Text Data Mining of English Books on Tourism

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Abstract: Nowadays, approximately sixteen million Japanese travel abroad, and six million foreigners come to Japan for sightseeing. It can be said that it is just the time of sightseeing right now. Therefore, the knowledge of tourism has become more and more important, and reading materials in English that can be said to be a world common language has been indispensable. If we have beforehand enough knowledge of the features of English in this field, reading of the texts will become easier. In this paper, we investigated several English books on tourism, comparing with journalism in terms of metrical linguistics. In short, frequency characteristics of character- and word-appearance were investigated using a program written in C++. These characteristics were approximated by an exponential function. Furthermore, we calculated the percentage of Japanese junior high school required vocabulary and American basic vocabulary to obtain the difficulty-level as well as the $K$-characteristic of each material. As a result, it was clearly shown that English materials for tourism have a similar tendency to literary writings in the characteristics of character-appearance. Besides, the values of the $K$-characteristic for the materials on tourism are high, and the books with older publication and with higher specialty are more difficult than journalism.

Keywords: English style analysis, Metrical linguistics, Statistical analysis, Text data mining, Tourism.

1. INTRODUCTION

Nowadays, approximately sixteen million Japanese travel abroad, and six million foreigners come to Japan for sightseeing. If including the number of domestic tourists, the total number of tourists will be several times higher. However, in spite of the tourism boom, there’s a shortage of experts and researchers in tourism industry. Then, the upbringings of skilled professionals in the industry has been strongly called for (Teikyo Univ., 2006).
The goal of “tourism” is to research characteristics of current status of tourism and its impact to the modern society. Studying tourism means to gain deep understanding of changes and systems in society and of business administration that could further develop the tourism industry in the future (Teikyo Univ., 2006).

In order to study tourism, reading materials in English that can be said to be a world common language has been indispensable. If we have beforehand enough knowledge of the features of English in this field, reading of the texts will become easier.

In this paper, we investigated several English books on tourism, comparing with journalism in terms of metrical linguistics. As a result, it was clearly shown that English materials for tourism have some interesting characteristics about character- and word-appearance.

2. METHOD OF ANALYSIS AND MATERIALS

The materials analyzed here are as follows:


We examined the first three chapters of each material. For comparison, we analyzed the American popular news magazines “TIME” and “Newsweek” published on January 9 in 2006. Because almost no changes are seen in the frequency characteristics of character- and word-appearance for these magazines for about 60 years, we have used them as a standard of comparison in various ways (Ban et al., 2002). Deleting pictures, headlines, etc., we used only the texts.

The computer program for this analysis is composed of C++. Besides the characteristics of character- and word-appearance for each piece of material, various information such as the “number of sentences,” the “number of paragraphs,” the “mean word length,” the “number of words per sentence,” etc. can be extracted by this program (Ban et al., 2004a) (Ban et al., 2005a).

3. RESULTS

3.1. Characteristics of Character-appearance

First, the most frequently used characters in each material and their frequency were derived. The frequencies of the 50 most frequently used characters including the blanks, capitals, small letters, and punctuations were plotted on a descending scale. The vertical shaft shows the degree of the frequency and the horizontal shaft shows the order of character-appearance. The vertical shaft is scaled with a logarithm. This characteristic curve was approximated by the following exponential function:

\[ y = c \cdot \exp(-bx) \]  

(1)

From this function, we are able to derive coefficients \(c\) and \(b\) (Ban et al., 2005).

The distribution of coefficients \(c\) and \(b\) extracted from each material is shown in Figure 1.
There is a linear relationship between \( c \) and \( b \) for the six materials. These values are approximated by \( y = 0.0079x + 0.0291 \). The values of coefficients \( c \) and \( b \) for Materials 1 to 4 are high: the value of \( c \) ranges from 11.336 (Material 1) to 14.175 (Material 2), and that of \( b \) is 0.1224 (Material 1) to 0.1410 (Material 2). On the other hand, in the case of the news magazines, \( c \) is 9.693 and 9.934, and \( b \) is 0.1052 and 0.1074, both of which are lower than those for the four materials for tourism. Previously, we analyzed various English writings and reported that there is a positive correlation between the coefficients \( c \) and \( b \), and that the more journalistic the material is, the lower the values of \( c \) and \( b \) are, and the more literary, the higher the values of \( c \) and \( b \) (Ban et al., 2001). Thus, the values of the coefficients for the books on tourism are higher than those for the news magazines, that is, journalism, which means the materials for tourism have a similar tendency to literary writings, as we have expected.

