EFFECT OF UTTERANCE LENGTH ON F0 SCALING

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ABSTRACT

This study examines the effect of utterance length on utterance-initial F0 values and H and L scaling of nuclear accent in Majorcan Catalan. Research on the correlation between utterance length and initial F0 values has thus far yielded contradictory answers to the question of whether utterance length is a determining factor for initial pitch height. Regarding the impact of utterance length on scaling of nuclear accents (known as *downstep*), it has been shown that downstep may be under the conscious control of the speaker and be governed by a clearly communicative function. Firstly, the results reveal that there exists a correlation between sentence length and initial pitch height, but this correlation is not constant across speakers and sentence-types, suggesting that this is an instance of *soft preplanning*. Secondly, our results show that *downstep* or, more precisely, the failure of downstep may be grammaticalized in a particular phonological context.

Keywords: utterance-length, F0 scaling, preplanning, downstep.

1. INTRODUCTION

The effect of utterance length on the scaling of utterance-initial F0 peaks is a controversial issue in intonational studies. A correlation between utterance-initial F0 peaks and length of utterance would mean that speakers are able to plan F0 contours at a phrase level by beginning higher when the utterance is longer and lower when the utterance is shorter (what is known as *hard preplanning* or *the global hypothesis*). Alternatively, speakers may proceed at a more local level, that is, accent-by-accent (i.e. *the local hypothesis*). Work in this field has produced conflicting results. Thus, some findings have reported that speakers begin higher or lower depending on utterance length ([3], [4], [10], [11]), while other researchers have reported no utterance length effect on peak values ([1], [2], [6], [7], [8], [12], [13], [14]). As regards the impact of length of utterance on scaling of nuclear accents, the research suggests that speakers can make a meaningful use of the presence or absence of downstep. The present study tests whether utterance length affects the scaling of utterance-initial F0 values as well as H leading tone and L tone F0 values.

2. METHODS

Yes-no questions and what-questions in Majorcan Catalan have been described as containing a difference in pitch height in the pretonic nuclear syllable. Thus, although both types of questions are characterized by a falling nuclear accent H+L*, that is, an H leading tone aligned with the pretonic nuclear syllable and a L* tone associated with the last stressed syllable, in the case of yes-no questions, the H leading tone has been shown to be systematically realized with a higher tone than that found in what-questions ([15]). Moreover, yes-no questions are headed by the unaccented interrogative particle *que* ('that') while what-questions are headed by the accented what-particle *què* ('what'). Previous work ([5]) has also reported that analogous prosodic features are able to disambiguate between different question types.

2.1. Material and experimental procedure

The data used in this study consisted of yes-no questions and what-questions of lengths ranging from 1 to 3 pitch accents and divided into blocks according to the number of pitch accents in each utterance. Each block was made up of paired yes-no and what-questions that were identical or very similar at the segmental level (see Table I). The last word always contained the stress on the penultimate syllable to provide more room for nuclear accent and boundary tone realization.

Table 1: Examples of the utterances used in this experiment. Stressed syllables are marked in boldface.

Yes-no questions	What-questions
*Que en va **ven**dre?*	***Què** en va **ven**dre?*

(‘Did s/he sell any of it?’) [kəɱ va ˈvəɲdrə]	(‘What did s/he sell of it?’) [ˌkəɱ va ˈvəɲdrə]
*Que n’esper**a**va **ven**dre?* (‘Did s/he expect to sell any of it?’) [kə nəspeˌɾavə ˈvəɲdrə]	***Què** n’esper**a**va **ven**dre?* (‘What did s/he expect to sell of it?’) [ˌkə nəspeˌɾavə ˈvəɲdrə]
*Que hi vol**i**a tor**nar** a **ven**dre?* (‘Did s/he want to sell there again?’) [kəj vuˌliə torˌna ˈvəɲdrə]	***Què** hi vol**i**a tor**nar** a **ven**dre?* (‘What did s/he want to sell there again?’) [ˌkəj vuˌliə torˌna ˈvəɲdrə]

Five native speakers of Majorcan Catalan (two females and three males) read three repetitions of the three blocks of utterances. Thus a total of 450 utterances (5 sentences x 2 types x 3 lengths x 3 repetitions x 5 speakers) were obtained. In order to facilitate interpretation of the utterances by the speakers, each test question was answered verbally by the author of this study.

