EARLY INTONATIONAL DEVELOPMENT IN CATALAN*

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ABSTRACT

This paper focuses on the development of intonation f0 patterns in four Catalan-speaking children between the ages of 12 and 26 months approximately. To our knowledge, to date no work has addressed the acquisition of Catalan intonation. Pitch contours were acoustically analyzed in all meaningful utterances produced by each child, for a total of 3,143 utterances. Contrary to what has been claimed in the literature, our results reveal that children's emerging intonation is largely independent of grammatical development. The four children had clearly mastered the production of a wide variety of language-specific pitch accents and boundary tones well before they produced two-word combinations, regardless of the fact that the age for two-word production was 1;6 for two of the children and 2;0 for the other two.

Keywords: acquisition of phonology, acquisition of intonation, infant prosody, infant intonation.

1. INTRODUCTION

This study investigates early intonation development in four Catalan children between the ages of 12 and 26 months, focusing on the capacity to use appropriate intonation for specific pragmatic meanings. The aim of the study was twofold. Our first descriptive goal focused on describing the development of different intonation patterns and pragmatic meanings at different stages and assessing whether the first intonation contours produced by the children reflected the language-specific prosodic properties of the input language. As part of this goal, we also wanted to test the hypothesis that children do not implement the pitch scaling patterns correctly at earliest stages of intonational acquisition.

Recent studies on prosodic development seem to indicate that the acquisition of intonation is paced by the child's development of grammar. As Snow [6] points out, "the milestone event in children's acquisition of expressive syntax is the appearance of two-word combinations at about 18 months, which coincides exactly with the dramatic growth in intonation that was observed in this and other studies." Thus, the second (and main) goal of our study was to assess whether the mastery of certain intonation patterns correlated with grammatical development and the start of the two-word period.

2. METHOD

2.1. Participants

The primary empirical basis for this study is an extensive longitudinal corpus consisting of the transcribed speech of four Catalan children (Gisel·la, Guillem, Laura, and Pep) coming from the Serra-Solé corpus on Catalan available in CHILDES ([2]). The children and both parents used Central Catalan almost exclusively in their family context (they all are from Barcelona), with slightly different degrees of contact with Spanish.

2.2. Materials

Each child was video-taped on a monthly basis from the start of the use of 25 words (between 1;1 and 1;8, depending on the child) up until four years of age. Data was collected following a naturalistic design, that is, spontaneous situations were recorded at home with the mother and the researcher. The data was transcribed in orthographic form by a team directed by Miquel Serra and Rosa Solé, and is available at the CHILDES website ([2]). Table 1 presents a summary of the data used for this study.

* We are particularly indebted to M. Serra (Departament de Psicologia Bàsica, Universitat de Barcelona) for generously sharing the Serra-Solé Catalan database in CHILDES and granting us access to the original videotapes. We would like to thank A. Chen, L. D'Odorico, P. Fikkert, M. Nadeu for comments on an earlier version, C. Amado and A. Estrella for phonetically transcribing the children in PHON and to Y. Rose and B. McWhinney for their help during the early stages of transcription with this program. This research was funded by the Generalitat de Catalunya (grant 2005SGR-00753) and by the Spanish Ministry of Education and Science-FEDER (HUM2006-01758/FILO).

Table 1: Description of the subset of the Serra-Solé CHILDES Catalan corpus used in the study.

Child	Age	# sessions	# utterances
Gisel·la	1;7.14 - 2;1.23	6	757
Guillem	1;1.29 - 1;11.13	7	419
Laura	1;7.20 - 2;2.13	6	1096
Pep	1;1.24 - 2;0	10	871

Note that the age range analyzed is different for each child. Our data analysis spanned from the beginning of the 25-word vocabulary stage up until past the start of the two-word utterance period.