3.2. Characteristics of Word-appearance

Next, the most frequently used words were derived. Just as in the case of characters, the frequencies of the 50 most frequently used words in each material were plotted. Each characteristic curve was approximated by the same exponential function. The distribution of \( c \) and \( b \) is shown in Figure 2.
As of the coefficient $c$, the values for Materials 1 to 4 are high: they range from 1.752 (Material 4) to 2.327 (Material 2), compared with those for news magazines, that is, 1.677 (Newsweek) and 1.720 (TIME). In the case of word-appearance, we can see a positive correlation between coefficients $c$ and $b$ for the four materials for tourism, and the values are approximated by \[ y = 0.0164x + 0.0173 \]. On the other hand, the values for news magazines are relatively similar and we might be able to regard them as a cluster.

As a method of featuring words used in a writing, a statistician named Udny Yule suggested an index called the “$K$-characteristic” in 1944 (Yule, 1944). This can express the richness of vocabulary in writings by measuring the probability of any randomly selected pair of words being identical. He tried to identify the author of *The Imitation of Christ* using this index. This $K$-characteristic is defined as follows:

\[ K = 10^4 \left( \frac{S_2}{S_1^2} - 1 / S_1 \right) \]  

where if there are $f_i$ words used $x_i$ times in a writing, $S_1 = \Sigma x_i f_i$, $S_2 = \Sigma x_i^2 f_i$.

We examined the $K$-characteristic for each material. The results are shown in Figure 3.

![Figure 3: $K$-characteristic for each material.](image)

According to the figure, the values for the four materials for tourism are high: they range from 85.188 (Material 4) to 152.936 (Material 3), compared with those for news magazines, that is, 78.575 (Newsweek) and 83.696 (TIME). The values for the books on tourism have a wide range as much as about 67.7, and Material 4, which is the lowest among the four tourism books, is almost equal to TIME magazine.

Besides, the value of $K$-characteristic gradually increases in the order of Newsweek, TIME, Material 4 and Material 1. This order corresponds with the coefficient $c$ for word-appearance, as well as the intervals of the values in both cases are very similar. In addition, the characteristic of the values of the books on tourism being higher than journalism is the same as the cases of the coefficients $c$ and $b$ for the frequency characteristics of character-appearance. We would like to investigate the relationship between $K$-characteristic and the coefficients for word- and character-appearance in the future.

### 3.3. Degree of Difficulty

In order to show how difficult the materials for readers are, we derived the degree of difficulty for each material through the variety of words and their frequency (Ban *et al.*, 2003). That is, we came up with two parameters to measure difficulty; one is for word-type or word-sort ($D_{ws}$), and the other is for the frequency or the number of words ($D_{wn}$). The equation for each parameter is as follows:

\[ D_{ws} = \left( 1 - \frac{n_{rs}}{n_b} \right) \]  

\[ D_{wn} = \left\{ 1 - \left( \frac{1}{n_t} \times \Sigma n(i) \right) \right\} \]
where \( n_t \) means the total number of words, \( n_s \) means the total number of word-sort, \( n_{rs} \) means the required English vocabulary in Japanese junior high schools or American basic vocabulary by *The American Heritage Picture Dictionary* (American Heritage Dictionaries, Houghton Mifflin, 2003), and \( n(i) \) means the respective number of each required or basic word. Thus, we can calculate how many required or basic words are not contained in each piece of material in terms of word-sort and frequency.

Thus, we calculated the values of both \( D_{ws} \) and \( D_{wn} \) to show how difficult the materials are for readers, and to show at which level of English the materials are, compared with other materials. Then, in order to make the judgments of difficulty easier for the general public, we derived one difficulty parameter from \( D_{ws} \) and \( D_{wn} \) using the following principal component analysis:

\[
z = a_1 \cdot D_{ws} + a_2 \cdot D_{wn}
\]

where \( a_1 \) and \( a_2 \) are the weights used to combine \( D_{ws} \) and \( D_{wn} \). Using the variance-covariance matrix, the 1st principal component \( z \) was extracted: \([z = 0.2301 \cdot D_{ws} + 0.9732 \cdot D_{wn}]\) for the required vocabulary, and \([z = 0.1129 \cdot D_{ws} + 0.9936 \cdot D_{wn}]\) for the basic vocabulary, from which we calculated the principal component scores. The results are shown in Figure 4.

![Figure 4: Principal component scores of difficulty shown in one-dimension.](image)

According to Figure 4, in the case of the required vocabulary, Material 1 published in 1995, which is the oldest among the six materials, is the most difficult. The difficulty level decreases in the order of Material 2 and Material 3, as the publication years of the materials are more updated. However, the degree of difficulty of Material 4, whose publication year is the newest among the four tourism materials, is high next to Material 1. It seems that this is because the specialty of Material 4 seems to be considerably high. Besides, *Newsweek* is also difficult as much as Material 1 and Material 4.

