions need to be word-segmented first. Text-sentences are automatically tokenized by the system presented in Bigi (2011).

Phonetization is the process of representing sounds with phonetic signs. There are two general ways to construct a phonetization process: either rule-based systems (with rules based on inference approaches or proposed by expert linguists), or dictionary-based solutions, which consist in storing a maximum of phonological knowledge in a lexicon. SPPAS uses the latter approach, that is, the dictionary-based approach. Electronic pronunciation dictionaries commonly used in automatic speech recognition systems are integrated in SPPAS: the CMU (Carnegie Mellon University) dictionary for the English part (http://www.speech.cs.cmu.edu/cgi-bin/cmudict) and a compilation of various dictionaries for the French part. The phonetization is the equivalent of a sequence of dictionary look-ups. The problem is that there are of course different ways to pronounce the same word, the same utterance, and the question is how to reflect the orality of the corpus. The dictionary offers different variants for all the words, and no rules are applied, all the possibilities are stored. French "je", for example, has the following variants: jj|jj.eu|ch, and French "suis": ss.yy.ii|ss.yy.ii.zz|ss.uu.ii|yy.ii|yy.ii.zz. This means that the phonetization consists in having all the variants, as is shown in figure 2 below (the figure is extracted from a former version of SPPAS with a non-standard phonetic alphabet; the phonetization is now performed with the SAMPA alphabet (SAMPA is the Speech Assessment Methods Phonetic Alphabet, a computer-readable phonetic script using 7-bit printable ASCII characters, based on the IPA, see Wells *et al.*, 1992) in SPPAS:

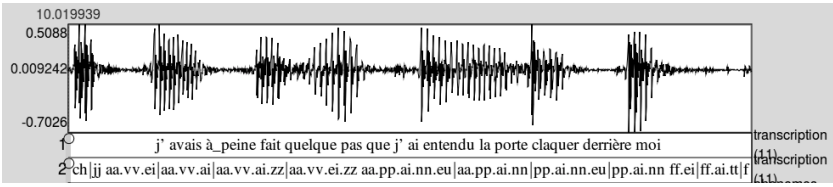

Figure 2: Phonetization with all the variants for each word.

Those phonetic variants are proposed for the aligner to choose the phoneme string. The hypothesis is that the answer to the phonetization question is in the signal. The alignment problem consists in a time-matching between a given speech unit along with a phonetic representation of the unit. The goal is to generate an alignment between the speech signal and its phonetic representation.

To perform the alignment, a finite state grammar that describes sentence patterns to be recognized and an acoustic model are needed. The Julius speech recognition engine (Nagoya Institute of Technology, 2010) is used by SPPAS to estimate the phonetization and the temporal boundaries of each phoneme, and then, the temporal boundaries of each word.

4.1.3. Syllabification

The syllabification of phonemes is performed with a rule-based system (RBS) previously described for French in Bigi *et al.* (2010). This RBS phoneme-to-syllable segmentation system is based on 2 main principles:

- a syllable contains a vowel, and only one;
- a pause is a syllable boundary.

These two principles raise the problem of finding the boundary between two vowels. Phonemes were grouped into 6 classes (Fricatives, Glides, Liquids, Nasals, Occlusives, Vowels) and rules established to deal with these classes and solve the problem of the syllabic boundary between two vowels. Tiers 4 & 5 in figure 1 show the syllabification and the syllable structure. The syllabification is available for French, and is efficient (*cf.* Bigi *et al.*, 2010) even if there are still errors, as can be seen in figure 1. It is not available for English yet.

4.1.4. Enriched orthographic transcription

For SPPAS to be really efficient, the problem of the orthographic transcription is crucial (*cf.* Bigi *et al.*, 2012). Indeed, as explained above, the input being the orthographic transcription, the better the transcrip-

tion, the better the phonetization; thus, the better the alignment, and the better the syllabification. This is of the utmost importance with learners' corpora, since these speakers make a lot of mistakes, hesitate, and mispronounce many words.

