How do ordinary people evaluate noise pollution in the context of environmental issues?

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ABSTRACT

Noise pollution is an environmental issue, and noise policies should thus be developed in the context of such issues. Noise policies also need to reflect public opinion; thus, in developing noise policies, it is important to understand the opinions of ordinary people. This study investigates the evaluation by ordinary individuals of the importance of and their familiarity with noise pollution in the context of environmental issues. A two-dimensional mapping method, which was developed in the field of health education and health promotion, was employed. Participants were asked to evaluate eight items—air pollution, water pollution, soil pollution, odor, noise pollution, ground subsidence, greenhouse gasses, and radioactive pollution—in terms of their importance and familiarity. Noise was most frequently evaluated as the least important environmental issue by the participants, though familiarity with noise pollution varied widely among them. Some participants did evaluate noise pollution as an important and familiar issue: those participants also tended to regard odor as an important issue and to evaluate greenhouse gasses and radioactive pollution, which cannot be sensed directly, as unimportant and unfamiliar.

Keywords: Environmental issues, Two-dimensional mapping method I-INCE Classification of Subjects Number(s): 66, 60

1. INTRODUCTION

The Rio Declaration (1) has been deemed fundamental to environmental policies, and it was reaffirmed by the international community in 2012 (2). The declaration clearly states that "environmental issues are best handled with the participation of all concerned citizens, at the relevant level" (principle 10). In addition, the declaration also affirms that "states and people shall co-operate in good faith and in a spirit of partnership in the fulfillment of the principles embodied in this Declaration and in the further development of international law in the field of sustainable development" (principle 27). As those principles indicate, public participation, including participation in decision-making processes, is required to solve environmental issues, and the relationship among the participants should be one of partnership. To establish partnership relationships, participants need to understand and respect each individual's position.

Noise pollution is an environmental issue, and noise policies thus need to be developed in the context of such issues. Accordingly, noise policies should reflect public opinion through public participation in decision making; public participation as partners is also necessary in reducing noise pollution.

Achieving public participation in noise issues in a spirit of partnership necessitates understanding ordinary people's opinions about noise. Thus, the present study investigates an evaluation made by ordinary individuals about the importance of and their familiarity with noise pollution in the context of environmental issues.

2. METHOD

This study employs a two-dimensional mapping method (3), which was developed in the field of health education and health promotion. This method can visualize one aspect of the participants' concept of a certain theme, e.g., environmental issues in the present study, by evaluating some items

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related to the theme using two virtual evaluation axes. In this study, the following eight environmental issues were selected as the items for evaluation: *water pollution*, *air pollution*, *soil contamination*, *offensive odor*, *noise pollution*, *ground subsidence*, *greenhouse gas*, and *radioactive contamination*. In addition, "subjective importance" and "subjective familiarity" were selected as the virtual evaluation axes.

The survey procedure was as follows. First, an evaluation sheet (Figure 1) was distributed to each participant, and the items for evaluation were presented to the participants by means of that sheet. Participants were asked to put the items (row Ⓐ in Figure 1) in order of subjective importance: the most important item appeared in the furthest right space and least important item in the furthest left space. Participants were then asked to evaluate each item in terms of subjective familiarity using a seven-point scale and draw a circle at the appropriate point in the upper grid of the evaluation sheet: if an item was evaluated as very familiar, the circle was drawn at the top of the column; if an item was evaluated as very unfamiliar, the circle was drawn at the bottom of the column. The red circles and items in row Ⓐ in Figure 1 show an example of a filled-in evaluation sheet.

