

# Acoustical study on spectral characteristics of teachers' English vocalization

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**Abstract.** With the increase of English teaching courses, the specific vocal characteristics of teachers in English teaching are studied and used as the basic data for the design of teachers' spatial acoustics. In order to study this problem, three different English voice materials were read in an anechoic room under three sound intensity levels: large, medium and small, respectively, so as to analyse the equivalent continuous sound pressure level (SPL) and frequency characteristic curves of male and female teachers at 0.3m. In the low frequency band, the SPL increases as the frequency increases. In the mid-frequency band, the SPL reaches the first peak, then decreases briefly as the frequency increases, then increases again to the second peak, and then decreases again briefly as the frequency increases. Then increase again to the third peak. In the high frequency band, the SPL decreases as the frequency increases.

## 1 Introduction

With the continuous improvement of domestic education level, in order to be in line with international standards, on the one hand, there are English courses for all ages, and on the other hand, the use of English for course teaching has become an important direction of Chinese teaching reform in recent years [1]. As early as 2001, the Ministry of Education clearly pointed out that in accordance with the requirements of "education facing modernization, facing the world, facing the future", actively promote the use of foreign languages such as English for teaching. More and more courses adopt bilingual teaching, and the frequency of using English in courses is also increasing. However, according to relevant studies, the pronunciation of Chinese and English is different, so it is necessary to meet the acoustic environment in the classroom in different languages.

Acoustic environment quality is an important part of campus environment quality. [2] Poor classroom acoustic environment affects the teaching of course content on the one hand. On the other hand, it also affects the health of teachers [3], and even the early intellectual development of students [4]. On the contrary, a good classroom acoustic environment can not only reduce the fatigue of teachers and students, but also improve students' attention [5-6]. This is not only the collection of basic data on the vocal characteristics of teachers, but also the design of the classroom acoustic environment in school from the perspective of the vocal characteristics of sound sources, and contributes to the creation of a better classroom acoustic environment. [7-9]

## 2 Research method

In the anechoic room of the State Key Laboratory of Subtropical Building Science of South China University of Technology, 16 subjects were selected, 8 men and women each, and the selected subjects were of the same age, all between 24-28 years old. The size of the anechoic room is 14.5m×8.0m×9.2m, and the background noise is -2.0dBA.

The spectrum analysis method used in this paper is the long-term average spectrum (LTAS). For the duration of the acoustic signal, in order to obtain a relatively stable LTAS, it is generally required that the length of the speech acoustic signal be at least 20-40s. For the length of the Hanning window, the sound frequency characteristics do not change significantly within 10-40ms, so the length of the Hanning window should be 10-40ms. In order to study the influence of vocalization intensity on the frequency spectrum characteristics of teachers, the same content was read with low intensity, medium intensity, and high intensity during the test.

## 3 Experimental results and analysis

### 3.1 SPL and dynamic range

When male and female teachers read three different English materials (E1-E3) with different strengths, the sound pressure level at 0.3m is shown in Table 1-2. It can be seen from the table that the SPL of different English materials under the same intensity are not much different, all within 2dBA, and the greater the intensity used, the smaller the deviation of SPL produced by different

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English materials. And for the same English material, the medium intensity is about 7dBA higher than the low intensity, and the high intensity is about 5dBA higher than the medium intensity.

**Table 1.** SPL and dynamic range at 0.3m of male teachers' reading at medium intensity (dBA).

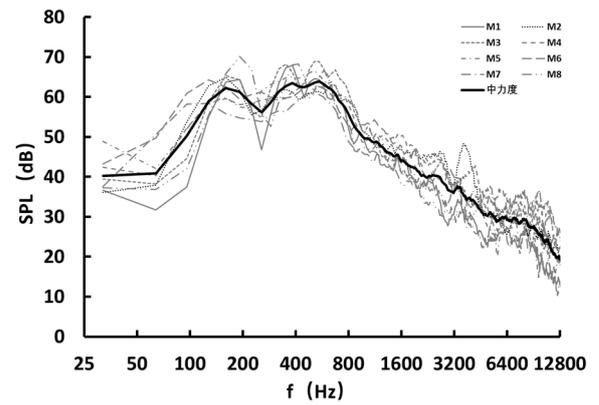
| Vocal Intensity  | English Materials | Max   | Min   | Average |
|------------------|-------------------|-------|-------|---------|
| Low Intensity    | E1                | 70.59 | 59.07 | 63.34   |
|                  | E2                | 71.23 | 59.21 | 63.94   |
|                  | E3                | 71.87 | 60.41 | 65.36   |
| Middle Intensity | E1                | 74.04 | 66.68 | 70.79   |
|                  | E2                | 75.68 | 66.89 | 72.08   |
|                  | E3                | 75.29 | 67.87 | 72.75   |
| High Intensity   | E1                | 83.1  | 75.05 | 78.21   |
|                  | E2                | 81.74 | 71.07 | 78.08   |
|                  | E3                | 82.23 | 75.75 | 78.72   |

**Table 2.** SPL and dynamic range at 0.3m of female teachers' reading at medium intensity (dBA).

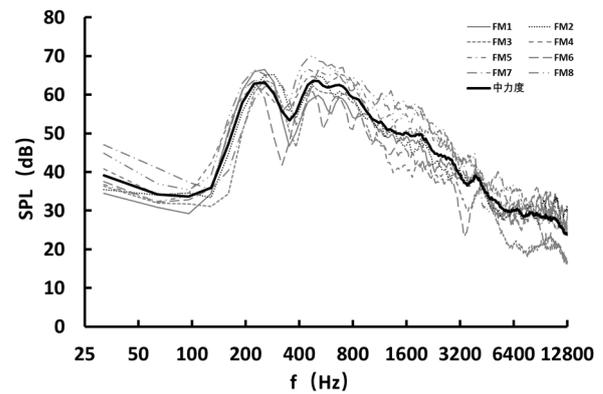
| Vocal Intensity  | English Materials | Max   | Min   | Average |
|------------------|-------------------|-------|-------|---------|
| Low Intensity    | E1                | 70.58 | 56.02 | 65.12   |
|                  | E2                | 72.95 | 57.08 | 66.4    |
|                  | E3                | 73.44 | 56.87 | 66.06   |
| Middle Intensity | E1                | 76.56 | 67.15 | 72.47   |
|                  | E2                | 77.66 | 69.44 | 72.99   |
|                  | E3                | 77.64 | 67.61 | 73.62   |
| High Intensity   | E1                | 83.71 | 73.82 | 78.48   |
|                  | E2                | 81.48 | 73.64 | 77.75   |
|                  | E3                | 83.16 | 72.93 | 78.17   |

### 3.2 Sound frequency characteristic curve

Due to space limitations, it is inconvenient to present all the original measurement results. Choose the LTAS frequency characteristic curve of male and female subjects reading English material 1 under the scene of medium intensity, as shown in Figure 1. The thin gray line in the figure is the long-term average spectral frequency characteristic curve of 8 subjects, and the thick black line is the average long-term average spectral frequency characteristic curve of the subjects. It can be seen from the figure that the overall trend of the frequency characteristic curves of the 8 subjects has certain commonality: In the low frequency band, the SPL increases as the frequency increases. In the mid-frequency band, the SPL reaches the first peak, then decreases briefly as the frequency increases, then increases again to the second peak, and then decreases again briefly as the frequency increases. Then increase again to the third peak. In the high frequency part, the SPL decreases as the frequency increases.



(a) Male Teacher

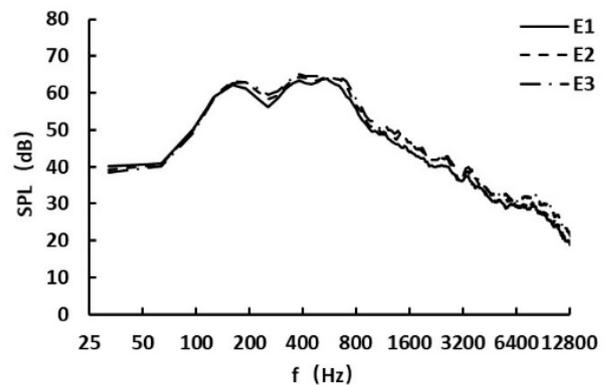


(b) Female Teacher

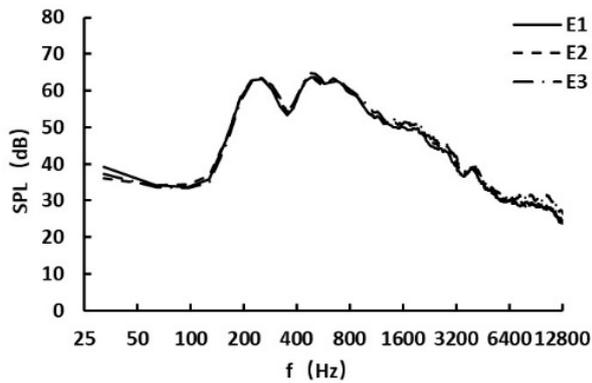
**Figure 1.** The spectrum characteristic curve of teacher reading C1 at medium intensity.

#### 3.2.1 The influence of different vocal material on the frequency characteristic curve.

During the test, each subject reads three kinds of English materials. Figure 2 shows the LTAS frequency characteristic curves of male and female teachers when they read different materials at medium intensity. It can be seen that the curves of different vocal material in English are generally similar.



(a) Male Teacher



(b) Female Teacher

**Figure 2.** The spectrum characteristic curve of teacher reading different voice materials.

In order to further study the similarity between the curves, a straight-line fitting was performed for each frequency characteristic curve, and the corresponding slope and intercept were calculated, as shown in Table 3. It can be seen from the table that the slope of the frequency characteristic curve fitting line is basically the same, the intercept value is close, and there is only a small deviation.

**Table 3.** The fitting line parameters of spectrum characteristic curve of teacher reading different voice materials.

| Teacher Gender | Male Teacher |           | Female Teacher |           |
|----------------|--------------|-----------|----------------|-----------|
|                | Slope        | Intercept | Slope          | Intercept |
| E1             | -0.0019      | 45.021    | -0.0020        | 47.957    |
| E2             | -0.0020      | 46.074    | -0.0020        | 48.329    |
| E3             | -0.0019      | 47.460    | -0.0020        | 49.561    |

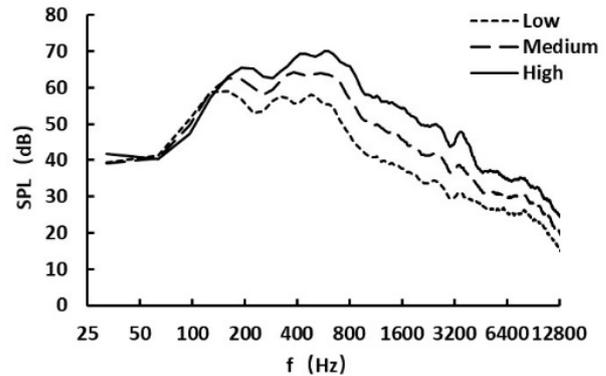
At the same time, the correlation analysis of the curves in the same figure is carried out, and the correlation coefficient  $r$  is calculated, as shown in Table 4. The correlation coefficients between the frequency characteristic curves of the teachers in the process of vocalization of different language materials are all above 0.99, indicating that the similarity between the curves in the same figure is high.

**Table 4.** Correlation coefficient of spectrum characteristic curve of teachers reading different materials in the same language.

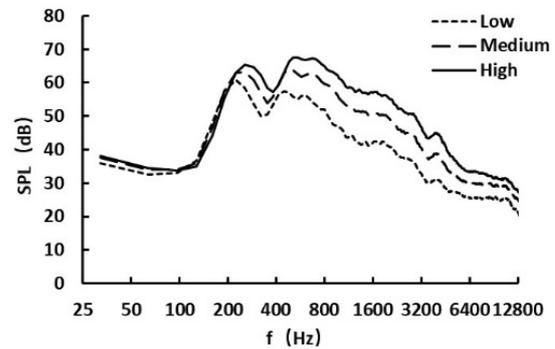
| Male Teacher    |        |        |        |
|-----------------|--------|--------|--------|
| Vocal Materials | E1     | E2     | E3     |
| E1              | -      | 0.9989 | 0.9986 |
| E2              | 0.9989 | -      | 0.9988 |
| E3              | 0.9986 | 0.9988 | -      |
| Female Teacher  |        |        |        |
| Vocal Materials | E1     | E2     | E3     |
| E1              | -      | 0.9993 | 0.9986 |
| E2              | 0.9993 | -      | 0.9987 |
| E3              | 0.9986 | 0.9987 | -      |

### 3.2.2 The influence of different sound intensity on the frequency characteristic curve.

The frequency characteristic curve of the LTAS of the teacher using the same language under different intensity is shown in Figure 3. It can be seen from the figure that when the teacher lectures with different intensity, the frequency characteristic curve shape is relatively close, but as the vocal strength decreases, the peak value on the frequency characteristic curve gradually moves to the low frequency and the peak value also decreases.



(a) Male Teacher



(b) Female Teacher

**Figure 3.** The spectrum characteristic curve of teacher reading at different vocal intensity.

## 4 Conclusion

Test the frequency characteristics of male and female teachers in anechoic room. Analyzed the equivalent continuous SPL and dynamic range of male and female teachers at 0.3m, and further studied its LTAS characteristic curve, and the following conclusions are obtained:

(1) The SPL of different English materials under the same intensity are not much different, all within 2dBA, and the greater the intensity used, the smaller the deviation of SPL produced by different English materials.

(2) The frequency characteristic curves of male and female teacher: In the low frequency band, the SPL increases as the frequency increases. In the mid-frequency band, the SPL reaches the first peak, then decreases briefly as the frequency increases, then increases again to the second peak, and then decreases again briefly as the frequency increases. Then increase again to the third peak.

In the high frequency part, the SPL decreases as the frequency increases.

(3) The vocal materials and voice rate have little effect on the teacher's frequency characteristic curve. The vocal intensity has a greater impact on the teacher's frequency characteristic curve.

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