An enriched transcription is therefore necessary for a better alignment. The French part of the AixOx was enriched by speech phenomena like short pauses (the '+' symbol was used), noises (annotated with the '*' symbol), repetitions, hesitations and truncated words (with a '-' at the end of the truncated word). This annotation was made manually during the IPU-segmentation stage.

Unknown words are also dealt with in SPPAS: an algorithm called "longest matching" performs a match from left to right in the dictionary, enabling the phonetization to work on unknown words. Here is an example: the sentence to be read is the following:

> *Could you please tell me the best connections to Sheffield from East Greenstead? I need to arrive by 10:30 a.m. on Saturday.*

The standard orthographic transcription is therefore the same:

> *Could you please tell me the best connections to Sheffield from East Greenstead? I need to arrive by 10:30 a.m. on Saturday.*

However, the speaker (a learner) makes hesitations and repetitions. The transcription is enriched with # for a pause and the repetitions are transcribed as such:

> *Could you please tell me # the best connections to Sheffield from East Greenstead? # I need to arrive by ten uh uh half past ten on Saturday.*

But the speaker also mispronounces the two proper names Sheffield and Greenstead. He pronounces /Sefl/ and /gri:nsti:d/ (transcribed in SAMPA here). If we create unknown words which correspond to the speaker's mispronunciation, SPPAS will be able to phonetize them and reflect the learner's pronunciation. So this is the even richer transcription we can make:

> *Could you please tell me # the best connections to **Sheffel** from East **Greensteed**? # I need to arrive by ten uh uh half past ten on Saturday.*

4.2. MOMEL and INTSINT

The MOMEL (MOdelling MELody) algorithm (Hirst & Espesser, 1993) was developed to provide a phonetic representation of intonation patterns. The fundamental frequency curve is assumed to be the product of two independent components: a global macroprosodic component, corresponding approximately to the underlying intonation pattern of the utterance, and a local microprosodic component, representing the deviations from the macroprosodic curve which is caused by the segmental content of an utterance. The discontinuity observed in the raw fundamental frequency curve is modelled by the microprosodic component while the underlying macroprosodic component is modelled as a continuous and smooth curve, using a quadratic spline function (Figure 3). The algorithm thus takes as input a raw F0 curve and gives as output a corresponding sequence of target points for the quadratic interpolation.

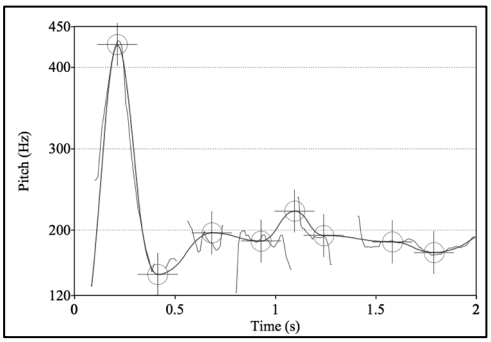

Figure 3: Example of automatic output given by the MOMEL algorithm.

The INTSINT system (INternational Transcription System for INTonation, *cf.* Hirst, 2011) was developed to provide a surface phonological representation of intonation patterns. The system is based on an inventory of minimal pitch contrasts found in published descriptions of intonation patterns and basically describes an intonation contour as a sequence of tonal segments, which are labelled using an alphabet of 8 symbols. The tonal segments are of three types:

- Absolute tones –T(op), M(id), B(ottom)– are assumed to refer to the corresponding position of the speaker's current pitch range;
- Relative tones –H(igher), S(ame), L(ower)– are assumed to be defined with respect to the preceding tonal segments; and
- Iterative relative tones –U(pstepped), D(ownstepped)– are also defined relative to the preceding tonal segment but generally involve smaller pitch changes and often occur in a sequence of steps either upwards and downwards.