2.3. Phonetic and prosodic transcription

After digitizing the original videotapes for compatibility with PHON ([4]), we segmented and phonetically transcribed the recorded data for the 4 children using this software. In this first stage, all utterances uttered by the children were transcribed, including speech-like utterances like vocalizations, cries, or whisperings. The acoustic part of each utterance was exported for acoustic and prosodic analysis.

2.4. Perceptual and prosodic analysis

After exporting the sound files, we judged each utterance to be meaningful or nonmeaningful. Following Snow [6], meaningful utterances were identified on the basis of four criteria: (1) some phonetic relation to an adult-based word, (2) appropriate use in context, (3) consistency, and (4) the parent's confirmation that the child's utterance was meaningful. As is well known, intentionality is very relevant for intonation because tone contours phonetically encode the pragmatic intentions of the speaker. Imitated utterances were also transcribed, but are not reported in this paper.

After that, each meaningful utterance was annotated for the following fields: (1) orthographic transcription; (2) prosodic transcription in the Catalan version of ToBI, CatToBI (Prieto et al. 2007); (2) pragmatic meaning; (3) annotation of the main differences between the adult and the children's intonation patterns. The pitch contours of the meaningful utterances produced by each child were acoustically analyzed using Praat ([1]). Figure 1 shows the orthographic and prosodic transcription of the utterance [ˈalaaa] *hola* 'hello' produced by Guillem at 1;4.26. Pitch accents and boundary tones are transcribed in one tier and phrase breaks in another:

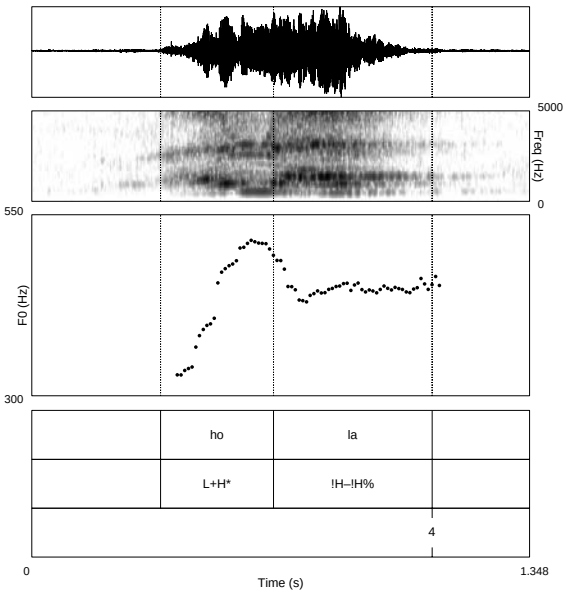

Figure 1: Waveform display, spectrogram, f0 contour, and prosodic labelling of the utterance [ˈalaa] *hola* 'hello' produced by Guillem at 1;4.26.

3. RESULTS

3.1. Methodological issues: one-word and two-word stages

One of the most widely used indices of language development and grammatical complexity, at least in the first stages, is the Mean Length of Utterance in morphemes (MLUm) or words (MLUw). In this study, we calculated both using the "mlu" and "wlen" commands in CLAN, and the two measures were highly correlated. Figure 2 shows the MLUw for each of the sessions, for each child.

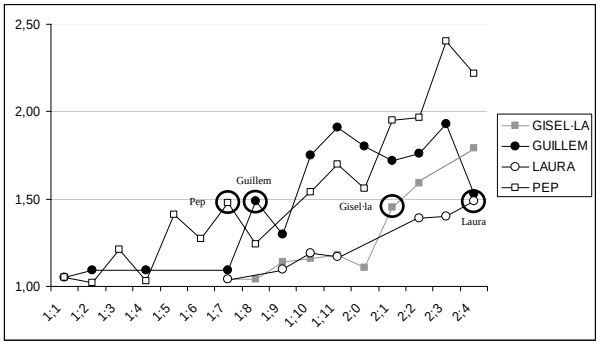

Figure 2: Measures of Mean Length of Utterance in words (MLUw) for each of the sessions, for each child.

