

## Using MDS to Predict the Educational Expectations of Students

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雑誌名	dialogos
号	9
ページ	59-68
発行年	2009-03
URL	<a href="http://id.nii.ac.jp/1060/00004973/">http://id.nii.ac.jp/1060/00004973/</a>

# Using MDS to Predict the Educational Expectations of Students

Peter Ilic

## Abstract

This paper represents an attempt to better understand the educational expectations of Japanese university students. Eighty students were asked to indicate whether or not they felt there was some relationship between 24 English words. The results were then added and entered into a table where the number at each intersection of words represented the total number of students that felt there was some relationship between those two words. This table was then analyzed using Multidimensional Scaling to produce a two dimension plot representing the relationship between these 24 words. Since the distance between the words on the plot represents the level of similarity, a study of the result gives some insight into the educational expectations of these students. A description of the data collection and analysis, as well as, one possible interpretation of the results is included.

It is important for both students and teachers to have a clear understanding of the educational expectations each has of the other. It is widely recognized that teachers should state their strategies and goals explicitly to the students and should give the students the opportunity to explain their perspective (Thompson, 1995). This is supported by research which indicates that student perceptions about the characteristics of instruction have been shown to be determinates in predicting student motivation and success in the classroom (Clark & Salmon,

1986), and that academic achievement is positively affected when teaching is matched with students' preferred learning style (Dunn, 1989); (Mickler & Zippert, 1987); (Miller, Always, & McKinley, 1987). However, this situation becomes more complicated when placed in the context of an English language classroom setting where the student and teacher do not share the same first language (L1), and have differing cultural expectations of student and teacher roles.

In many cases, foreign teachers in Japan speak little or no Japanese when they begin teaching, so the amount of direct teacher-to-student communication is limited and opinions of either party might not be appropriately evaluated (Japanese Ministry Of Education, 2002). Without a clear means of communicating with the students, the teacher is often left wondering what the students are expecting from their course.

In addition to language, socialization adds to the confusion. Socialization is the process where people of one culture acquire shared social norms and values (Chinoy, 1961: 75). This shared view of social norms leads to a common culture specific view of what roles the teacher and student are to play in the classroom. This can lead to conflict when two or more cultures with differing expectations, such as a teacher and a student, are placed in the same classroom.

In this paper I attempt to give some insight into the educational expectations of Japanese University students. If we agree that the perceived similarity between words can be seen as giving some insight into an individual's view of what is normal in a general sense, then by measuring a student's perceived similarity between words related to education, a picture of their educational expectations can be gained. First year Japanese University students were surveyed for their perceived similarity between 24 English words. Then the data was analyzed using multidimensional scaling (MDS) techniques to produce a visual plot

of these similarities or dissimilarities. MDS allows us to see the dissimilarity between words represented by the distance between them. This means that two words which appear next to each other on the plot have less dissimilarity than a third word that appears at a greater distance from these same two words.

## The Data

The data is symmetric similarity data and consists of student perceptions of the similarity among 24 English words (Appendix 1). Eighty students in the first year of study at a private university in Tokyo, Japan, were asked to complete a 24 x 24 table containing these words (Appendix 2). The students were asked to place a mark in the box at the intersection between two words that they felt had some relationship. They were given no other instructions other than to indicate if they felt there was some similar relationship between the words. Then the total marks for each word intersection were added and entered in a table. Each number in the table represents the total number of marks made by the students between the row word and the column word. A higher number indicates a greater number of students thought there was some type of similarity between the intersecting row and column words. This type of data is known as proximity data which consists of measures of similarity or dissimilarity between objects of interest (Everitt & Rabe-Hesketh, 1997). In this case the objects of interest are the row words and the column words.