The relative position of each tone can be drawn as shown in figure 4 below:

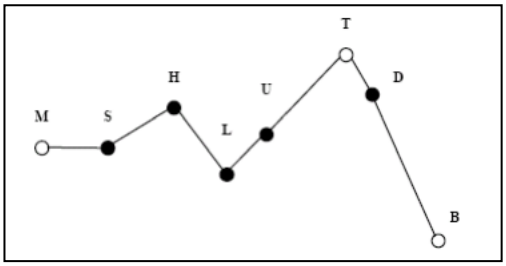

Figure 4: INTSINT tones

There is then a mapping between the INTSINT tones and the MOMEL target points and the corresponding F0 values are recalculated. This is exemplified by the last three tiers of figure 1 above, duplicated in figure 5 below:

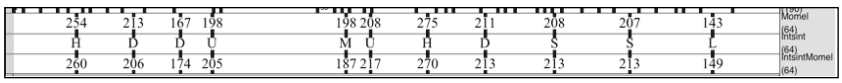

Figure 5: 3 tiers showing (i) the MOMEL target points, (ii) the INTSINT tones, (iii) the INTSINT-MOMEL mapping.

The MOMEL and INTSINT algorithms are available in PRAAT as a plugin (Hirst, 2007) and are also integrated in SPPAS (Bigi & Hirst, 2012).

5. A possible pedagogical application: the example of questions

As already mentioned above, AixOx provides data enabling the researcher to work on several aspects. Thanks to the multi-layered annotation, segmental and supra-segmental studies can be led. L1 and L2 speech can be analysed and comparisons can be made.

We propose to give an example of a possible pedagogical application in this section, focusing on the intonation of questions. Following Halliday (1967) and the British tradition, the analysis relies on tonality (the division into intonation phrases), tonicity (the place of nuclear syllables) and tones (the distinctive pitch movements). Questions are very interesting because in English the intonation is different according to whether we have an open (yes/no) question, or a closed (*wh*-) question. It is acknowledged in the literature (*cf.* amongst others O'Connor & Arnold, 1963; Ginésy, 1995; Wells, 2006; Roach, 2009) that the default tone for open questions in English is a rising tone. It is also possible for a *yes-no* question to be said with a fall, but this makes the question more insistent, more businesslike, authoritative and abrupt. On the contrary, *wh*-questions in English are always uttered with a falling tone, except for very particular contexts, when the speaker wants to be particularly gentle or repeats a question.

In French, the default tone for total questions (*yes-no* questions) is a rising tone and for partial questions (those with an interrogative pronoun), the contour is generally falling (Delattre, 1966; Carton, 1974, Léon & Léon, 1976, Di Cristo, 1998, Horgues, 2010). These are general considerations and for Beyssade *et al.* (2007), the contour does not depend on the type of question: the context is relevant. In fact both contours are possible for both types of questions, but in controlled speech, such as the read speech available in AixOx, we rather expect rising contours in French for total questions and either a fall or a rise for the partial questions depending on the context.

The issue here is to see how the learners are going to deal with the questions analysed and to show that visualizing a curve, seeing the tones and the alignment in words and in phonetics can be helpful

when teaching and learning a second language. The study presented here is still in progress and based on four questions in AixOx, two in each language (the whole corpus contains 22 questions in each language):

- Can you tell me what's on television tonight?
- What can I have for dinner tonight?
- Vous pourriez me dire ce qu'il y a à la télévision ce soir ?
- Qu'est-ce que je vais manger ce soir ?

The productions of the 20 natives (10 French natives, and 10 English natives) were analysed and compared to the productions of the 40 learners (10 in each of the 4 groups: the independent users –ENFRB and FRENB– and the proficient users –ENFRC and FRENC). This amounts to 120 occurrences, which were closely looked at, using the annotation, and in particular the labelling into words and into phonemes (SPPAS) and the INTSINT tones and F0 values.

The very last question in French is expected to be pronounced with a falling intonation since it is a rhetorical question that the speaker asks him/herself. The aim of this pilot-study is to show the usefulness of AixOx and its annotation for the teaching of English and French as foreign languages studied by French and English learners, respectively.