Interestingly, the graph shows that while Pep and Guillem reach an MLUw level of 1.5 between 1;5 and 1;8, Laura and Gisel·la do not reach this level until they are 2;1 or 2;2. The dual distribution of the data makes it possible to test the claim that there is a sound correlation between grammatical and intonational development (Snow [6], [7], among others). In the following two sections we describe the intonational patterns produced by the two pairs of children separately.

3.2. Guillem and Pep

3.2.1. One-word period

This section examines the intonational development of Guillem and Pep, the two children who start producing two-word combinations at around 1;6. The analysis reveals that both begin to use a handful of intonational contours at about 13-15 months of age. The most widely used contour is the "statement", used as a way to designate an object or as a response to a question. For example, Figure 3 shows the waveform, the spectrogram, and the f0 contour of the utterance [ˈpilo] *pilota* 'ball' produced by Pep at 1;2.3. This was Pep's answer to the question by his mother *Què és això?* 'What is this?'.

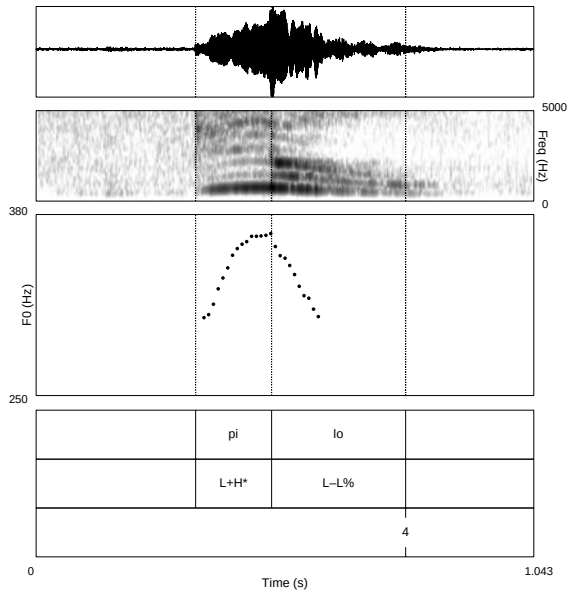

Figure 3: Waveform display, spectrogram, f0 contour, and prosodic labelling of the utterance [ˈpilo] *pilota* 'ball' produced by Pep at 1;2.3.

Importantly, the alignment properties of the L+H* and L-L% boundary tones are largely mastered: the rise of the L+H* pitch accent starts to rise at the beginning of the syllable, and it ends towards the end of the syllable; after that, the f0 falls in the posttonic.[1] Yet the final boundary tone L-L% is realized as a mid tone by the child, and not as a low tone.[2] As in other languages, a high proportion of level contours was found in early meaningful speech, indicating that children in the one-word period are still learning to implement the pitch scaling patterns of different tonal units.

Yet there are also other facts that indicate that adult-like use of accent range is developing very fast. For example, the two children use a wider pitch accent range to express emphasis or focus, as is the case of the calling contour [ˈaja,ˈaja] *Laia, Laia* 'proper name' uttered by Pep at 1:2.28, while trying to desperately catch his sister's attention.

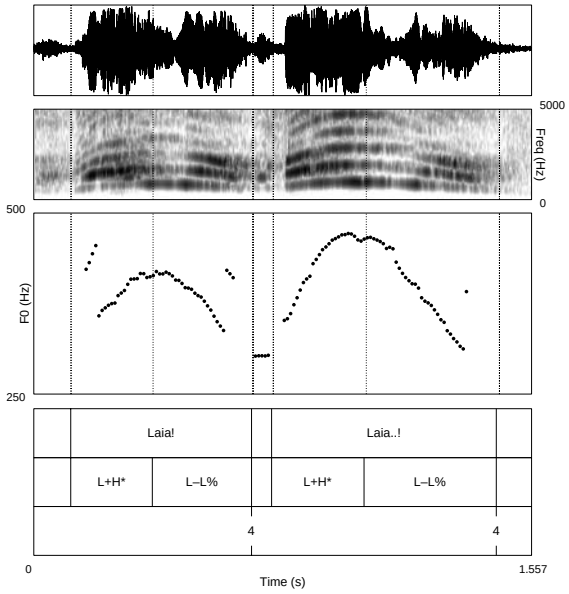

Figure 4: Waveform display, spectrogram, f0 contour, and prosodic labelling of the utterance [ˈaja,ˈaja] *Laia, Laia* 'proper name' produced by Pep at 1;2.28.