In this paper, Kruskal's terminology will be used (Kruskal & Wish, 1978), where the data pertains to a collection of objects indexed firstly by the letter  $i$  and secondarily by  $j$  and that run from 1 to  $n$ . This paper uses 24 words so in this case  $n = 24$ . The proximity, the data value connecting an  $i$ -th object ( $o_i$ ) with a  $j$ -th object ( $o_j$ ), is represent by  $\delta_{ij}$ . The values  $\delta_{ij}$  form a matrix  $\Delta$ . In other words, we have a set of  $n^2$  numerical relationships, called  $\delta_{ij}$  between pairs

of objects. The value  $\delta_{ij}$  represents the extent to which an object  $i$  is related to an object  $j$ . (Bezdek, Keller, Krisnapuram, & Pal, 1999).

### Type of Analysis (MDS)

Multidimensional Scaling (MDS) is a method for capturing efficient information from observed dissimilarity data by representing the data structure in lower dimensional spatial space. As a metric MDS, the following model (Gower, 1966), (Kruskal & Wish, 1978) has been proposed:

$$d_{ij} = \left\{ \sum_{\lambda=1}^R d^k(x_{i\lambda}, x_{j\lambda}) \right\}^{\frac{1}{k}} + \varepsilon_{ij}. \quad (1.1)$$

In (1.1)  $d_{ij}$  is an observed dissimilarity between objects  $i$  and  $j$ , and  $x_{i\lambda}$  shows the value of the coordinate of an object  $i$  with respect to dimension  $\lambda$  in  $R$  dimensional configuration space. For the purpose of this paper  $R = 2$  so the result is presented in a two dimensional plot.  $\varepsilon_{ij}$  is an error.  $d^k(x_{i\lambda}, x_{j\lambda})$  shows dissimilarity between objects  $i$  and  $j$ , and usually  $d^k(x_{i\lambda}, x_{j\lambda}) = |x_{i\lambda} - x_{j\lambda}|^k$ . MDS finds  $R$  dimensional points  $(x_{i1}, \dots, x_{iR})$  and illustrates the structure of the similarity relationship among the objects by representing the observed  $d_{ij}$  as the distance between a point  $(x_{i\lambda})$  and a point  $(x_{j\lambda})$  in  $R$  dimensional space. In (1.1) we use Euclidian distance when  $k = 2$ .

A special representation of a dissimilarity matrix consists of a set of  $R$  dimensional coordinates representing each object, chosen so that the distances between the points in the  $R$  dimensional space, match closely to the observed dissimilarities. Finding the 'best' fitting set of coordinates is the goal of multidimensional scaling techniques (Everitt & Rabe-Hesketh, 1997, p. 21). As previously mentioned, in this paper a two-dimensional ( $R = 2$ ) solution is used. This is because it has the benefit of being simple and provides an easily understood basis for an understanding of the dissimilarity data (Everitt & Rabe-

Hesketh, p. 27). The target data of MDS is dissimilarity data,  $d_{ij}$ . However, our observed data is similarity data between a pair of objects  $i$  and  $j$ ,  $s_{ij}$ . So, this similarity data needs to be transformed to dissimilarity data as follows:

$$d_{ij} = \frac{s_{ij}}{\max_{i,j} (s_{ij})}, \quad i, j = 1, \dots, n.$$

Then this dissimilarity data can be applied to the MDS shown in (1.1) and the result is obtained.

### Results of analysis:

The R statistical computing environment (R Project, 2007) was used to perform the MDS analysis of the data. The output from MDS is in the form of

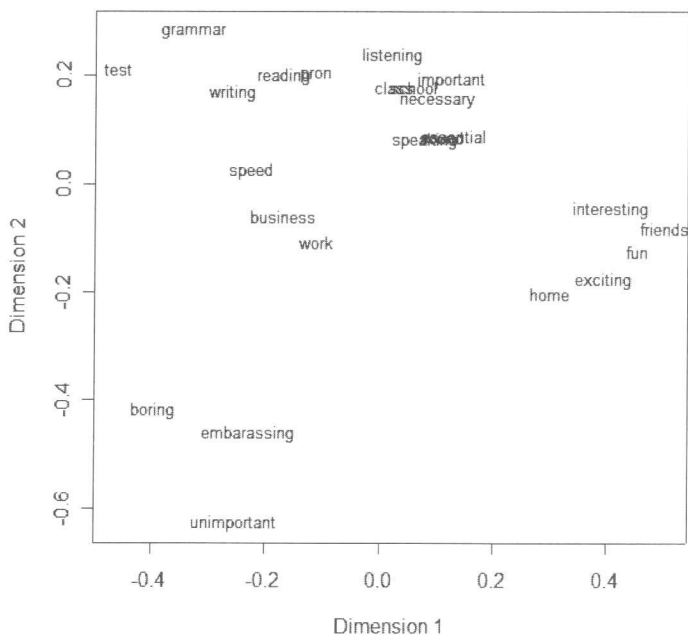


Figure 1: Results of MDS on 24 words

a plot of all the objects (words), and the distance between them indicates the value of dissimilarity. In other words, the closer the words appear in the plot the higher the perceived similarity.

Figure 1 shows the plot that resulted from the MDS analysis of the student data. The stress or badness of fit is 0.1, which is considered to be a good result. The range of the stress is from 0 to 1, where 0 is the best result.

Methods differ widely on how fitted distances and observed proximities badness-of-fit (goodness-of-fit) are measured. (Everitt & Rabe-Hesketh, 1997, p. 21).

### **Interpretation of the Result**

After studying the plot, dimension 1 may be interpreted as represent activities, where school and work activities are on the left side of the plot and other activities are on the right side of the plot. Next, dimension 2 could be seen as representing the level of importance of those activities as perceived by the students, where important words appear at the top and unimportant ones at the bottom.

Since the proximity of words in the plot is considered a measure of the similarity relationship between the words, we can learn much about what the students expectations are by considering this result. For example, several pairs of words are completely overlapping in the plot with respect to dimension 2 (importance) and partially overlapping with respect to dimension 1 (activities). This indicates that the students feel these words have a very strong, almost identical relationship to each other. The overlapping pair made up of the words “class” and “school” is self explanatory. More interesting are the overlapping words “speaking” and “essential”. This shows that the students have a strong belief that speaking is an essential skill. This would tend to indicate that when

Japanese students appear hesitant to speak up in language class it is not for a lack of valuing it as a skill.

Though not overlapping, several close groupings can also be seen in the plot. Again the group on the right side of the plot which indicates a close relationship between the words “interesting”, “friends”, “fun”, “exciting”, and “home” is not difficult to understand. Also the group made up of the words “speed”, “business” and “work” is not surprising. However, some insight into the students’ expectations concerning tests could be gained from looking at the close position of the words “test”, “grammar”, “reading”, “writing”, and “pronunciation”. This indicates that they expect testing to involve one or more of these four skills. At the same time, “speaking” appears at a relatively large distance away from the word “test”. This suggests that the students are not expecting the skill of speaking to be tested, even though, as mentioned above, they recognize it as essential. One possible explanation for this is that it is a carry over from their high school thinking, where priority is placed on only those skills needed to successfully complete the university entrance examinations in Japan.

The words “school”, “important”, “necessary”, and “essential” appear very close and at opposite ends of the plot from the word “unimportant”, which indicates that the students place a high level of importance on education as a whole.

While some of the relationships amongst the words can be explained there are some that are not as clear. One example is the pair of overlapping words “reading” and “pronunciation”. The students may have assumed that reading referred to reading aloud or possibly listening to someone else reading. However, this is not clear at this time.



## Conclusion

When we consider the barriers that both language and culture can present in the English language classroom, it is important to consider ways to improve teacher student communications. In this paper a study has been presented that uses MDS to analyze the similarity between 24 English words as perceived by first year Japanese university students. The result gives some insights into the students' perceived importance of certain aspects of education, which in turn gives us a picture of the expectations of these students. When teachers know what the students expect, they are better able to fit their lessons to the students' expectations and predict possible points of friction.

In the future, I would like to repeat this study with a larger sample group and a larger number of words. In addition, I would like to repeat the analysis using a 3 dimensional MDS analysis in place of this 2 dimensional one. It is hoped that this will decrease the stress and so increase the fitness of the result.

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