5.1. Yes-no questions

The French question 'Vous pourriez pas me dire ce qu'il y a à la télévision ce soir ?' is a typical total question with no inversion, very common in French. The fact that there is no inversion is very interesting since in order to make it a question, the speaker has to use a rising tone. The question is therefore expected to be pronounced with a rise. Since its English equivalent 'Can you tell me what's on television tonight' has the interrogative syntactic form, either a fall or a rise can be pronounced, but a rise is given as the default tone in the literature (as mentioned above). Table 2 below shows the percentage of rises and falls uttered in the different groups. Two speakers realized a falling-rising tone, symbolized by FR in the table. As expected, the intonation is rising for the French question: all the native speakers utter

this sentence with a rising tone. As expected too, it is less clear for the English question: 60% of the speakers utter the sentence with a falling tone, which counters the idea that the rise is the default-tone.

Yes-no question	natives	independent	proficient
Can you tell me…	F 60%	R 90%	R 60%; FR 20%; F 20%
Vous pourriez me dire …	R 100%	R 70%	R 70%

Table 2. Intonation contour for the 2 *yes-no* questions in the different groups

There is no difference between the two groups of English learners of French. Whether they be more advanced or not, the intonation is rising for 70% of the learners on the French question, which is the right intonation contour. A few speakers do pronounce it with a falling contour though, which sounds unnatural, and may even be confusing since there is no syntactic inversion. For the English sentence pronounced by French learners, it is interesting to comment upon the difference between the two groups. Nine independent users out of ten produce a rising tone, whereas the proficient speakers use a wider range of contours, the main one remaining the rising contour too. The partial conclusion that can be drawn from the analysis of table 2 is that French learners seem to favour the rising contour for yes-no questions in English, while the default tone for the English yes-no question studied is the falling tone.

If we take a closer look and analyse the production of one native English speaker (ENEN_F04) in detail for the *yes-no* question (figure 6), we see that the tones are relevant, but not only so. Several points are appealing and deserve some special attention:

- A Top tone appears on the word “tell”, which is therefore the head of the tone unit. This is an interesting point, since in the literature it is generally agreed that an auxiliary in initial position should be placed as the head of the tone unit (*cf.* Ginésy, 1995, amongst others) and this is what we teach our French learners of English. It is not the case here, nor is it for the other native speakers of the corpus. They all place a higher F0 value on “tell” than on “can”.

- Another interesting point is that for the word "television", the speaker places the stress on the penultimate syllable, as can be seen on figure 6 with an H tone after the syllable –vi– and then an L tone, marking a fall on the last syllable. Our corpus reveals the evolution of the accentuation of this particular word, whose irregular pronunciation with a primary stress on the first syllable is supposed to be the most frequent one (Jones, 2006; Wells, 2008). Our speakers are young (they are aged between 20 and 35) and all of them pronounce "television" with the primary stress on the penultimate syllable.
- The fall (HL tones) just mentioned for the word "television" marks this word as the nucleus of the tone unit and we clearly see that "tonight" is uttered on a low static tone, marked by the Bottom tone on the last syllable.

The intonation of this question is therefore a falling tone for this particular speaker, and not a default rising tone. It has been seen in table 2 that 60% of the native speakers uttered this question with a falling tone, and 40% with a rising tone.

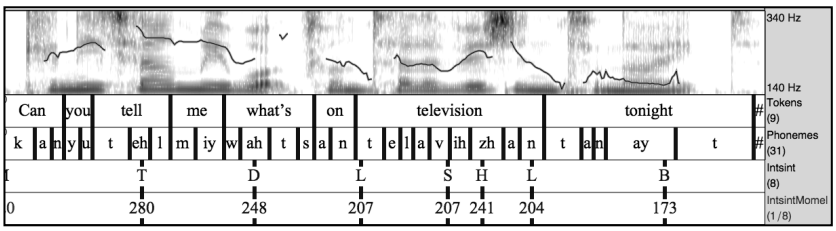

Figure 6: English native speaker: yes-no question (ENEN_F04_T35)