Another contour produced by the two children is the "calling contour" or "stylized call or chant", which is phonetically realized with a rising accent

[1] Fine control of tune-text alignment was consistent in all productions of statements for all children. Moreover, we found cases where intrasyllabic alignment was also mastered in monosyllables.

[2] We calculated the semitone difference from the peak to the utterance-final F0 value in this utterance and compared it with the semitone difference in the mother's pronunciation. Indeed, Pep has a lower semitone range than his mother: Pep: 2,54 st - 0,28 st = 2,26 st; Mother: 5,76 st - 2,07 st = 3,69 st.

on the accented syllable L+H* followed by a mid sustained boundary tone !H-!H% (see the utterance [ˈalaaa] *hola* 'hello' produced by Guillem at 1:4.26 in Figure 1). This contour is produced with other "chanted" utterances such as the typical pattern [ˈat^{h}aaa] *ja està* 'all done'.

The precocious development of intonation during the one-word period is demonstrated by the appearance of complex boundary tones at the end of this stage. Figure 5 shows the intonation pattern of the sequence [ˈalaaa] *hola* 'hello' produced by Guillem at 1:4.26. This contour is an insistent calling contour realized with a rising pitch accent on the accented syllable (L+H*) plus a complex L-H% boundary tone (cf. also Figure 1).

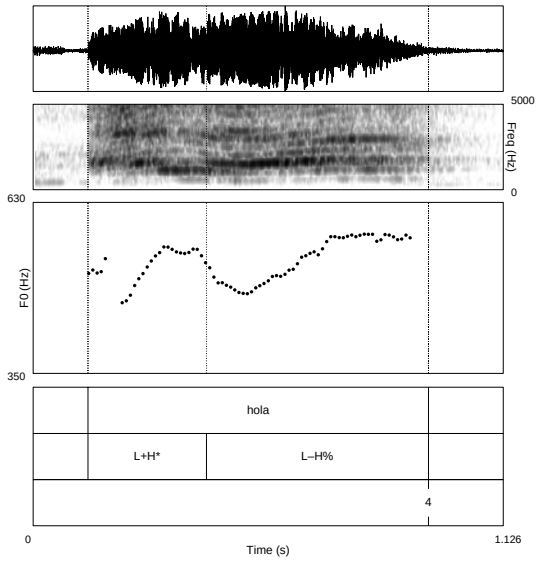

Figure 5: Waveform display, spectrogram, f0 contour, and prosodic labelling of the utterance [ˈalaa] *hola* 'hello' produced by Guillem at 1;4.26.

Finally, interrogative utterances also appear in the one-word period. Pep has the first interrogative contour at 1;1.28, and after that questions regularly appear in each session. For each case, the children's pragmatic intention of request was assessed independently of intonation by watching the video tapes. We found that requests generally appear when the mother does not respond to an utterance: then the infant usually repeats it more emphatically or uses the request intonation. Figure 6 shows the waveform, spectrogram, and f0 curve of the interrogative utterance [ˈakɛt^{h}ə] *aquesta?* 'this one?' produced by Pep at 1;5. Interestingly, in this case the final boundary tone is also realized as a level tone.