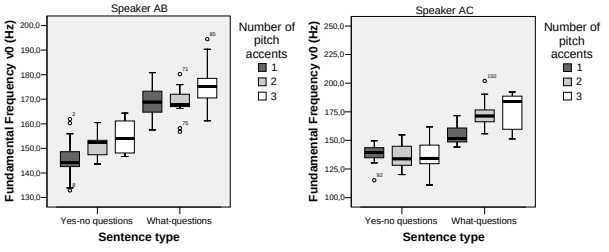
Pitch extraction and measurements were performed using Praat software. As the aim of this work was to examine the effect of utterance length on utterance-initial F0 values and H and L scaling of nuclear accent, no measurements related to prenuclear pitch accents were taken. Non-parametric statistical tests were used to test for differences in F0 values.

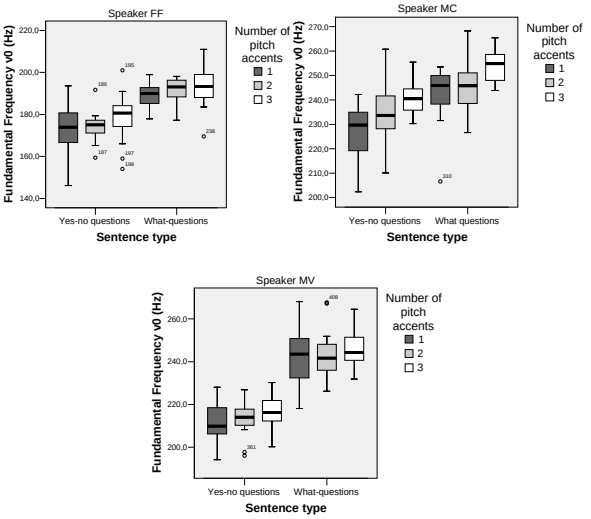
3. RESULTS

3.1. Utterance-initial F0 values.

Figure 1 shows the box plots of F0 for the vowel [ə] of the particle *que/què* in yes-no questions (left-hand boxes) and what-questions (right-hand boxes) for each of the five speakers, broken down into different utterance lengths (1-3 pitch accents).

Figure 1: Box plots of F0 for the vowel [ə] of the interrogative particles *que* (yes-no questions) and *què* (what-questions) in utterances of different lengths for each speaker.





Results of Friedman tests (Table 2) revealed that speakers AB, AC and MC showed a significant tendency in what-questions to anticipate the length of the utterance by beginning higher if the utterance was longer (presumably to avoid the pitch falling much lower) and lower if the utterance was shorter. This anticipation also occurred in yes-no questions, though for only two speakers (AB and MC).

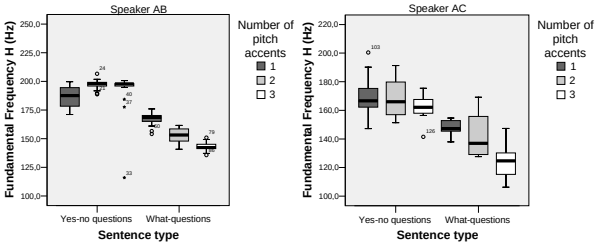
Table 2: Results of Friedman tests with significance level set at 0.05.

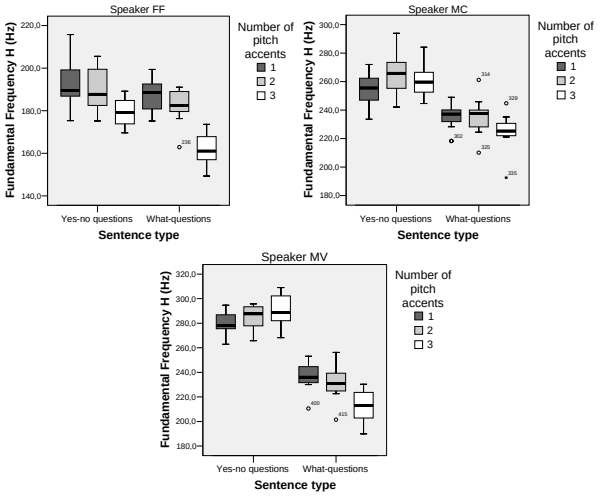
Subject	Yes-no questions	What-questions
AB	$\chi^2(2)=12.4$	$\chi^2(2)=6.40$
AC	$\chi^2(2)=1.00$, ns	$\chi^2(2)=8.22$
FF	$\chi^2(2)=3.60$, ns	$\chi^2(2)=1.85$, ns
MC	$\chi^2(2)=12.13$	$\chi^2(2)=12.13$
MV	$\chi^2(2)=.93$, ns	$\chi^2(2)=.40$, ns

3.2. H leading tone F0 values

Figure 2 shows the box plots of F0 at the start of the fall within the falling nuclear accent H+L* in utterances containing from 1 to 3 pitch accents for yes-no questions (left-hand boxes) and what-questions (right-hand boxes).

Figure 2: Box plots of H-F0 within the nuclear accent H+L* for yes-no questions and what-questions in utterances of different lengths for each speaker.





Note that although there is evidence that utterance length affects the H pitch height value, this utterance length effect is greater for what-questions (right-hand boxes) than for yes-no questions (left-hand boxes), since it is statistically significant for all speakers in what-questions but only for one speaker (FF) in yes-no questions (Table 3).

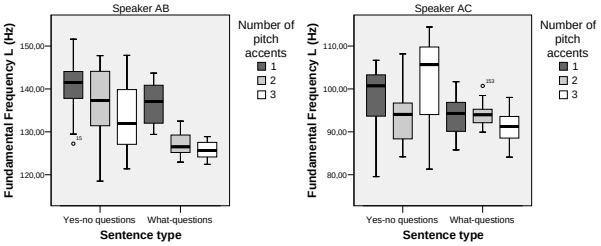
Table 3: Results of Friedman tests with significance level set at 0.05.

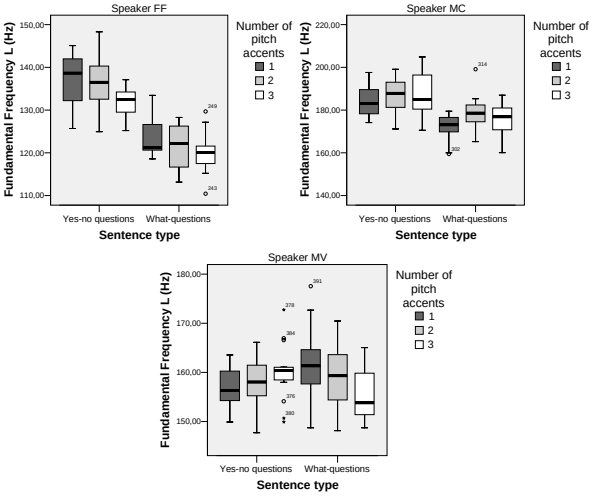
Subject	Yes-no questions	What-questions
AB	$\chi^2(2)=5.20$, ns	$\chi^2(2)=28.13$
AC	$\chi^2(2)=2.71$, ns	$\chi^2(2)=10.66$
FF	$\chi^2(2)=16.93$	$\chi^2(2)=23.28$
MC	$\chi^2(2)=4.80$, ns	$\chi^2(2)=6.53$
MV	$\chi^2(2)=5.73$, ns	$\chi^2(2)=19.60$

3.3. L tone F0 values

Figure 3 shows the box plots of F0 for the end of the fall within the nuclear accent H+L* in utterances of different lengths (1 to 3 pitch accents) for yes-no questions (left-hand boxes) and what-questions (right-hand boxes).

Figure 3: Box plots of L-F0 within the nuclear accent H+L* for yes-no questions and what-questions in utterances of different lengths for each speaker.





A constant utterance-length effect is not present in the L-F0 value. Nevertheless, it seems that utterance length affects the L-F0 of what-questions more that that of yes-no questions: the longer the utterance, the lower the L-F0—with the exception of speaker MC, who does not follow this pattern. Statistical analysis (Table 4) confirms that the utterance length effect on the L-F0 value is significant only for speaker AC in yes-no questions and for speakers AB, MC and MV in what-questions.

Table 4: Results of Friedman tests with significance level set at 0.05.

Subject	Yes-no questions	What-questions
AB	$\chi^2(2)=4.13$, ns	$\chi^2(2)=23.33$
AC	$\chi^2(2)=8.14$	$\chi^2(2)=1.55$, ns
FF	$\chi^2(2)=3.60$, ns	$\chi^2(2)=2.71$, ns
MC	$\chi^2(2)=1.73$, ns	$\chi^2(2)=6.93$
MV	$\chi^2(2)=1.20$, ns	$\chi^2(2)=10.80$

4. DISCUSSION

As regards utterance-initial F0 values, evidence was found for significant anticipatory raising for three of the five speakers in what-questions and for two of the five speakers in yes-no questions. Thus, speakers may vary the height of the initial F0 values in what-questions and yes-no questions depending on the utterance length as measured by the number of pitch accents in the utterance. In other words, our results are consistent with those previous findings which report that speakers begin higher or lower (with a higher or lower pitch) depending on utterance length ([3], [4], [10], [11]). By contrast, other researchers have reported no utterance length effect on F0 values ([1], [2], [6], [7], [8], [12], [13], [14]). However, the fact that the interaction between utterance length and initial F0

values is not statistically significant for all speakers suggests that the observed global preplanning must be interpreted as *soft preplanning*, that is, a strategy that speakers may opt to use but that is not essential as a production mechanism ([6], [9]).

The present results also confirm the interaction between utterance length and the H value of the nuclear accent, with the F0-H value falling much lower as the number of pitch accents increases. However, though this interaction between length and H is high in what-questions, it is nearly non-existent in yes-no questions. Considering the difference in the height of the leading tone that characterizes yes-no questions as opposed to what-questions in Majorcan Catalan (described in [15]), this sort of blocking of the downtrend tendency in yes-no questions could be interpreted as contrast enhancement between yes-no questions and what-questions in this language. This strategy would facilitate the perception of the L tone in yes-no questions, since otherwise the L tone might be misinterpreted from a downstepped or plain H.

By contrast, the L point is less affected by utterance length than the H point. The effect of utterance length on the L-F0 value is still nearly null in yes-no questions and lower than that of the H-F0 value in what-questions.

5. CONCLUSIONS

The results reported in this article confirm that Majorcan Catalan speakers plan the height of the initial F0 values in what-questions and in yes-no questions, that is, they anticipate the length of the utterance by beginning higher when the utterance is longer and lower if the utterance is shorter. However, the fact that there is variation within speakers in the magnitude of the interaction between utterance length and the height of the initial peak indicates that any global preplanning that occurs in this instance must be interpreted as *soft preplanning* ([6], [9]).

Utterance length is also shown to have an important effect on the H scaling of nuclear accent as long as this effect does not conflict with the effect that the sentence-type factor exerts on the pitch height of the leading tone H of the nuclear accent H+L*. This failure of downstep could be interpreted as contrast enhancement between yes-no questions and what-questions in Majorcan Catalan.

6. REFERENCES

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