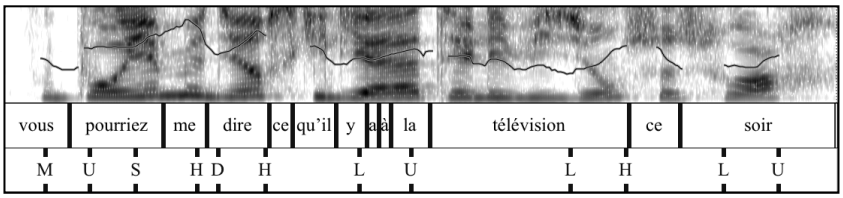

Figure 7: French native speaker (FRFR_F03_T35)

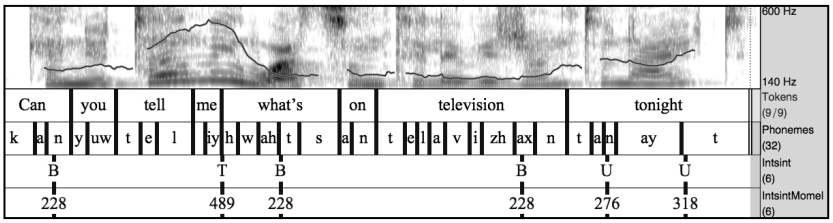

Figure 8: French learner of English (FRENB_F07_T35)

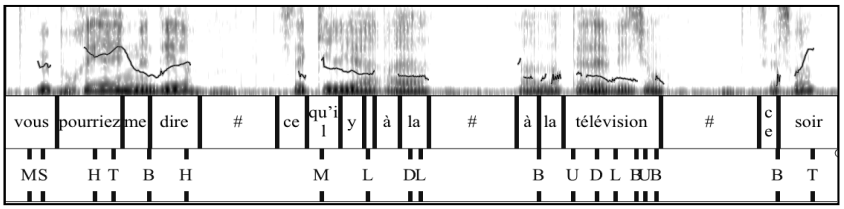

Figure 9: English learner of French (ENFRB_M04_T35)

If we look at the same sentence in French, produced by a native speaker too (FRFR_F03, figure 7), we see a completely different intonation pattern. The contour is globally rising (LU at the end), the highest word at the beginning of the tone unit is “me” and it is uttered with a falling tone (H tone immediately followed by a Downstep) and we note a rise on the last syllable of “télévision” (LH). Two consecutive rises, on “television” and on “soir” are typical of French intonation. The nuclear syllable is “soir”. The rising pattern for this question is typical in French, as shown in table 2: all the natives speakers use a rising tone.

Let us now analyse the production of a French learner of English for the same sentence: speaker FRENB_F07, an independent user (figure 8).

- A Top tone also appears at the beginning of the question, as is the case in the production of the English native, but not on “tell”, or on “can”, as could be expected, but on “me”. This is

a typical error by French learners of English: unlike English speakers, French speakers do not make a difference between the so-called "tool words" or grammatical words and "lexical words", or open-class words, as far as the accentuation at sentence level is concerned. Every word is accented in French and the strongest accent is the final syllable. This is exemplified in the production of the French native speaker (figure 7) who puts a high tone on "me" in the French sentence. In the segment "can you tell me", the last word being "me", the learner puts the strongest accent on it, while the native speaker will put the accent on "tell".

- Two Bottom tones appear on "what" and on the final syllable of "television", showing that this word is not accented at the level of the sentence and that it is not the nucleus of the tone unit, as should be the case in English.
- Two Upstepped tones appear on "tonight", showing that the two syllables of the last word are rising, as can be seen on the F0 curve. Those two rises are typical of the French intonation, as mentioned above. Since there is no other pitch movement before, this word is the nucleus of the tone unit. Typically, the French learner has uttered the question with a rise, which in this particular case is not erroneous, but with the main accent on the last word, which does not sound natural.

The production of this learner is clearly influenced by her L1, but interestingly enough, the global contour is right, the differences can be heard and noticed at other levels, that of the rhythm in particular: the choice of the words to be accented is often wrong.