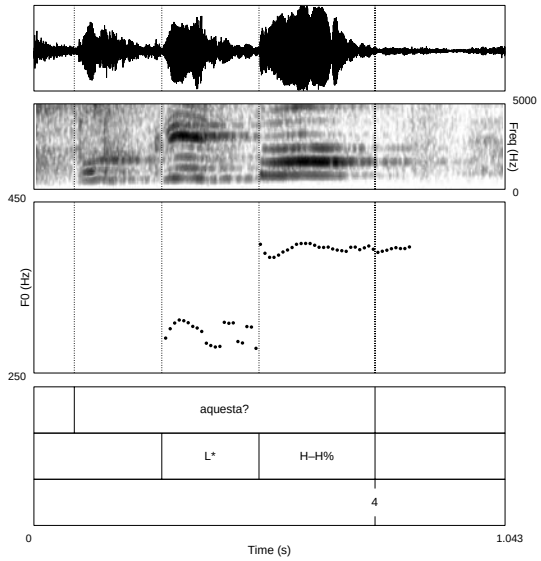

Figure 6: Waveform display, spectrogram, f0 contour, and prosodic labelling of the utterance [ˈəkɛt^{h}ə] *aquesta?* 'this one?' uttered by Pep at 1;5.22.

3.2.2. Two-word period

In this period, the two children start producing a variety of tunes to express requests, discontent or insistence, patterns which are especially complex in Catalan. For example, one of the discontent contours in adult Catalan is produced with a nuclear accent L* followed by a complex H-L% boundary tone. Figure 7 shows the first production of this contour by Pep: [ˈəma, ˈuna ˈkɔja] *home, una cullera!* 'man, a spoon!'.

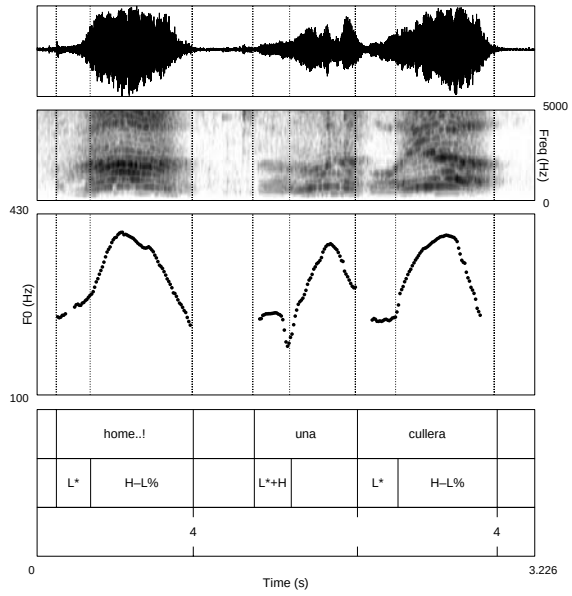

Figure 7: Waveform display, spectrogram, f0 contour, and prosodic labelling of the sequence [ˈəma, ˈuna ˈkɔja] *home, una cullera!* 'man, a spoon!' uttered by Pep at 1;8.0.

The example in Figure 7 demonstrates that the child at this age is capable of succesfully producing the complex tune-text association patterns with some f0 contours: the child associates the tone L* to the three accented syllables (*home* 'man', *una,* and *cullera* 'a spoon'), and associates a complex H-L% boundary tone with the postaccentual syllable.

Another example of an especially complex intonation pattern is the insisting request shown in Figure 8. Insistent requests in Catalan can be expressed through an intonation contour that consists of a H* pitch accent followed by a complex boundary tone sequence LH-L%. The production of this contour demonstrates that relatively early Guillem has an outstanding control over the complex alignment of edge tunes.