On the other hand, in the case of the basic vocabulary, the degree of difficulty of Material 1 is rather high, and Material 2 is a little more difficult than Material 4. Because the difficulty of *Newsweek* is calculated as rather lower in this case, we can judge that the three materials for tourism except Material 3 are more difficult than *TIME* and *Newsweek* magazines.

In addition, we can see that Material 1, 2, and 3 are more difficult in the case of the basic vocabulary than in the required vocabulary.

### 3.4. Other Characteristics

Other metrical characteristics of each material were compared. The results of the “average of
word length,” the “number of words per sentence,” etc. are shown together in Table 1. Although we counted the “frequency of prepositions,” the “frequency of relatives,” etc., some of the words counted might be used as other parts of speech because we didn’t check the meaning of each word.

### Table 1: Metrical data for each material.

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total num. of characters</td>
<td>135,828</td>
<td>96,581</td>
<td>132,220</td>
<td>207,028</td>
<td>141,650</td>
<td>155,444</td>
</tr>
<tr>
<td>Total num. of character-type</td>
<td>80</td>
<td>71</td>
<td>79</td>
<td>80</td>
<td>82</td>
<td>80</td>
</tr>
<tr>
<td>Total num. of words</td>
<td>21,453</td>
<td>15,098</td>
<td>21,705</td>
<td>33,058</td>
<td>23,810</td>
<td>25,792</td>
</tr>
<tr>
<td>Total num. of word-type</td>
<td>3,261</td>
<td>2,700</td>
<td>4,562</td>
<td>4,965</td>
<td>5,889</td>
<td>6,342</td>
</tr>
<tr>
<td>Total num. of sentences</td>
<td>779</td>
<td>741</td>
<td>861</td>
<td>1,449</td>
<td>1,033</td>
<td>1,281</td>
</tr>
<tr>
<td>Total num. of paragraphs</td>
<td>145</td>
<td>133</td>
<td>137</td>
<td>397</td>
<td>218</td>
<td>245</td>
</tr>
<tr>
<td>Mean word length</td>
<td>6.322</td>
<td>6.384</td>
<td>6.338</td>
<td>6.266</td>
<td>5.940</td>
<td>6.027</td>
</tr>
<tr>
<td>Words/sentence</td>
<td>27.539</td>
<td>20.403</td>
<td>25.209</td>
<td>17.868</td>
<td>23.049</td>
<td>20.134</td>
</tr>
<tr>
<td>Sentences/paragraph</td>
<td>5.372</td>
<td>5.564</td>
<td>6.285</td>
<td>4.657</td>
<td>4.739</td>
<td>5.229</td>
</tr>
<tr>
<td>Comma/sentence</td>
<td>1.199</td>
<td>0.935</td>
<td>1.762</td>
<td>0.917</td>
<td>1.302</td>
<td>1.171</td>
</tr>
<tr>
<td>Coefficient b for character-appearance</td>
<td>0.1224</td>
<td>0.1410</td>
<td>0.1266</td>
<td>0.1248</td>
<td>0.1074</td>
<td>0.1052</td>
</tr>
<tr>
<td>Coefficient c for word-appearance</td>
<td>1.8948</td>
<td>2.3272</td>
<td>2.9929</td>
<td>1.7515</td>
<td>1.7195</td>
<td>1.6770</td>
</tr>
<tr>
<td>Coefficient b for word-appearance</td>
<td>0.0480</td>
<td>0.0552</td>
<td>0.0510</td>
<td>0.0458</td>
<td>0.0502</td>
<td>0.0515</td>
</tr>
<tr>
<td>Difficulty (prim. comp. score) [Japan]</td>
<td>0.0199</td>
<td>-0.0146</td>
<td>-0.0307</td>
<td>0.0122</td>
<td>-0.0023</td>
<td>0.0157</td>
</tr>
<tr>
<td>Difficulty (prim. comp. score) [US]</td>
<td>0.0325</td>
<td>0.0110</td>
<td>-0.0237</td>
<td>0.0035</td>
<td>-0.0162</td>
<td>-0.0071</td>
</tr>
</tbody>
</table>

### 3.4.1. Mean Word Length

As for the “mean word length” for the four materials for tourism, it varies from 6.138 letters for Material 3 to 6.384 letters for Material 2. They are a little longer than *TIME* (5.949 letters) and *Newsweek* (6.027 letters). It seems that this is because the materials for tourism contain many long-length technical terms for tourism such as ATTRACTION, DESTINATION, RESTAURANT, and TRAVELLER.