Finally, let us analyse the production of the English learner of French (ENFRB_M04, figure 9). There are hesitations marked by silences visible on the figure and marked by the # symbol. We can see an H tone followed by a Top tone and immediately after a Bottom tone on "pourriez me". Like the native speaker, the learner utters "me" with a falling tone, and it sounds very natural. The only difference is that the F0 peak is on "me" for the native speaker (but at the beginning of the vowel) and on the end of "pourriez" for the learner (compare figures 7 and 9). This does not make much difference perceptively since in both cases the fall is on "me". "Dire" is rising, like in the

native production, which is very good, too. The end of the sentence differs from the native production in that "télévision" is uttered on a flat very low tone (2 B tones at the end of the word) and there is only one rise on "soir", but the pitch movement is too large, from B to T, which is not the case in the native production: the rise on "soir" does not reach the top of the pitch range. Apart from that, the learner's realization of the question is rather good and sounds much more natural than the FRENB production. This would tend to prove that it is more difficult for FREN learners to produce the right intonation on *yes-no* questions than for ENFR learners.

Is it true for *wh*-questions too?

5.2. WH-questions

Wh-questions were analysed and as for *yes-no* questions, L1 and L2 productions were compared. As already explained, *wh*-questions in English are uttered with a globally falling intonation, while in French, both rising and falling contours are found. This is shown in table 3 below: all the English natives utter the question with a falling tone, and 70% of the French natives use a falling tone for the same question in French. The result for French is interesting since in our corpus the default tone is the falling tone and not the rising tone acknowledged in the literature. However, the context is a bit particular. This is a question addressed to the speaker themselves, a rhetorical question where no answer is expected. Hence the more frequent falling tone, probably: the syntactic form of the question is relevant for intonation, but the pragmatic type of question is important as well.

The results for the learners are also worth commenting: there is hardly any difference between the two groups of French learners. Falling and rising tones are heard, with a slight preference for the falling contour in the more advanced group. The English learners massively use the falling tone for the French question.

Wh-question	natives	independent	proficient
What can I have…	F 100%	F50%	F 60%
Qu'est-ce que je vais …	F 70%	F 80%	F 100%

Table 3. Intonation contour for the 2 *wh*-questions in the different groups

Again a more precise analysis reveals interesting features. Figure 10 below shows the production of an English native speaker (ENEN_M04). The annotation is helpful: the highest tone in the sentence is on "can" (H tone) and the pitch movement is a falling one (B tone at the end). The F0 peak on "can" is interesting because manuals for learners usually indicate that the first accent (the head) should be placed on the interrogative pronoun (see for example Ginésy, 1995). The present analysis seems to question this point since all the English natives in AixOx accentuate "can" and not "what" as the head of the tone unit. We also see in figure 10 that the nuclear syllable is the first syllable of "dinner" since we have a Downstep on "din-" followed by LB on "tonight", which is deaccented (it has no accent at the level of the sentence since it follows the nucleus, it is the tail of the tone-unit).

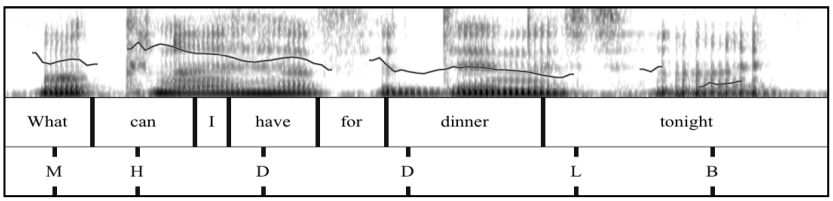

Figure 10: Native speaker (ENEN_M04_T32)

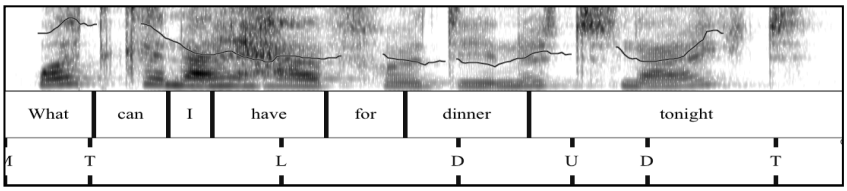

Figure 11: Learner (FRENB_F07_T32)