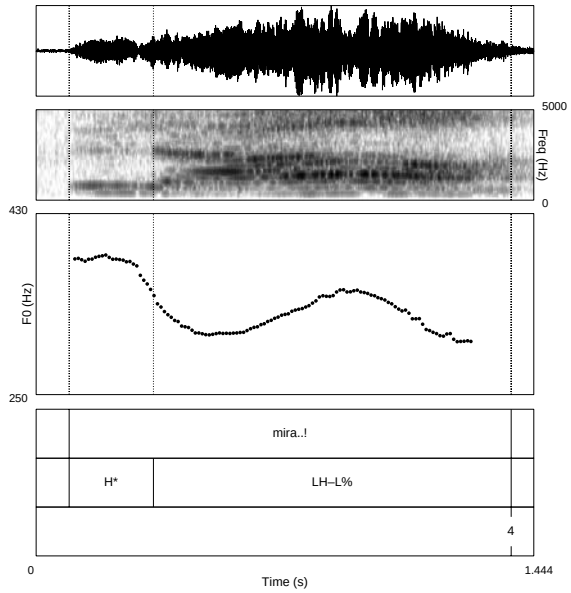

Figure 8: Waveform display, spectrogram, f0 contour, and prosodic labelling of the sequence [ˈmiɹaa] *mira..* 'please take a look' uttered by Guillem at 1;11.13.

3.3. Gisel·la and Laura

Analysis of the intonation contours produced by the other two children reveals that there is a great increase in the use of intonation between 19 and 20 months, well before they start using two-word combinations. By this time both produce statements and a variety of exclamative, imperative and interrogative intonation contours correctly, and they also use a variety of tunes to express requests, discontent or insistence. Importantly, the children master the tune-text alignment patterns in these contours. Figure 9 shows an interrogative utterance produced by Laura at 1;7, realized as a L* nuclear contour followed by a H-H% boundary tone.

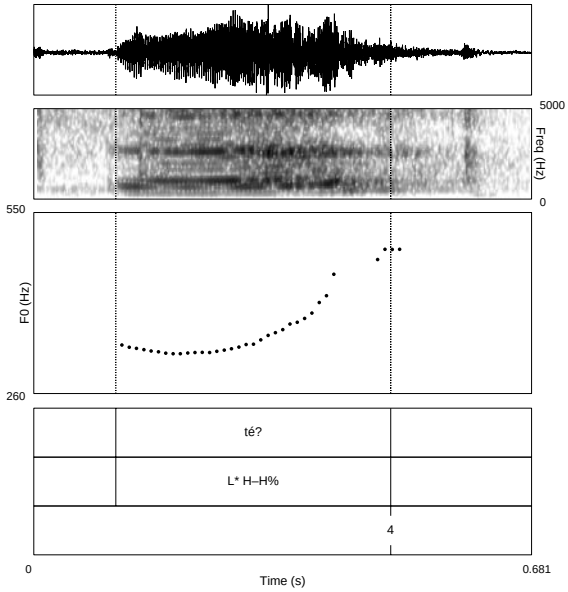

Figure 9: Waveform display, spectrogram, f0 contour, and prosodic labelling of the sequence [ə ˈtʰɛ:] *té*? 'do you want it?' uttered by Laura at 1;7.10.

Figure 10 shows the first complex contour produced by Gisel·la at 1;10. This is the Catalan discontent contour realized as a nuclear accent L* followed by a complex H-L% boundary tone.

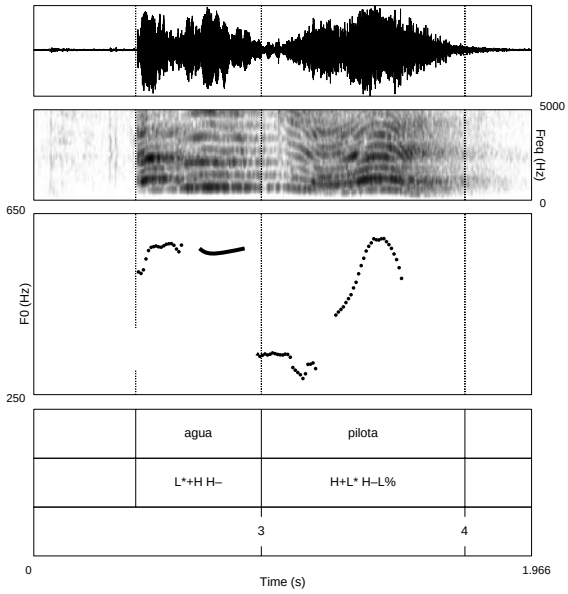

Figure 10: Waveform display, spectrogram, f0 contour, and prosodic labelling of the utterance [ˈaɣu,ˈtee] *aigua, pilota* 'water and a ball' uttered by Gisel·la at 1;10.07.