### 3.4.2. Number of Words per Sentence

The “number of words per sentence” for Material 1 is 27.539 words, which is the most of the six materials, and approximately 10 words more than Material 4 (17.868 words), which is the fewest. From this point of view, as well as the result of the difficulty derived through the variety of words and their frequency, Material 1 seems to be rather difficult to read. In the case of other three materials for tourism, it is 20.403 (Material 2) to 25.209 (Material 3) words, which are almost equal to *Newsweek* (20.134 words) and *TIME* (23.049 words).

### 3.4.3. Number of Sentences per Paragraph

The “number of sentences per paragraph” for Materials 1, 2, and 3 is from 5.372 (Material 1) to 6.285 sentences (Material 3), which is a little more than the news magazines (4.739 and 5.229 sentences).

### 3.4.4. Frequency of Relatives

The “frequency of relatives” for the four tourism materials is 1.944% (Material 1) to 2.710% (Material 2), which is a little fewer than the case of *TIME* magazine (2.944%). Therefore, we can assume that as the materials for tourism tend to contain fewer complex sentences than *TIME* magazine, they are easy to read than *TIME* from this point of view.

### 3.4.5. Frequency of Auxiliaries

There are two kinds of auxiliaries in a broad sense. One expresses the tense and voice, such as *BE* which makes up the progressive form and the passive form, the perfect tense *HAVE*, and *DO* in interrogative sentences or negative sentences. The other is a modal auxiliary, such as *WILL* or *CAN* which expresses the mood or attitude of the speaker (Ban et al., 2004b). In this
study, we targeted only modal auxiliaries. As a result, while the “frequency of auxiliaries” of Material 4 (1.607%) is highest among the six materials, other three tourism materials contain 0.747% (Material 3) to 0.927% (Material 2) auxiliaries, which are fewer than TIME magazine (1.134%). Therefore, it might be said that while the writers of Material 4 and TIME tend to communicate their subtle thoughts and feelings with auxiliary verbs, the style of the materials for tourism can be called more assertive.

3.5. Word-length Distribution

We also examined word-length distribution for each material. The results are shown in Figure 5.

![Figure 5: Word-length distribution for each material.](image)

The vertical shaft shows the degree of frequency with the word length as a variable. As for the four materials for tourism, the frequency of 2- or 3-letter words is the highest: the frequency of 2-letter words ranges from 14.595% (Material 4) to 18.479% (Material 2), and that of 3-letter is 15.499% (Material 2) to 19.115% (Material 3). Although the frequency decreases until the 6-letter words, the frequency of 7-letter words such as TOURISM, TOURIST, and TRAFFIC is 0.951% (Material 1) to 1.636% (Material 2) higher than that of 6-letter words in the three tourism materials except Material 3.

Besides, the news magazines have higher frequency than the tourism books in 4-, 5-, and 6-letter words, and the degree of decrease for the news magazines gets a little higher than the tourism materials after the 8-letter words.

3.6. Correlation of the Number of Words with that of Characters, Sentences, and Paragraphs

We checked the correlation of the total number of words with the total number of characters, sentences, and paragraphs for the four materials for tourism. The results are shown in Figure 6. While the principal shaft shows the total number of characters, the secondary vertical shaft shows the total number of sentences and paragraphs with the total number of words as a variable.

According to the figure, we can see a strong positive correlation between the total number of words and that of characters. We can also see a positive correlation between the total number of words and that of sentences, as well as the total number of words, and that of paragraphs, although each correlation is a little weaker than in the case of the characters. For values of four materials, approximations shown in the Figure 6 were provided. Therefore, if we know the total
number of words for a certain material for tourism, we can estimate the total number of characters using the function \[ y = 6.1934x + 1710.2 \], the total number of sentences by \[ y = 0.0666x - 463.75 \], and the total number of paragraphs by \[ y = 0.016x - 162.36 \].

![Figure 6: Word-length distribution for each material.](image)

4. CONCLUSIONS

We investigated some characteristics of character- and word-appearance of some famous English books on tourism, comparing these with *TIME* and *Newsweek* magazines. In this analysis, we used an approximate equation of an exponential function to extract the characteristics of each material using coefficients \( c \) and \( b \) of the equation. Moreover, we calculated the percentage of Japanese junior high school required vocabulary and American basic vocabulary to obtain the difficulty-level as well as the \( K \)-characteristic. As a result, it was clearly shown that English materials for tourism have the same tendency as English literature in the character-appearance. The values of the \( K \)-characteristic for the materials on tourism are high, compared with the journalism. Moreover, the books with older publication and with higher specialty are more difficult than journalism.

In the future, we plan to apply these results to education. For example, we would like to measure the effectiveness of teaching the 100 most frequently used words in a writing beforehand.

REFERENCES