Now if we look at the learner's production (figure 11), we see that the beginning of the tone unit looks like that of the native, but the end is not properly realized. The intonation is rising and the French prosodic characteristics are found, with the two rises on "dinner" and on "tonight", in the same way as those realized on "télévision" and "soir" (figure 7). The comparison of figures 7 and 11 clearly shows the same intonational realisations (except for the level of the rises). It is interesting to compare them with the partial question "qu'est-ce que je vais manger ce soir?" in French: a fall is the most common pattern for natives (only three native speakers out of ten realize a rise on this question) and yet, about half of the learners pronounce the English question with a rise. This tends to prove that French learners of English probably do not make the difference between a *yes-no* and a *wh*-question when speaking a foreign language and that for a French speaker the primitive intonation for a question, whatever the type of question, is a rising contour. The same is not true for English learners. Almost all ENFR learners, even in the independent group, utter this question with a falling tone.

As a conclusion to this study, it is important to insist on the importance of the annotation in AixOx to show the learners the productions they realize and to explain them the mistakes they make. Visualizing what they produce and what a native speaker produces, not only the F0 curve, but also the alignment in words, phonemes and tones, can be a decisive help for them in the production of intonation contours when learning a foreign language.

6. Conclusion and perspectives

We have shown in the previous section that AixOx could be used for pedagogical purposes and that the multi-layered annotation is very helpful. More work needs to be done concerning the intonation of questions as regards the comparison between L1 and L2. This is only

a pilot-study, but interesting research topics have been advanced that deserve to be studied further.

AixOx can also be used for research purposes. We aim at carrying out a larger and more detailed study on the intonation of questions in L1 and L2, following Santiago & Delais-Roussarie (2012) who worked on Mexican learners of French. Many other scientific issues could be tackled, both at the segmental and supra-segmental levels. For example, Tortel's results (Tortel, 2009; Tortel & Hirst, 2010) are currently being tested on AixOx. She applied different rhythm metrics on the Anglish corpus in order to see if rhythm is a relevant factor in the quality of L2 production. She showed that 3 groups (natives, advanced, beginners) can be clearly distinguished (70%). Normalized metrics, *i.e.* those taking tempo variations into account, are the best predictors. This means that discrimination between L1 and L2 is possible and that learners can be classified into different levels. The same procedure, also following Loukina's work (see Loukina *et al.*, 2011), is being applied to AixOx for both English and French.

We also aim at improving the corpus. The alignment for the ENEN and FREN parts is currently being completed with SPPAS. The issue of syllabification needs more reflection. SPPAS can syllabify French, but not English. Syllabifying English words is a complex issue and more research needs to be done, and hopefully AixOx will offer interesting data for that purpose.

To conclude, the AixOx corpus, with its multi-layered annotation, is a very rich oral database for all kinds of studies on L1 productions, L2 productions, language contact, both at the segmental and supra-segmental levels since it offers a phonemic segmentation and alignment and a prosodic labelling.

Acknowledgements

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Appendix 1

Fiche de renseignements / Information sheet

Date de l'enregistrement / Date of the recording: ……..…
Lieu et conditions de l'enregistrement / Place and setting of the recording:…….

