

PAPER

Equivalence of noise annoyance scales in Japanese and English: An experiment using bilingual subjects

Kirk Masden^{1,*} and Takashi Yano²

¹Kumamoto Gakuen University, 2-5-1, Oe, Kumamoto, 862-8280 Japan

²Kumamoto University, 2-39-1, Kurokami, Kumamoto, 860-8555 Japan

(Received 11 December 2002, Accepted for publication 19 June 2003)

Abstract: A method established by ICBEN (International Commission on the Biological Effects of Noise) Team 6 (Community Response to Noise) has been used to develop equivalent noise annoyance scales in nine languages. A key assumption of this method is that subjects who speak different languages interpret the concept of “highest degree” of annoyance similarly. In this study, an experiment was conducted using 73 bilingual subjects to test this assumption and thereby assess the equivalence of the Japanese and English ICBEN scales. All of the bilingual subjects followed a slightly modified version of the ICBEN method to produce scales in both Japanese and English. The results indicate that English- and Japanese-speaking subjects do not differ significantly in their interpretations of the “highest degree” of annoyance. Thus, a key premise of the ICBEN method for producing equivalent scales in different languages was confirmed for English and Japanese. In addition, although the Japanese modifier “hijoni” has frequently been translated as “very,” the results of this study show that “extremely” is a more appropriate translation. Finally, evidence was found that bilingual subjects may differ significantly from monolingual subjects in their interpretations of certain words.

Keywords: Social survey, Bilingual, Noise annoyance scales, Japanese, English

PACS number: 43.50.Qp [DOI: 10.1250/ast.25.144]

1. INTRODUCTION

Over the past several decades a large number of social surveys on community response to noise have been conducted in developed and, to a lesser extent, developing countries. Studies that compare data from multiple surveys have been conducted [1], but differences in languages, wording, and scale composition have made such comparison difficult.

Several proposals have been made to standardize the wording and scale composition used in English and Japanese noise annoyance surveys. In regard to English-language surveys, Fidell *et al.* [2], Levine [3], and Fields [4], have presented arguments favoring the use of 5-, 7-, and 4-point scales respectively. Similarly, Furihata *et al.* [5] and the Committee of Social Surveys on Noise Problems of the Acoustical Society of Japan [6] have recommended 7- and 3-point scales respectively for use in the Japanese language. However, these proposals for standardization were limited to either English or Japanese and did not address the question of the comparability of

scales between languages.

The first systematic effort to address the problem of comparability between languages began in 1993, when the Community Response to Noise Team (Team 6) of the International Commission on the Biological Effects of Noise (ICBEN) initiated a project to develop standards for the construction of noise annoyance scales and questions in multiple languages. The project resulted in the development of a procedure for constructing comparable scales, which was implemented in parallel in nine languages [7].

In the ICBEN method, the scales for each language are determined using data obtained from a survey of subjects in the target language. The subjects are required to select modifiers for 5- and 4-point scales from a pool of 21 candidate modifiers and to evaluate the intensity of each modifier. A key premise of this method is that cultural and linguistic differences will not have a significant effect on how subjects interpret these tasks. Specifically, it is assumed that the upper extreme of the range of possible annoyance imagined by subjects does not differ widely between cultures and languages. Significant differences in the upper extreme imagined by subjects might influence modifier preferences and would distort the intensity scores

*e-mail: masden@kumagaku.ac.jp

that the subjects assign.

In this study, 73 bilingual subjects were used to test the hypothesis that the upper extremes of annoyance imagined by English and Japanese speakers do not differ substantially and thereby to evaluate the equivalence of the English and Japanese scales produced by IC BEN's Team 6.

2. EXPERIMENT

The procedure was essentially the same as the IC BEN study [7] except that all subjects chose modifiers for use in both English and Japanese scales and evaluated the intensities of both English and Japanese modifiers. Moreover, a paired comparison test of 12 English and Japanese modifiers was appended, though paired comparison was not part of the original IC BEN procedure.

2.1. Subjects

Seventy-three subjects between the ages of 20 and 71 who were fluent in Japanese and English participated in the study. They were bilingual in the sense that they were fluent in both Japanese and English. However, they were not bilingual in the sense of having used languages with equal facility and frequency since childhood; in all cases, one of the two languages was acquired first, as the native or primary language, and the other learned later. In this paper, we borrow the terms "L1" (first language) and "L2" (second language) from the field of linguistics when we refer to the first language of subjects or the relationship between the subjects and the language they are evaluating. Thus, we use the phrase "English L1 subjects," for example, to refer to subjects for whom English is the first or primary language. Similarly, when the phrase "L1 subjects" is not prefaced by "Japanese" or "English," it refers to bilingual subjects as evaluators of words in their first language; those same subjects would be "L2 subjects" when evaluating words in their second language.

English was the first language (L1) of 19 males (mean age: 38) and 17 females (mean age: 37) while Japanese was the first language of 17 males (mean age: 45) and 20 females (mean age: 40). The nationalities of the subjects who spoke English as their first language were as follows: U.S.A., 21; Australia, 4; United Kingdom, 3; Ireland, 2; France, 1; New Zealand, 1; Japan, 1. The Japanese subjects had lived in English-speaking areas for an average of five years while those for whom English was L1 had lived in Japan for an average of 11 years.

We initially recruited subjects from among acquaintances in the Kumamoto area and other parts of Japan. Subsequently, subjects were also recruited on the Internet. The Honyaku mailing list [8] was a particularly good source of highly qualified subjects. The list serves over 1,000 professional Japanese/English translators ("honyaku" means "translation" in Japanese). The recruitment

message explained the purpose of the study and our interest in recruiting subjects who are "fluent in both aural and written communication in Japanese and English." Unless there was a specific reason to question the qualifications of a potential subject, we assumed that persons who claimed to be fluent in both languages were indeed qualified and did not administer a systematic test of fluency. Our recruitment methods led to the participation of many professional translators, interpreters, and language teachers as subjects.

2.2. Questionnaires

There were two types of questionnaire: "Annoyed" was used as the base descriptor throughout in one while "urusai" was used in the other. Both types were bilingual. In the questionnaires in which "annoyed" was used as the base descriptor, English text appeared in a column on the left side of each page and the corresponding Japanese appeared in a column on the right. This arrangement was reversed in the questionnaires in which "urusai" was the base descriptor. These questionnaires were distributed evenly to each of the following four groups of the subjects: 1) female, L1 is Japanese; 2) male, L1 is Japanese; 3) female, L1 is English; 4) male, L1 is English. Each questionnaire contained the following tasks:

- 1) Construction of 5- and 4-point scales in English: Subjects constructed 5- and 4-point equidistant annoyance scales in English from the minimum to the maximum by selecting suitable modifiers from the 21 English modifiers (Table 1).
- 2) Construction of 5- and 4-point scales in Japanese: Subjects constructed 5- and 4-point equidistant annoyance scales in Japanese from the minimum to the maximum by selecting suitable modifiers from the 21 Japanese modifiers (Table 2).
- 3) Line-marking exercise for 42 modifiers in English and Japanese: Subjects evaluated the intensity of the 42 English and Japanese modifiers by placing a mark on a 10 cm line as shown in Fig. 1. The modifiers were presented sequentially in a random order.

Table 1 21 English modifiers.

extremely, tremendously, severely, strongly, highly, very, significantly, substantially, considerably, importantly, rather, moderately, fairly, somewhat, partially, slightly, a little, hardly, barely, insignificantly, not at all

Table 2 21 Japanese modifiers.

hijoni, kiwamete, hidoku, sugoku, taihen, soto, totemo, kanari, daibu, warini, hikakuteki, tasho, yaya, ikuraka, sukoshi, wazukani, sorehodo...nai, taishite...nai, amari...nai, hotondo...nai, mattaku...nai

3. RESULTS

3.1. Scale Construction

In accordance with the method devised by ICBEN Team 6 [7], the following criteria were used to determine the scale-point labels:

- 1) Intensity difference score (I-C Delta): the difference between the modifier's mean and the scale point's ideal intensity score (0, 25, 50, 75 or 100).
- 2) Net preference score (P%): the net number of selections of the modifier for a particular scale point (the number of selections for the scale point minus the number of selections for other scale points) divided by the total number of subjects.
- 3) Standard deviation of intensity scores (StD): the standard deviation of the intensity scores for each modifier.

Table 4 shows the 5-point scales constructed using the data produced by all subjects of the present study (bilingual) and the 5-point scales produced by the ICBEN study. The English scale is the same as ICBEN's English scale except that "a little" was selected as the second lowest category. However, the Japanese scale is completely different from that of the ICBEN study as "mattaku...nai" was fixed as the lowest category.

This result stems in part from differences between Japanese and English. In each of the five intensity ranges English seems to have one clearly dominant modifier whereas in Japanese two or more modifiers of similar quality are available in each intensity range [9]. Moreover, in Japanese, impressions about various modifiers are more affected by differences between subject groups than is the case in English. For example, when regression analysis was applied to the data from the ICBEN study (the intensity score was a dependent variable and the age of the subjects was an independent one) the age effect on the intensity was more dominant in Japanese than English [10]. The regression coefficients were significant at the 1% level for eight of 21 modifiers and at the 5% level for three modifiers in Japanese, whereas they were significant at 1% for three modifiers and at 5% for three modifiers in English.

3.2. Classification of the Modifiers

Table 5 shows the mean intensity scores of the 21 English and the 21 Japanese modifiers on a scale of 100 for this bilingual study and the ICBEN study. Cluster analysis

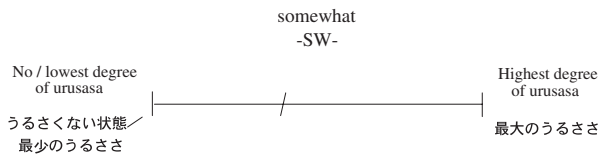


Fig. 1 Line-marking exercise.

Table 3 12 modifiers used in the paired comparison test.

Higher intensity		Lower intensity	
		Middle intensity	
extremely, tremendously, hijoni, sugoku,	severely, taihen,	strongly, soto,	highly, very, kanari, daibu

- 4) Paired comparison test: Six English and six Japanese modifiers of intensities equal to or lower than that of the modifier selected for the highest scale point and equal to or higher than that of the modifier selected for the second highest scale point in each language were selected on the basis of the results of the ICBEN study [7] for evaluation in a paired comparison test. As paired comparison tests are only appropriate for the evaluation of slight differences in intensity or preference, the 12 modifiers were divided into three groups of similar intensity (higher, middle, and lower) and all possible pairs within each group were compared (Table 3). The higher intensity group consisted of the three modifiers of highest intensity in each language (a total of six) while the lower intensity group consisted of the remaining six modifiers. The middle intensity group consisted of the middle two modifiers in each language (a total of four) or, in other words, the lowest modifiers from the higher intensity group and the highest modifiers from the lower intensity group. Of the six possible pairs in the middle group, two were ignored because they duplicated pairs already obtained in the lower and higher groups. Thus, a total of 34 pairs were composed (15 in the higher intensity group, 4 in the middle group, and 15 in the lower intensity group) and then presented to the subjects in randomized order.

It took about an hour to complete the questionnaire.

Table 4 Modifiers for 5-point scales in English and Japanese.

English, bilingual:	"extremely," "very," "moderately," "a little" and "not at all"
English, ICBEN:	"extremely," "very," "moderately," "slightly" and "not at all"
Japanese, bilingual:	"kiwamete," "totemo," "hikakuteki," "sukoshi" and "mattaku...nai"
Japanese, ICBEN:	"hijoni," "daibu," "tasho," "sorehodo...nai" and "mattaku...nai"

Table 5 Intensity scores of 42 modifiers.

English	Bilingual ICBEN	Japanese	Bilingual ICBEN	ICBEN
extremely	96.9	94.9	kiwamete	93.3
tremendously	95.6	92.3	hijoni	92.2
severely	91.8	90.7	hidoku	90.6
strongly	80.3	79.7	sugoku	86.5
highly	80.1	78.7	taihen	84.1
very	78.4	75.6	totemo	79.9
significantly	73.9	67.2	kanari	73.6
considerably	71.3	62.2	soto	72.2
importantly	71.3	65.1	daibu	71.2
substantially	70.7	64.5	hikakuteki	50.9
rather	56.0	47.9	warini	49.2
fairly	55.2	40.5	ikuraka	36.4
moderately	48.1	43.7	tasho	35.6
somewhat	35.3	35.7	yaya	34.2
partially	31.9	29.6	sukoshi	20.3
a little	17.2	13.2	sorehodo...nai	17.6
slightly	16.3	15.4	wazukani	15.0
insignificantly	12.7	7.6	taishite...nai	14.5
hardly	9.0	10.3	amari...nai	10.8
barely	7.5	8.1	hotondo... nai	6.0
not at all	0.6	0.8	mattaku... nai	0.8
				1.0

Table 6 Results of cluster analysis.

Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
extremely	sugoku	rather	ikuraka	sukosi
tremendously	taihen	fairly	tasho	sorehodo...nai
kiwamete	strongly	hikakuteki	somewhat	a little
hijoni	highly	warini	yaya	slightly
severely	totemo	moderately	partially	wazukani
hidoku	very			taishite...nai
	significantly			insignificantly
	kanari			amari...nai
	soto			hardly
	importantly			barely
	considerably			hotonndo...nai
	daibu			mattaku...nai
	substantially			not at all

was applied to the intensity scores of the 42 modifiers. When the modifiers were classified into five clusters, “kiwamete” and “hijoni” both were in the same cluster as “extremely” (Table 6). When Tukey’s Multiple Comparison Procedure was applied to the pairs of the modifiers in the highest cluster, there were significant differences at the 5% level between “extremely” and “kiwamete” and at the 1% level between “extremely” and “hijoni” and no significant difference between “kiwamete” and “hijoni.” “Extremely” seems to be a little more intense than “kiwamete” and “hijoni.”

3.3. Effects of Subjects’ First Language (L1) and Bilingualism on Intensity Scores

3.3.1. Analysis of variance in intensity scores

In order to analyze variation in intensity scores more precisely, a two-factor analysis of variance was conducted in which the factors were the L1 of the subject and the base descriptor (“annoyed” or “urusai”) that appeared on the questionnaire. The L1 of the subject was found to be statistically significant at the 5% level in four English modifiers (“rather,” “significantly,” “very,” “tremendously”) and at the 1% level in another four (“insignificantly,” “fairly,” “strongly,” and “extremely”). In Japanese, L1 was a significant factor at the 5% level in three modifiers (“wazukani,” “kanari,” and “kiwamete”) and at the 1% level in two (“hotondo” and “soto”). The base descriptor was only found to be a significant factor in one Japanese modifier (“kiwamete”); it was not a significant factor in any of the English modifiers.

3.3.2. Comparison of L1, L2, and ICBEN scores

Figure 2 compares the average English intensity scores for all subjects in this study with the ICBEN results. Similarly, Fig. 3 compares the Japanese intensity scores produced by the two studies. In both cases, results at the highest intensity levels are quite consistent. However, the middle-range intensity scores in this study are generally higher in English and lower in Japanese. Figures 4 and 5 compare the results for the English L1 subjects with the English ICBEN results and the results for the Japanese L1 subjects with the Japanese ICBEN results. Though in all cases subjects were evaluating modifiers in their native or first language, the results exhibit the same tendencies observed in Figs. 2 and 3. Finally, Figs. 6 and 7 compare the results of the English L1 and Japanese L1 subjects in each language. Significant differences in intensity can be observed in certain individual modifiers (e.g. “fairly” in

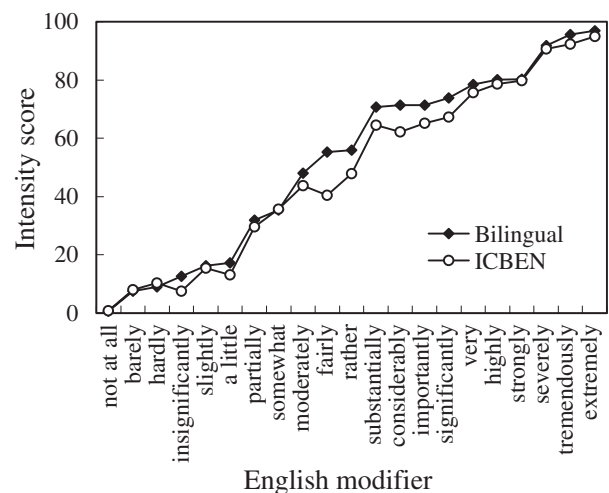


Fig. 2 Comparison of English intensity scores for all bilingual subjects with ICBEN scores.

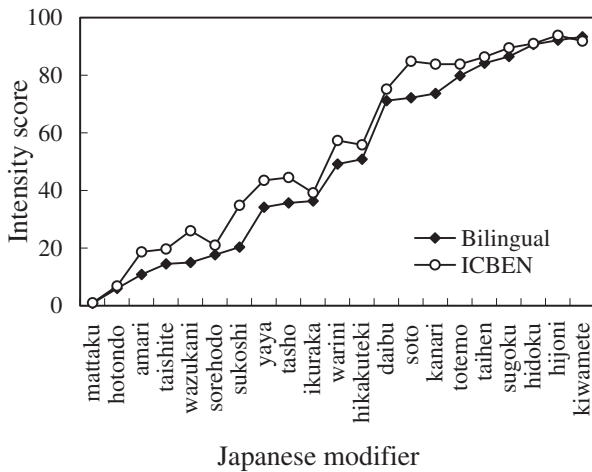


Fig. 3 Comparison of Japanese intensity scores for all bilingual subjects with ICBEN scores.

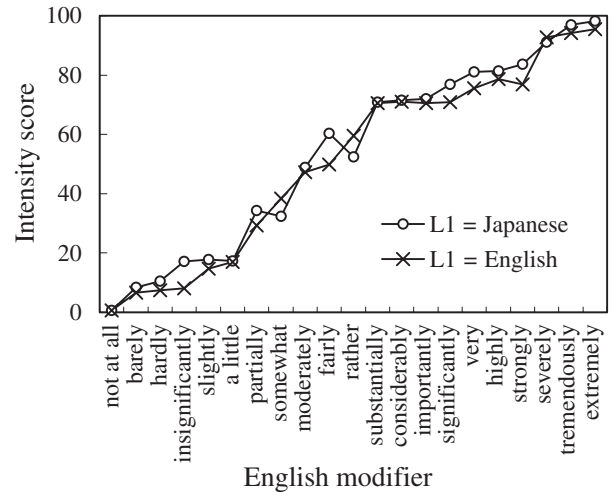


Fig. 6 Comparison of English intensity scores for English L1 and Japanese L1 subjects.

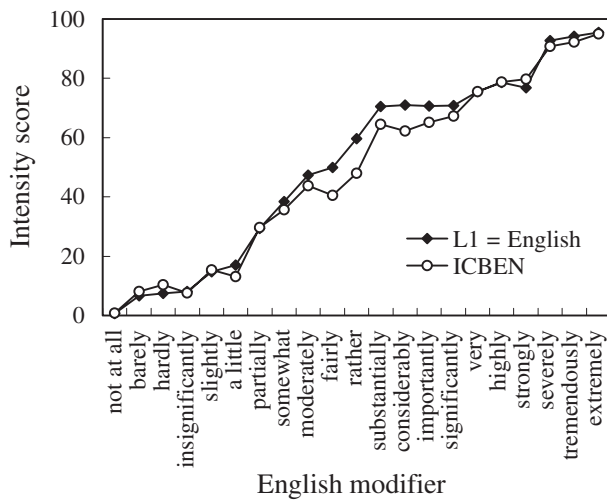


Fig. 4 Comparison of English intensity scores for English L1 subjects with ICBEN scores.

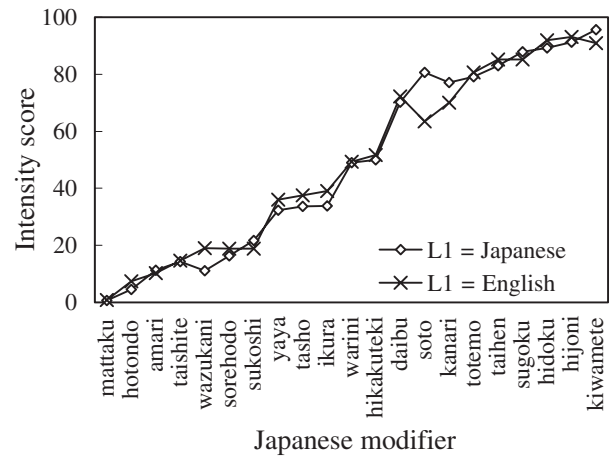


Fig. 7 Comparison of Japanese intensity scores for English L1 and Japanese L1 subjects.

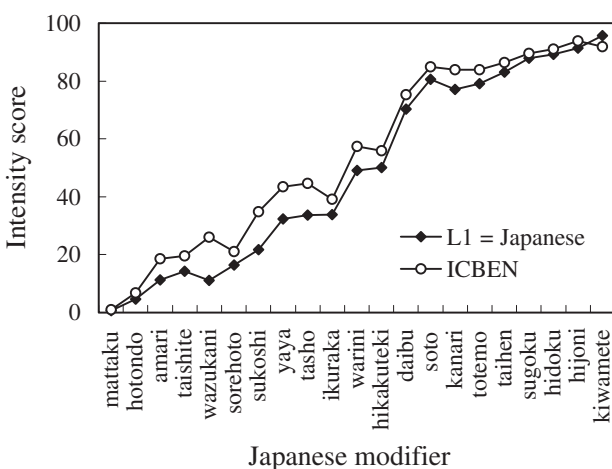


Fig. 5 Comparison of Japanese intensity scores for Japanese L1 subjects with ICBEN scores.

English and “soto” in Japanese) but a general pattern of difference such as observed above is not apparent.

3.3.3. Standard deviation in intensity scores

Figures 8 and 9 compare the standard deviation in intensity scores between English L1 and Japanese L1 subjects. Predictably, the standard deviation tends to be greater when subjects are evaluating modifiers in their second language (L2). The discrepancy is particularly great for a few modifiers such as “insignificantly” and “hardly” in English and “wazukani” and “soto” in Japanese.

3.4. Paired Comparison Test

Tables 7 and 8 show the results of the paired comparison test for the higher and lower intensity groups. The order of modifier intensity produced by the paired comparison test was “extremely,” “tremendously,” “hi-joni,” “severely,” “sugoku” and “taihen” for the higher intensity modifiers. That for the lower intensity modifiers

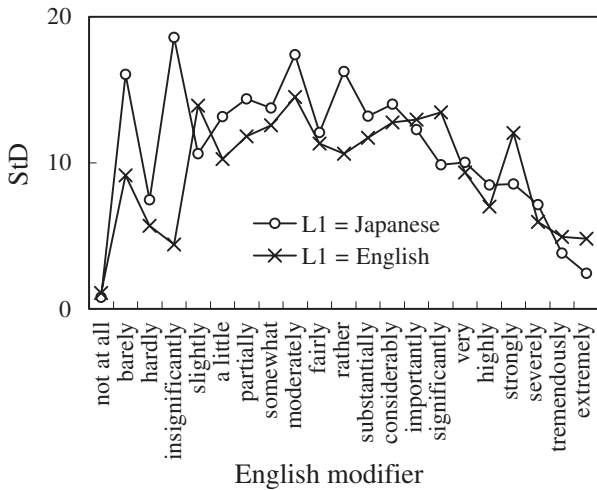


Fig. 8 Comparison of standard deviation of English intensity scores by native language.

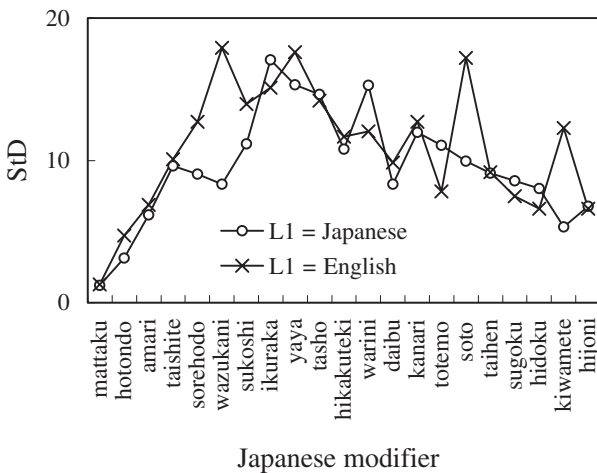


Fig. 9 Comparison of standard deviation of Japanese intensity scores by native language.

was “strongly,” “highly,” “very,” “soto,” “kanari” and “daibu.” Comparing the orders with the intensity scores in Table 5, they were consistent with the scores except that the positions of “soto” and “kanari” were reversed between the line-marking exercise and the paired comparison test.

4. DISCUSSION

4.1. Interpretation of “Highest Degree”

Under the ICBEN protocol, before subjects begin to evaluate the intensity of individual modifiers in the line-marking exercise, they are instructed that the “highest degree” point on the line-marking exercise is the “highest degree of annoyance imaginable.” This imaginary “highest degree” then becomes the standard against which the intensity of each modifier is measured. The cross-cultural comparability of the resulting intensity scores is predicated on the hypothesis that subjects of differing linguistic and

Table 7 Results of paired comparison test for the higher intensity modifiers.

<i>p</i>	extremely	tremendously	hijoni	severely	sugoku	taihen
extremely		0.31	0.29	0.23	0.07	0.03
tremendously	0.69		0.36	0.38	0.17	0.17
hijoni	0.71	0.64		0.49	0.23	0.09
severely	0.77	0.61	0.51		0.33	0.13
sugoku	0.93	0.83	0.77	0.67		0.39
taihen	0.97	0.83	0.91	0.87	0.61	
Σp	4.07	3.23	2.84	2.65	1.41	0.80
Distance	1.80	1.29	1.14	1.03	0.39	0

Table 8 Results of paired comparison test for the lower intensity modifiers.

<i>p</i>	strongly	highly	very	soto	kanari	daibu
strongly		0.43	0.26	0.39	0.41	0.21
highly	0.57		0.37	0.44	0.44	0.20
very	0.74	0.63		0.43	0.37	0.21
soto	0.61	0.56	0.57		0.49	0.29
kanari	0.59	0.56	0.63	0.51		0.29
daibu	0.79	0.80	0.79	0.71	0.71	
Σp	3.29	2.97	2.62	2.49	1.41	1.20
Distance	0.94	0.81	0.65	0.60	0.56	0

cultural backgrounds interpret this “highest degree” level similarly. Testing this hypothesis is difficult, however, because there is no obvious standard against which subjects can be asked to measure their interpretations directly. The use of bilingual subjects in this study, however, allows us look for indirect indications of different interpretations.

In this study, each of the English L1 and Japanese L1 subjects evaluated all of the English and Japanese modifiers using the line-marking exercise. On each questionnaire, the base descriptor and the bilingual format of the exercise was consistent throughout; that is, the format of the line-marking exercise was the same for both English and Japanese modifiers. If there were a significant difference in the “highest degree” imagined by English L1 subjects and Japanese L1 subjects, that difference should lead to a significant numerical difference in intensity scores between the two groups. Moreover, the difference should be most apparent in the modifiers of high intensity because they are closest to the “highest degree” standard.

Accordingly, the average intensity scores for all six modifiers in Cluster 1 were calculated for English L1 subjects and Japanese L1 subjects as shown in Table 9. Although Japanese L1 and English L1 subjects differed by as much as nearly 5 points in their interpretations of individual modifiers, the average difference in their intensity scores in this cluster is less than 1 point. This

Table 9 Average intensity scores for all six modifiers in Cluster 1.

Subjects	hido-ku	kiwamete	hijoni	severely	tremendously	extremely	Japanese average	English average	Average
English L1	92.0	90.8	93.1	92.7	94.2	95.5	92.0	94.1	93.1
Japanese L1	89.2	95.7	91.3	91.1	96.9	98.2	92.1	95.4	93.7
English ICBEN				90.7	92.3	94.9		92.6	
Japanese ICBEN	91.0	91.8	93.8				92.2		

indicates that they did not interpret the “highest degree” standard in significantly different ways.

For half of the subjects the base descriptor on the line-marking exercise was the English “annoyance” while the remaining subjects received questionnaires in which the Japanese “urusasa” was used. It is also conceivable that these English and Japanese base descriptors might elicit different responses from the subjects based on differing cultural and linguistic norms, but such a difference was found for only one modifier in the two-factor analysis of variance test. Thus, the analysis of variance test did not produce strong evidence of a cultural difference that might affect the interpretation of “highest degree” on the line-marking exercise.

Finally, the agreement between the intensity scores and the order determined by the paired comparison test is further evidence that a difference in the interpretations of “highest degree” did not corrupt the intensity data.

4.2. Relationship of “Hijoni” to English Modifiers

Igarashi [11] argued that differences he observed in the dose-response relationships derived from various social surveys resulted in part from differences in the number of steps corresponding to “highly annoyed” and the verbal labeling of the scales. In his review, most Japanese curves shifted to the left compared with the foreign studies. He speculated that this was partly because the labels of the upper two steps were usually “extremely” and “very” in foreign studies whereas they were “hijoni” (translated as “very”) and “urusai” (Japanese for “annoyed”) without a modifier in the Japanese studies. While it is true that “annoyed” alone without any modifier is much less intense

than “very annoyed” [3], Tables 5 and 6 refute the possibility that “kiwamete” and “hijoni” are closer to “very” than to “extremely.” The second highest modifiers in Japanese, “daibu” in the ICBEN study and “totemo” in the present study, are in the same category as “very” in Table 6.

4.3. Characteristics of Bilingual Subjects

Three general observations can be made regarding bilingual subjects on the basis of these results. First, L1 subjects and L2 subjects differ markedly in their average evaluations of the intensity of certain modifiers. Second, L2 subjects are less consistent in their intensity evaluations, particularly in regard to certain modifiers. Third, and perhaps most interesting, in some instances L2 knowledge seems to have a significant impact on the interpretation of the intensity of L1 modifiers.

The first and second phenomena may be due in part to the use of English-Japanese and Japanese-English dictionaries in the process of L2 acquisition. Table 10 shows the Japanese modifiers that are presented in several standard English-Japanese dictionaries as equivalents of some of the English modifiers used in this study. Similarly, Table 11 presents the results of a survey of Japanese-English dictionaries. The numerals in the “English” and “Japanese translation” columns of Table 10 and the numerals in the analogous columns of Table 11 indicate the ICBEN intensity scores for these modifiers. The “Ave.” column shows the average of the intensity scores of the equivalents presented in the dictionaries. Columns “L1” and “L2” show the average intensity scores of subjects for whom the language of the column on the far left is L1 and L2. The

Table 10 Equivalents of English modifiers listed in English-Japanese dictionaries shown with ICBEN intensity scores and compared with scores of bilingual subjects.

English	Japanese translation						Ave.	L1	L2	
extremely	94.9	kiwamete	91.8	hijoni	93.8	totemo	83.9	89.8	95.2	98.2
tremendously	92.3	sugoku	89.5	hidoku	91.0	totemo	83.9	88.1	94.2	96.9
very	75.6	kiwamete	91.8	hijoni	93.8	taihen	86.3	90.6	75.5	81.1
rather	47.9	kanari	83.9	tasho	44.5	yaya	43.5	57.3	59.6	52.4
fairly	40.5	kanari	83.9	soto	84.9			84.4	49.9	60.3
slightly	15.4	sukoshi	34.8	wazukani	26.0			30.4	14.7	17.8
a little	13.2	sukoshi	34.8	tasho	44.5	ikuraka	39.2	39.5	17.0	17.4
hardly	10.3	hotondo	6.9	mattaku	1.0	hidoku	91.0	33.0	7.4	10.6

Table 11 Equivalents of Japanese modifiers listed in Japanese-English dictionaries shown with IC BEN intensity scores and compared with scores of bilingual subjects.

Japanese		English translation						Ave.	L1	L2		
hijoni	93.8	extremely	94.9	highly	78.7	very	75.6	considerably	71.3	80.1	91.3	93.1
hidoku	91.0	extremely	94.9	hardly	10.3					52.6	89.2	92.0
soto	84.9	moderately	43.7	fairly	40.5			considerably	71.3	51.8	80.7	63.5
kanari	83.9	moderately	43.7	fairly	40.5			considerably	71.3	51.8	77.1	70.1
totemo	83.9	extremely	94.9	tremendously	92.3	very	75.6	rather	47.9	77.7	79.1	80.7
warini	57.4	rather	47.9							47.9	49.0	49.4
sukoshi	34.8	a little	13.2	slightly	15.4			somewhat	35.7	21.4	21.7	18.8
wazukani	26.0	barely	7.5	slightly	15.4					11.5	11.1	18.9

discrepancies that can be observed between the intensity scores of the modifiers in the far left column and the modifiers presented as their equivalents in dictionaries may help to explain some of the phenomena observed in this study. For example, while the L1 intensity score for “fairly” was 49.9, the L2 intensity score was 60.3, a result that is consistent with the association of “fairly” with modifiers of high intensity in English-Japanese dictionaries. In Japanese, a similar point can be made about the word “soto.” Moreover, discrepancies between the impressions about these words gained through use of the language and the intensities of equivalents offered in dictionaries may also be causing confusion about the intensities and thereby contributing to higher standard deviation scores in L2 users.

A striking example of the third phenomenon is the discrepancy between the IC BEN intensity score for “sukoshi” (34.8) and the L1 score obtained in this study (21.7). This later score is much closer to typical scores for “a little,” which is a common translation. Thus, it appears that intimate knowledge of English may have lead Japanese subjects to adjust their assessment of the intensity of “sukoshi.” The general similarity of the contours of Figs. 6 and 7, which compare the intensity scores of L1 and L2 subjects, and the pattern of difference observed in Figs. 4 and 5, which compare the intensity scores of monolingual IC BEN subjects and the bilingual L1 subjects in this study, may also indicate influence of L2 on L1. This possibility is of particular interest because L2 influence on L1 has only recently become the subject of research in the field of linguistics and is not yet well understood [12].

While the results of this study indicate that monolingual and bilingual subjects may differ significantly in their evaluations of middle-range modifiers, similar differences in the evaluations of modifiers in the highest intensity range were not found. Therefore, differences between monolingual and bilingual subjects discussed here should not cast significant doubt on the validity of the results discussed in relation to the interpretation of the “highest degree” in the line marking exercise.

5. CONCLUSIONS

An experiment in which bilingual subjects constructed annoyance scales in English and Japanese according to the IC BEN protocol was conducted. The results clearly indicate that English- and Japanese-speaking subjects do not differ significantly in their interpretations of the “highest degree” of annoyance. Thus, a key premise of the equivalence of the IC BEN scales was confirmed for English and Japanese.

In addition, though the Japanese modifier “hijoni” has frequently been translated as “very,” the results of this study show that “extremely” is a more appropriate translation.

Finally, the results of this study indicate that bilingual subjects may differ significantly from monolingual subjects in their interpretations of certain words.

ACKNOWLEDGEMENTS

This study was supported financially by a Grant-in-Aid for Scientific Research (No. 12650599) from the Japanese Ministry of Education, Culture, Sports, Science and Technology. We gratefully express our appreciation to Dr. James M. Fields for inspiring this research and for his useful suggestions.

REFERENCES

- [1] H. M. E. Miedema and H. Vos, “Exposure-response relationships for transportation noise,” *J. Acoust. Soc. Am.*, **104**, 3432–3445 (2002).
- [2] S. Fidell and S. R. Teffteller, “Scaling annoyance for social surveys of community reaction to noise exposure,” *Bolt Beranek and Newman Inc. Report*, No. 4211 (1980).
- [3] N. Levine, “The development of an annoyance scale for community response assessment,” *J. Sound Vib.*, **74**, 265–279 (1981).
- [4] J. M. Fields, “Effect of personal and situational variables on noise annoyance in residential areas,” *J. Acoust. Soc. Am.*, **93**, 2753–2763 (1993).
- [5] K. Furihata and T. Yanagisawa, “Reconstruction of vehicle noise-rating scale based on judgment of residents in and around Nagano city and its effectiveness,” *J. Acoust. Soc. Jpn. (J)*, **44**, 108–115 (1988).
- [6] Committee of Social Surveys on Noise Problems of Acoustical

- Society of Japan, "Report of the Committee of Social Survey on Noise Problems," *J. Acoust. Soc. Jpn. (J)*, **48**, 119–125 (1992).
- [7] J. M. Fields, R. G. d Jong, T. Gjestland, I. H. Flindell, R. F. S. Job, S. Kurra, P. Lercher, M. Vallet, R. Guski, U. Felscher-Suhr and R. Schumer, "Standardized general-purpose noise reaction questions for community noise surveys: Research and a recommendation," *J. Sound Vib.*, **242**, 641–679 (2001).
- [8] <http://www.crossroads.net/honyaku/>
- [9] T. Yano, J. Igarashi, J. Kaku, K. Kanda, T. Kaneko, S. Kuwano, Y. Nii, T. Sato, M. So, I. Yamada and Y. Yoshino, "International joint study on the measurement of community response to noise: The validity of noise annoyance modifiers and question wording in Japanese," *J. Acoust. Soc. Jpn. (J)*, **58**, 165–172 (2002).
- [10] K. Kanda, J. Igarashi, J. Kaku, T. Kaneko, S. Kuwano, Y. Nii, M. So, T. Sato, I. Yamada, T. Yano and Y. Yoshino, "International joint study on the measurement of community response to noise: Comparison of Japanese noise annoyance modifiers between age brackets and areas," *J. Acoust. Soc. Jpn. (J)*, **58**, 93–100 (2002).
- [11] J. Igarashi, "Comparison of community response to transportation noise: Japanese results and annoyance scale," *J. Acoust. Soc. Jpn. (E)*, **13**, 301–309 (1992).
- [12] V. J. Cook, Ed., *Portraits of the L2 User* (Multilingual Matters, Clevedon, 2002).



Kirk Masden is an associate professor at Kumamoto Gakuen University where he teaches courses related to comparative culture and intercultural communication. He received a Master of Musicology degree from the Tokyo University of Fine Arts and Music and is currently a Ph.D candidate in the Graduate School of Science and Technology of Kumamoto University.



Takashi Yano is a professor at Kumamoto University where he teaches courses related to architectural acoustics and lighting design and studies community response to environmental noises. He received a Doctor of Engineering from Osaka University. He is a member of Acoustical Society of Japan, Institute of Noise Control Engineering, Japan, and Architectural Institute of Japan.