The contour in Figure 10 was produced by Gisel·la in the following context: she and her mother were reading a book, and the mother asked her a number of times what was depicted on a particular page. After answering three times, Gisel·la angrily repeated one more time to her mother. Crucially, the same contour was produced by Pep at the same age, in spite of the difference in grammatical development between the two children (see Fig. 7).

Finally, in the same session at 1;8, Gisel·la produces an insistent request that consists of a H+L* pitch accent followed by a complex boundary tone sequence H-L% (see Figure 11), demonstrating a good control of tune-text alignment of boundary tones. The same complex combination of boundary tones was produced by Guillem at 1;11 (see Figure 8).

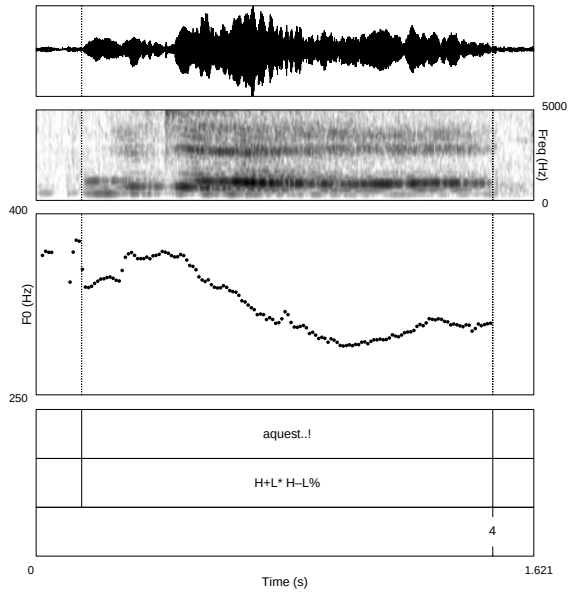

Figure 11: Waveform display, spectrogram, f0 contour, and prosodic labelling of the utterance [aˈkɛɛɛt] *aquest.* 'this one' uttered by Gisel·la at 1;8.24.

In conclusion, Laura and Gisel·la's examples of intonational development between 1;7 and 1;11 show a good phonetic and phonological command of a variety of pitch accents and boundary tones, all produced during the one-word stage. No substantial increase in intonational grammar was attested when they started producing two-word combinations.

4. CONCLUSION

In this article, we have examined developmental data from four Catalan-speaking children and analyzed the patterns of intonational development over time. Our results demonstrate that, contrary to what has been claimed in the literature, children's emerging intonation is largely independent of grammatical development, at least for some children.

The distribution of MLUw in our data allowed for a comparison between two pairs of children. While Guillem and Pep started producing two-word combinations at around 1:6, Laura and Gisel·la did so at around 24 or even 25 months. Despite the fact that the start of the two-word period was so different, we did not find a substantial difference in the production of nuclear pitch accents and boundary tones between the two pairs of children. Importantly, our study reveals that Catalan children have an important knowledge of intonational grammar before they produce two-word combinations. Specifically, they control the phonetic production and intonational meaning of a variety of phonologically distinct pitch accents and boundary tones by about 1;9, regardless of their level of grammatical development. We described a very early mastery of tone-text alignment of pitch accents and boundary tones, which are finely produced from the beginning. This means that an important part of the phonetic substance of word stress is produced appropiately early in development. Yet the pitch scaling properties, contrary to the alignment properties, seem not to be mastered from the beginning.

5. REFERENCES

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