Prénom / First name: ……..……
Nom / Name:……..……
Nationalité / nationality: ……
Age au moment de l'enregistrement / Age at date of recording: ……
Lieu de naissance / Place of birth: ….……
Lieu de residence au moment de l'enregistrement / Current place of residence:
……
……..……
Lieux de residence antérieurs / Previous places of residence:
Lieu/ place nombre d'années / number of years age(de_à_)/age (from_ to_)
……
……
……
……
……
Activité / Occupation:……
Activités antérieures / Previous occupations:
……
……
Education (specifier jusqu'à quel age et quel type d'éducation)/ Education (specify until what age and what type of education):……

……
……
……

Langues parlées / Languages spoken:

Langue/ language	niveau/level of proficiency		
	(basic)	(intermediate)	(fluent)
……	☐	☐	☐
……	☐	☐	☐
……	☐	☐	☐
……	☐	☐	☐

Langue / language	frequency of use		
	(rarely)	(monthly)	(daily)
……	☐	☐	☐
……	☐	☐	☐
……	☐	☐	☐
……	☐	☐	☐

Père de l'informant / Informant's father:

Année de naissance / year of birth: ……...

Lieu d'origine / Place of origin:…….

Activité / Occupation: ……

Education / Education:……..

Langues ou dialect local parlés / Languages or local dialect spoken: ……

Mère de l'informant / Informant's mother:

Année de naissance / year of birth: ……

Lieu d'origine / Place of origin:……

Activité / Occupation: ……

Education / Education:……

Langues ou dialect local parlés / Languages or local dialect spoken:…….....……

Conjoint de l'informant / Informant's partner:……..

Lieu d'origine / Place of origin:……

Activité / Occupation: ……

Education / Education:……

Langues ou dialects locaux parlés / Languages or local dialect spoken:……...……..

Nombre d'enfants, age / Number of children, age:
…….....
……
……
……

Personnes ayant joué un role important pour l'informant lors de l'acquisition de la langue / People who played an important role during the informant's acquisition of the language:
……
……
Endroit où l'informant reside (maison, appartement, quartier residentiel, banlieue, etc…) / Type of accommodation of the informant (house, flat, in a residential area, housing estate, block of flats, etc.):
……
Integration et relation avec le voisinage / Integration into the area, relationships within the neighbourhood:
……
……
Groupe ethnique / Ethnic group:
…….
Activités culturelles et de loisirs, voyages / Cultural and leisure activities, travels:
……
……
Information supplémentaire / Additional information:
……..
……
……
Remarques sur l'enregistrement / Remarks on the recording:
……
……
……

Appendix 2

Consentement éclairé

Je soussigné(e), ……..,

- autorise par la présente Mme/M. ……..
  à m'enregistrer en audio/vidéo
- autorise l'utilisation de ces données, sous leur forme enregistrée aussi bien que sous leur forme transcrite et anonymisée

➢ à des fins de recherche scientifique (mémoires, thèses, articles scientifiques, exposés à des congrès, séminaires)
➢ à des fins d'enseignement universitaire
➢ pour une diffusion dans la communauté des chercheurs sous la forme d'éventuels échanges et prêts de corpus à des chercheurs, moyennant la signature d'une convention de recherche ou d'une licence non-commerciale
➢ pour une diffusion sur le site du CRDO (http://crdo.fr) dédié à la recherche

- prends acte que, pour toutes ces utilisations scientifiques, les données ainsi enregistrées seront anonymisées, cela signifie que les bandes audio qui seront présentées à des conférences ou des cours sous forme d'extraits seront nettoyées de toute information personnelle (nom, adresse, n° de téléphone…)

-souhaite que la contrainte supplémentaire suivante soit respectée :
……
……
……
……

Lieu et date : Signature

Consent form

I the undersigned, ……..,

- give permission to Ms./Mr. …… to record me (audio/video)
- give permission to use the recordings and their transcriptions anonymously.

➢ For the purposes of scientific research (dissertations, PhD, scientific articles, conference talks, seminars)
➢ For the purposes of university teaching
➢ For distribution amongst the academic community by means of exchanging or lending corpora, dependent upon the signature of a research agreement or a non commercial licence.
➢ For broadcast on the CRDO website (http://crdo.fr) devoted to research

- note that for all scientific uses, the recorded data will be treated anonymously, meaning that all personal information (name, address, telephone n° etc.) will be deleted from any extracts on the audio tapes presented at conferences or in class.

- wish for the following supplementary constraint to be respected:
……
……
……
……

Place and date: Signature: