# A CROSS LINGUISTIC ANALYSIS OF PITCH RANGE IN ENGLISH L1 AND L2

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## ABSTRACT

This paper presents a preliminary investigation of the differences in pitch range in English spoken as L1 and L2. In this study, the productions of 5 English sentences read by 18 native (American) English speakers and 18 non-native (Italian) English speakers are compared. The hypothesis being tested is that Italian speakers of English have a narrower pitch range and less pitch variation that native English speakers. Different measures of pitch range are used to compare the productions of the two groups. The results of this preliminary study partially confirm the hypothesis and point to the existence of cross linguistic differences in pitch range that are worth further investigation.

**Keywords:** pitch range, cross linguistic differences, English L2, Italian

## 1. INTRODUCTION

One of the aims of second-language research is to describe and explain how speakers' L1 phonological and phonetic systems affect their productions in the L2. Previous studies have been aimed at investigating the characteristics and perceptual effects of second-language prosody, as well as its effects on intercultural communication. In this perspective, this paper presents a preliminary investigation of the differences in pitch range in English sentences produced by native (American) English speakers and Italian speakers of English.

## 2. PITCH RANGE AS A SOURCE OF DIFFERENCE ACROSS LANGUAGES

Previous studies suggest that languages may differ in their use and interpretation of pitch range. For example, in a study aimed at comparing the production of pitch range by Southern Standard British English speakers (SSBE) and Northern Standard German speakers (NSG), Mennen, et al. [9, 10] found that the former have higher and more varied pitch range than the latter. Differences in use and interpretation of pitch may be influenced by socio-cultural factors. For example, van Bezooijen [2] found that differences in the evaluation of high vs. low pitch by Dutch and Japanese listeners correlated with differences in the use of pitch by the two cultures. Cross-linguistic differences in pitch range may also appear in second-language speech, as a result of speakers' transferring their L1 patterns into the L2. Ullakonoja [14, 15] found some evidence that Finns speaking Russian as a second language use a narrower pitch range and a less variable pitch than Russian L1 speakers, though they show more Russian-like patterns in advanced stages of language learning. In fact, it has been suggested that L2 speech may be characterised by a narrower pitch range than L1 speech [1].

Differences in interpretation of pitch range between second–language speakers and first-language speakers may also occur at a paralinguistic level. For example, in a study investigating native and non-native speakers' perception of paralinguistic intonational meaning, Chen [5] found that native Dutch and English speakers differ significantly from non-native Dutch and English speakers in their perception of emphasis and surprise, due to L1 transfer. However, learner groups' transfer strategies may differ, as a result of differences in L2 proficiency, type of L2 input, and the salience of form-meaning relations in L2.

In some languages, limited pitch variation may be associated with lack of speaker's liveliness [6, 9, 13, 14]. In L2 speech, the use of limited pitch variation may be related to lack of proficiency in L2 rather than to prosodic differences between the L1 and the L2, and may be more frequent in particular speaking styles, such as public speaking [6, 7].

## 3. INVESTIGATING ITALIAN SPEAKERS' PITCH RANGE IN ENGLISH L2

Stereotypical imitations and skits of the Italian accent in English portray people who speak loudly, add extra vowels at the end of monosyllabic words,

and sound over-emphatic when they speak. However, anecdotal evidence and pilot studies by Busà [4] suggest that, in contexts such as oral presentations, Italian speakers of English L2 have a narrower pitch range and less pitch variation than native speakers. This use of pitch in English by Italian speakers may convey an idea of detachment or lack of interest and thus affect the reception of the speaker's message.

The present study was designed to investigate the existence of differences in pitch range in English sentences produced by Italians (non-native speakers) and American English native speakers, the hypothesis being that, when speaking English, Italians have a narrower pitch range and less variation that native English speakers.

### 3.1. Measures of pitch range

Pitch range has been the object of a number of recent studies [8, 9, 10, 11, 12, 14]. There is general consensus that pitch range can be quantified along the two dimensions of *level* and *span*, where level refers to the overall pitch height (register) of a speaker's voice, and span refers to the speaker's range of frequencies in a speech sample [8, 12]. However, there is no general consensus on how to quantify pitch range, and cross-linguistic differences in pitch range are particularly hard to measure because pitch is subjected to a wide range of inter-speaker and within-speaker variability, with data of speakers from different languages often overlapping.

To quantify differences in pitch range, a number of long-term distributional measures have been used, which include mean or median F0 for *level*, and maximum minus minimum F0 for *span*. Alternative to LTD measures are 'linguistic' measures, linked to specific linguistically-defined landmarks in the F0 contour [10, 12]. To quantify cross-linguistic differences in pitch range, other measures for *span*, elaborated by Mennen, et al. [10], include 90% and 80% range, and different standard deviations around the mean. Measures of skewness and kurtosis have also been found to be good predictors of cross-linguistic differences in pitch: because they do not assume that F0 is normally distributed around the mean, they may be closer to linguistic measure [11, 12]. However, documenting cross-linguistic differences in pitch range remains difficult, and requires an adaptation of the methods developed for capturing within-language pitch-range variation [11].

## 4. METHOD

### 4.1. Materials, subjects and procedure

The speech data consists of 5 English sentences (1 *yes-no* question ('yn'), 1 *wh*-question ('wh'), 1 statement ('st') and 2 answers ('an', 'yes') extracted from a corpus of 28 sentences, forming a short conversation. The sentences were read aloud by 18 native (north-East) Italian speakers and 18 native (California) English speakers. All the subjects were females, 20-25 year-old and students at the University of Padova, Italy.

The speakers read the text aloud once. They were instructed to read the text with a natural, conversational intonation, and were asked to repeat any sentence when they misread it. The recordings took place in a quiet room, and each recording session lasted about 10 minutes. The audio signal was acquired digitally on a computer via a Logitech PC Headset 120 microphone, placed about 10 cm from the subject, at a sampling rate of 24kHz.

### 4.2. Measurements and analysis

F0 was measured with Praat [3], with pitch floor set at 75 Hz and pitch ceiling at 500 Hz. Pitch was measured in Hertz (Hz) and semitones (ST).

To capture cross-language differences in pitch range, the following long-term distributional measures (LDT) for pitch level and span were calculated: F0 max, F0 min, F0 mean, F0 median, standard deviations, 80% range, 90% range, 100% range, skewness and kurtosis.

The statistical significance of the data was tested with mixed ANOVAs with 'language' as a between-subject factor, and 'sentence type' as a within-subject factor. The ANOVAs were run on both Hz and ST values. This paper only reports the results for level, span and skewness, in ST.
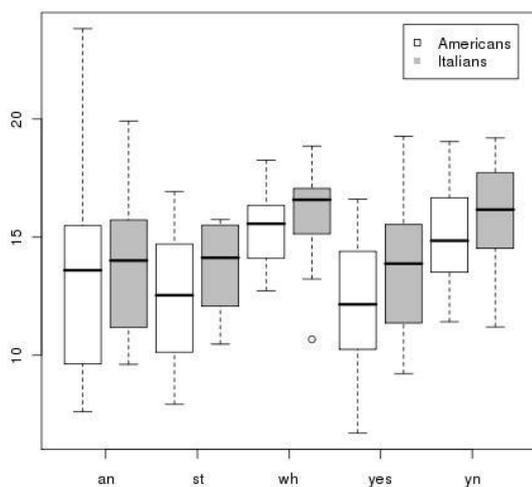
## 5. RESULTS

### 5.1. Level

For level (mean F0), the between-subject factor 'language' did not reach significance, while the within-subject factor 'sentence type' was highly significant: $(F_{(4,140)}=10.54, p=0.0000)$.

The box plot in Figure 1 shows the distribution of the mean F0 values, in ST, for the two language groups, evidencing clear differences in pitch level patterns. For all sentence types, the Italians have overall higher pitch levels than the Americans, as shown by the positions of the upper and lower box

lines, and the values of the median pitch (the black horizontal line in each box). Particularly in the sentence 'wh', the median value of the Italians' pitch is greater than the value of the third quartile of the Americans' pitch. Finally, in the sentences 'an' and 'st', the Italians show a narrower pitch range than the Americans, as shown by the upper and lower values of the whiskers extending from the boxes.

**Figure 1:** Box Plot showing the distribution of mean F0 values (for level, in ST) for the Americans and the Italians in the five sentences.



### 5.2. Span

For span, the between-subject factor 'language' showed a mild significance $(F_{(4, 34)}=3.82, p<0.05)$ for 90% range, but not for 100% range and 80% range. The within-subject factor 'sentence type' was highly significant for all range measures: for 100% $(F_{(4,140)}=7.45, p=0.0000)$; for 90% $(F_{(4,140)}=3.80, p<0.005)$; for 80% $(F_{(4,140)}=3.02, p<0.020)$.

The box plot in Figure 2 shows the distribution of the 90% range values, in ST, for the two language groups. The data show the existence of large differences in pitch range patterns. For all sentences, the Americans show a wider range of values (from minimum to maximum) than the Italians. In 3 out of 5 sentences (i.e., sentences 'an', 'st', 'yes') the American median values are well above the values of the Italian median values, and are greater or approaching the value of the third quartile in the Italian data set in the sentences 'st' and 'an' respectively.

**Figure 2:** Box Plot showing the distribution of 90% range values (for span, in ST) for the Americans and the Italians in the five sentences.
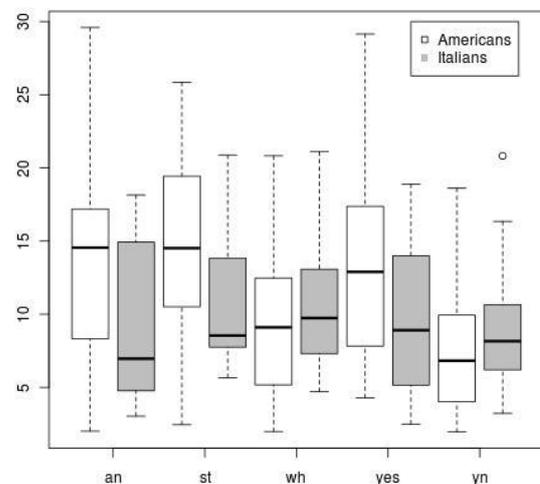


### 5.3. Skewness

For skewness, the between-subject factor 'language' was not significant, while the within-subject factor 'sentence type' was highly significant: $(F_{(4,140)}= 5.81, p<0.000)$.

Figure 3 shows how the two groups differ in their use of higher vs. lower pitch values in the different sentences. As can be observed from the figure, the Americans' ranges vary widely in the different sentences. They preferably use the lower range of values in the 'an' and 'st' sentences, the higher range of values in the sentences 'yes' and 'yn', and they have a symmetrical value distribution in the sentence 'wh'. Overall, this shows that F0 in this language is distributed over a wide range. On the other hand, the Italians show fewer asymmetries in distribution than the Americans. In the sentences 'an', 'st' and 'wh', the values are varying quasi-symmetrically above and below the median and the mean value, with little asymmetry in the 'wh' sentence and more in the 'an' and 'st' sentence. In the sentences 'yes' and 'yn', the Italians use more values at the lower end than at the upper end. Finally, unlike the Americans, the Italians have similar median values across the sentences, as indicated by the black horizontal line in each box. Thus, the Italian data appear less widely distributed than the American data.

**Figure 3:** Box Plot showing the skewness of the data range for the Americans and the Italians in the five sentences.
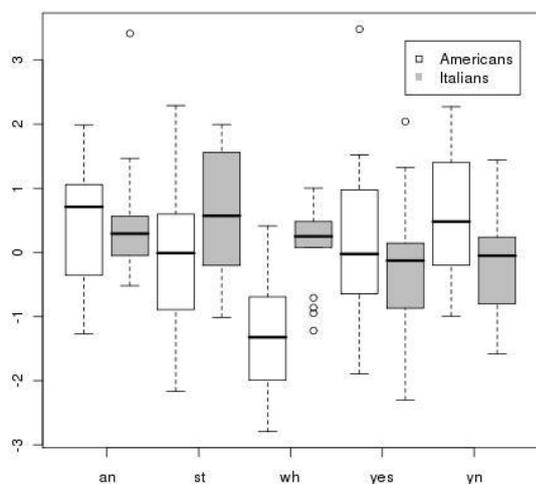


## 6. DISCUSSION AND CONCLUSIONS

This study compares measures of pitch range in English sentences produced by native (American) English and non-native (Italian) English speakers. The factor 'language' did not reach significance for level, span, or skewness, while 'sentence type' was highly significant for all the variables under study. However, the data indicate that there may be differences in the two groups' productions as regards pitch range. The English sentences produced by the Italians have overall higher pitch levels and narrower ranges than those produced by the Americans. In addition, the Italians' pitch shows overall less variation than the Americans'.

Several considerations can be drawn from the present study. In the first place, it may be possible that the LTD measures used in this investigation for quantifying the differences in pitch range across the two languages may in fact not be able to capture significant cross-linguistic differences, which however do exist. This is compatible with what has been suggested in previous research on cross-linguistic pitch range [9, 11, 12], and calls for further investigations using different methods and measures of analysis.

If confirmed by further studies, the tendencies observed in the present study would support previous studies on second-language prosody [1, 6, 14] which report that L2 speakers tend to have narrower pitch ranges and less variable pitch than native speakers. It would also remain to be determined if this can be considered a feature of early stages of second-language acquisition, whatever the L1 and the L2, or if it is a feature that occurs under particular circumstances (i.e. depending on the L1? on the discourse type? due to read speech in experimental conditions?). This too calls for further investigations, using larger data samples and/or different methods of analysis.

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