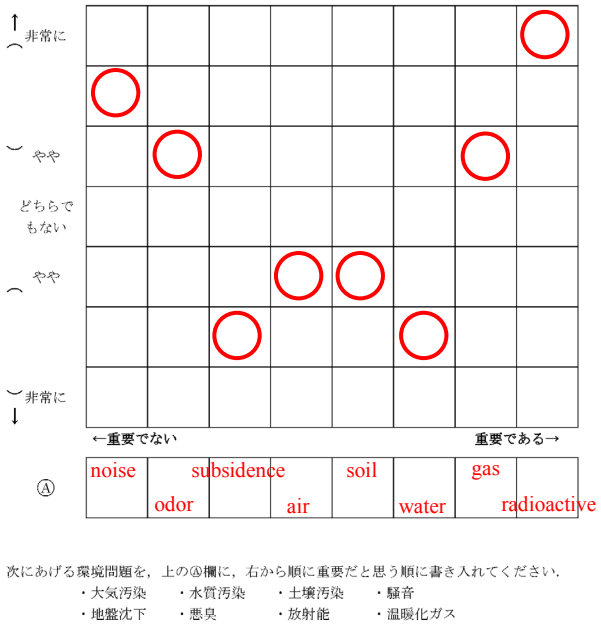


Figure 1 – Example of a filled-in evaluation sheet, with the response appearing as red circles and ordering of the items in red.

The surveys were conducted at Fukushima University in 2012 and 2013. The participants were students taking a class titled Compendium of Psychology in the Faculty of Symbiotic Systems Science and one titled Introduction to Human Support Systems in the Cluster of Human and Social Sciences. No participants were taking a course related to noise pollution at the time of the surveys. All the participants of the surveys in 2012 entered the university before the severe accident at Fukushima Daiichi Nuclear Power Plant following the Great East Japan Earthquake of 2011. Conversely, almost all the participants of the surveys in 2013 entered the university after the accident. The surveys were conducted on 29 May 2012 (n=39) and 4 June 2013 (n=57) for the students of the Compendium of Psychology class and on 11 January 2012 (n=34) and 24 October 2013 (n=34) for students of the Introduction to Human Support Systems class. Valid responses were obtained from all 73 participants in the 2012 survey and 90 participants in the 2013 survey. The data obtained from the 2012 and 2013 surveys were analyzed separately so as to assess their stability.

The obtained data were transformed into coordinate values as follows. For the horizontal axis, each item was numbered, starting with the least important item through to the most important item. For the vertical axis, each step was numbered, starting with very unfamiliar items through to very familiar items. For example, in Figure 1, *noise pollution* was given a coordinate (1, 6) and *radioactive contamination* (8, 7).

The analyses in this study were as follows. First, scatter diagrams of the respective items were

plotted. The averages and standard deviations were then calculated for each coordinate value of the items in the scatter diagrams. The correlation coefficient between subjective importance (horizontal axis) and subjective familiarity (vertical axis) was also calculated in the respective scatter diagrams.

A hierarchical cluster analysis was then used to classify the obtained maps according to their similarity. The similarity of the maps was defined using the following procedure. On a map obtained from subject i, coordinate values of the various items were combined as follows:

$$(x_{i,water\ pollution}, y_{i,water\ pollution}, x_{i,air\ pollutin}, y_{i,air\ pollution}, \cdots, y_{i,radioactive\ poluution})$$

The order of combination was *water pollution*, *air pollution*, *soil contamination*, *offensive odor*, *noise pollution*, *ground subsidence*, *greenhouse gas*, and *radioactive contamination*. The combined coordinates were considered as the coordinates on the respective maps on 16-dimensional spaces. Ward's method was applied for clustering and the squared Euclidean distance for the similarity among the maps. Based on the results of the cluster analysis, the maps were classified into groups with respect to each survey. To examine the characteristics of each group, the average of the coordinated values of the respective items on the maps were calculated for each group.

3. RESULTS

The scatter diagrams for the various items in the 2012 and 2013 surveys appear in Figures 2 and 3, respectively. The size of each solid circle and the number to its right indicate the number of participants who put the item on that particular coordinate. Table 1 presents the averages and standard deviations of each coordinate value for the various items in the scatter diagrams. The table also shows the correlation coefficient between subjective importance (horizontal axis) and subjective familiarity (vertical axis) in the scatter diagrams.

The number of participants who evaluated *noise pollution* as the least important environmental issue was the greatest in both surveys. In addition, the majority of participants (89% in the 2012 survey, 84% in the 2013 survey) evaluated this item as one of four unimportant items. Regarding familiarity, the evaluation differed depending on the participants; thus, the standard deviations for familiarity with *noise pollution* were the largest among all the items in both surveys.

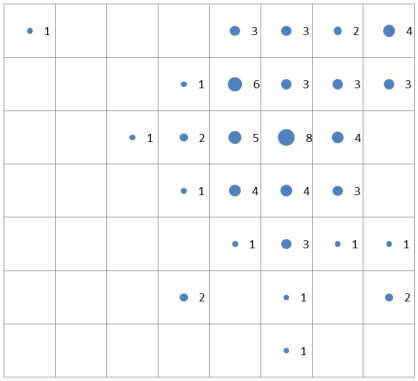
The number of participants who evaluated *offensive odor* as the second-least important environmental issue was the greatest among all the items in both surveys. In addition, the majority of participants (86% in the 2012 survey, 79% in the 2013 survey) evaluated this item as one of four unimportant items. Regarding familiarity, evaluation differed from person to person, although the standard deviations were somewhat smaller than those for *noise pollution*. Thus, the tendencies with the evaluations of *offensive odor* and *noise pollution* were similar, but *noise pollution* was clearly evaluated as being less important than *offensive odor*.

Ground subsidence was regarded as the next unimportant item after *noise pollution* and *offensive odor*. The majority of participants (82% in the 2012 survey, 76% in the 2013 survey) evaluated this item as one of four unimportant items. With this item, over 70% of participants (74% in the 2012 survey, 78% in the 2013 survey) evaluated it as one of three items of low familiarity.

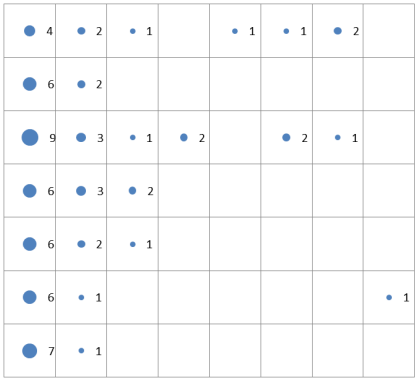
By contrast, *water pollution*, *air pollution*, and *radioactive contamination* were items that tended to be evaluated as important. Especially, *radioactive contamination* had the greatest number of participants who evaluated it as the most important and most familiar item (40% in the 2012 survey, and 20% in the 2013 survey). Regarding familiarity, over 90% of the participants (97% in the 2012 survey, 93% in the 2013 survey) evaluated this item as one of three familiar items in both surveys. However, regarding importance, 84% of the participants evaluated this item as one of four important items in the 2012 survey, though only 67% did so in the 2013 survey.

Over half the participants (52% in the 2012 survey, 59% in the 2013 survey) placed *water pollution* and *air pollution* next to each other on the evaluation sheet, with respect to their subjective importance. Almost half the participants evaluated *water pollution* as more important than *air pollution*; the others regarded *air pollution* as more important than *water pollution*. Also, almost half the participants (48% in the 2012 survey, 49% in the 2013 survey) evaluated their familiarity with those two items as the same.

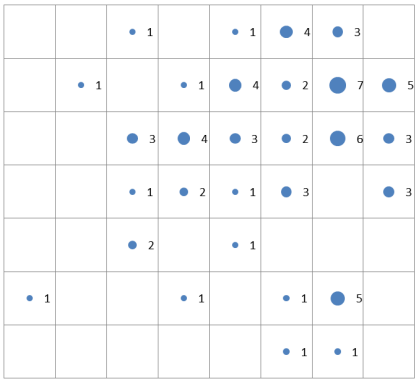
In addition, with respect to their subjective importance, *soil contamination* tended to be placed next to *water pollution* and *air pollution* on the evaluation sheet: about half the participants (51% in the 2012 survey, 52% in the 2013 survey) evaluated those three items in that manner. Around 70% of the participants (67% in the 2012 survey, 73% in the 2013 survey) evaluated *soil contamination* as having lowest importance among the three types of contamination.



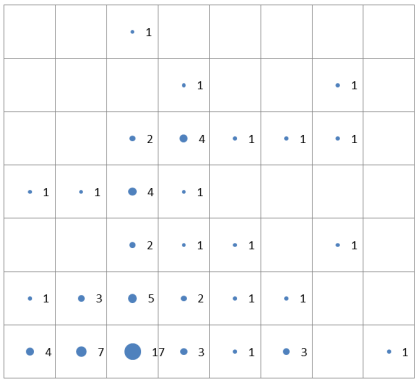
(a) water pollution



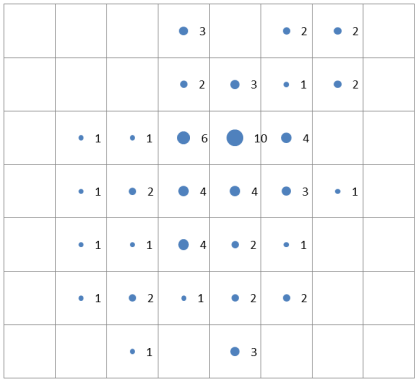
(e) noise pollution



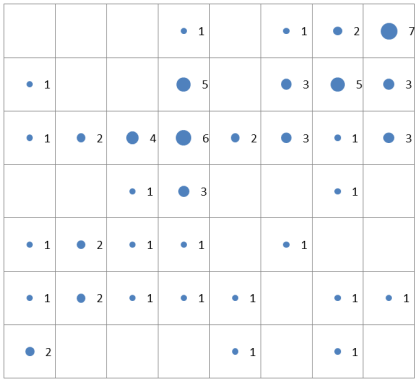
(b) air pollution



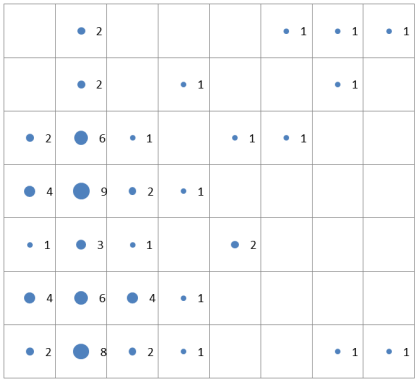
(f) ground subsidence



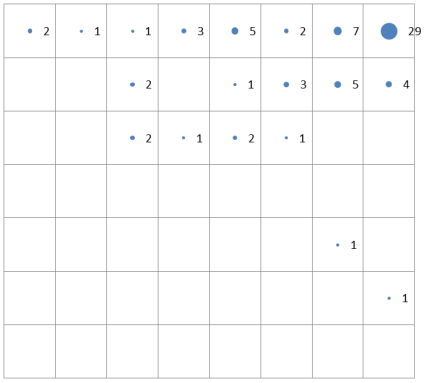
(c) soil contamination



(g) greenhouse gas

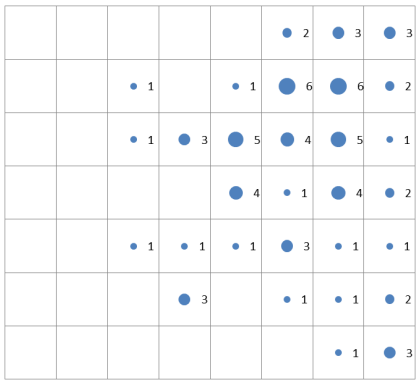


(d) offensive odor

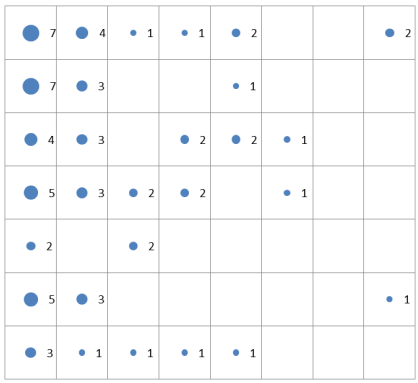


(h) radioactive contamination

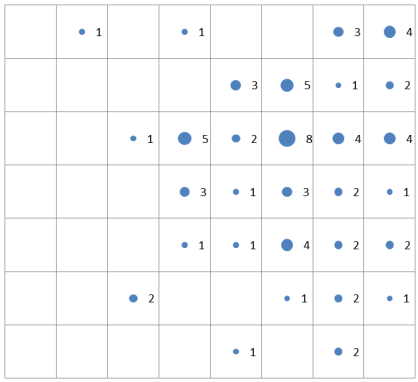
Figure 2 – Scatter diagrams for the items in the 2012 survey



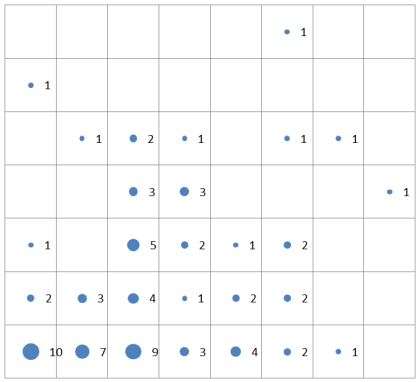
(a) water pollution



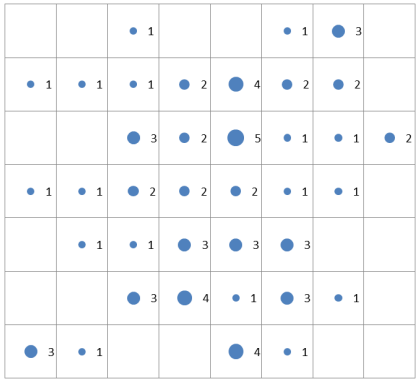
(e) noise pollution



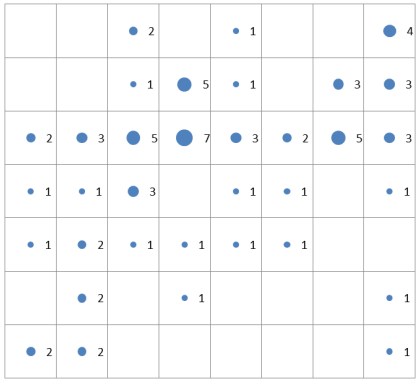
(b) air pollution



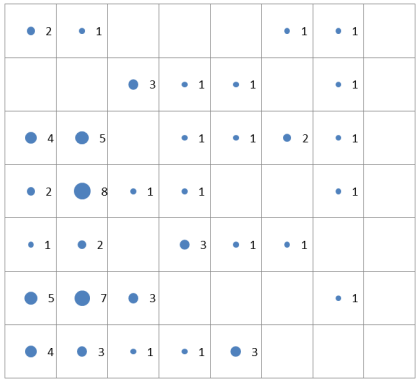
(f) ground subsidence



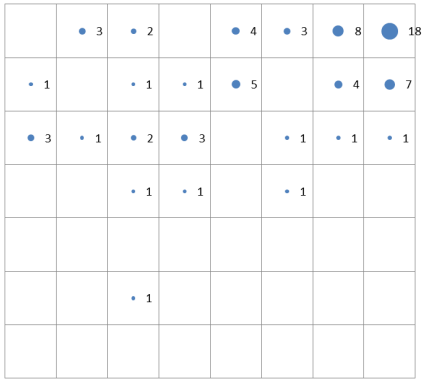
(c) soil contamination



(g) greenhouse gas



(d) offensive odor



(h) radioactive contamination

Figure 3 – Scatter diagrams for the items in the 2013 survey

Table 1 – Average, standard deviation, and correlation coefficient for each item in the scatter diagrams

(1) 2012 survey

Item	Average ± S.D. Importance	Familiarity	Correlation coefficient
water pollution	5.9 ± 1.3	4.9 ± 1.5	0.03
air pollution	5.8 ± 1.7	4.8 ± 1.6	0.11
soil contamination	4.7 ± 1.2	4.3 ± 1.6	0.29
offensive odor	2.7 ± 1.7	3.3 ± 1.8	0.21
noise pollution	2.0 ± 1.8	4.2 ± 1.9	0.27
ground subsidence	3.4 ± 1.5	2.3 ± 1.7	0.27
greenhouse gas	5.0 ± 2.3	4.8 ± 1.7	0.48
radioactive contamination	6.5 ± 1.9	6.5 ± 0.9	0.13

(2) 2013 survey

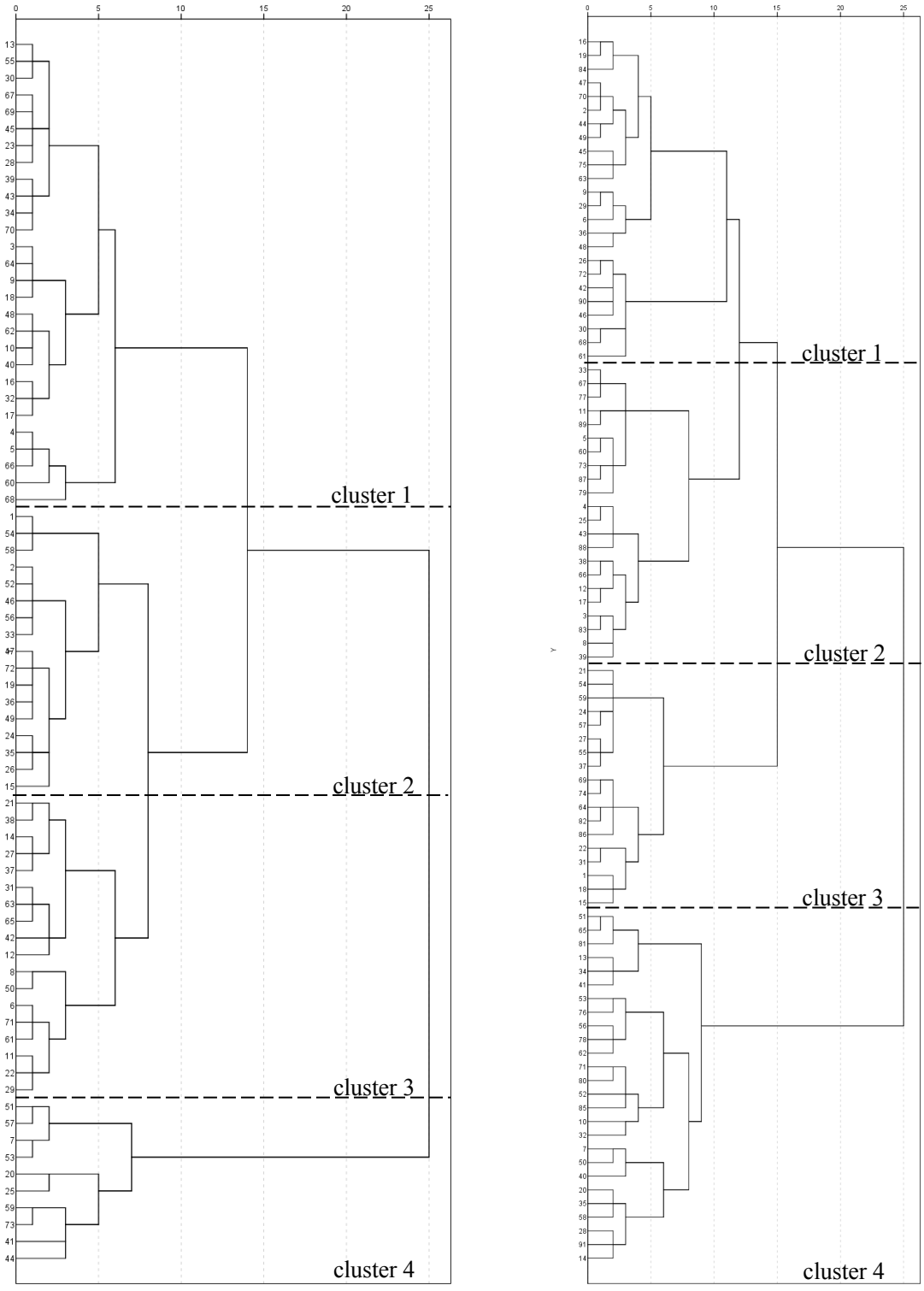
Item	Average ± S.D. Importance	Familiarity	Correlation coefficient
water pollution	6.3 ± 1.4	4.2 ± 1.6	0.07
air pollution	6.1 ± 1.5	4.6 ± 1.6	0.12
soil contamination	4.6 ± 1.7	4.0 ± 1.9	0.23
offensive odor	3.0 ± 1.9	3.6 ± 1.6	0.17
noise pollution	2.5 ± 1.9	4.6 ± 2.0	0.16
ground subsidence	3.2 ± 1.7	2.3 ± 1.6	0.28
greenhouse gas	4.5 ± 2.3	4.7 ± 1.6	0.32
radioactive contamination	5.7 ± 2.2	6.2 ± 1.1	0.34

Greenhouse gas was evaluated diversely by the participants. Participants who evaluated this item as important also tended to evaluate it as familiar.

As described above, the tendencies for evaluation were similar in the two surveys except for evaluating the importance of *radioactive contamination*. The results of cluster analysis are described in the following section.

The maps drawn by the participants in the surveys were classified using cluster analysis. The dendrograms for the two surveys appear in Figure 4. With both dendrograms, four clusters (clusters 1–4) were obtained. Further, the structures of the two dendrograms were similar: clusters 1, 2, and 3 were combined first; then, cluster 4 combined with the previously combined clusters.

Table 2 shows the average coordinate values for each item calculated by cluster. In both surveys, *noise pollution* was evaluated as unimportant by the participants in clusters 1–3, whereas it was regarded as relatively important by the participants who composed cluster 4. Comparing clusters 1–3 with cluster 4, *offensive odor* also tended to be evaluated as unimportant by the former, though it was regarded as relatively important by the latter. Conversely, *greenhouse gas* and *radioactive contamination* tended to be evaluated as relatively important by the former, but relatively unimportant by the latter. The participants in cluster 4 also tended to evaluate *noise pollution* as familiar in both surveys; *offensive odor* was regarded as familiar in the 2012 survey.



(a) 2012 survey (b) 2013 survey

Figure 4 – Dendrograms of the two surveys

Table 2 – Average of the coordinate values of each item calculated for each cluster

(1) 2012 survey

	Water pollution		***Air pollution***		***Soil contamination***		***Offensive odor***	
	Importance	Familiarity	Importance	Familiarity	Importance	Familiarity	Importance	Familiarity
Cluster 1	6.1	4.4	7.3	4.2	5.2	4.5	2.4	3.2
Cluster 2	5.8	4.5	5.2	4.9	4.4	3.4	1.9	2.3
Cluster 3	5.9	6.1	5.7	5.8	4.4	5.3	2.1	3.8
Cluster 4	5.8	5.6	3.9	4.9	3.7	3.5	5.9	4.7

	Noise pollution		***Ground subsidence***		***Greenhouse gas***		***Radioactive contamination***	
	Importance	Familiarity	Importance	Familiarity	Importance	Familiarity	Importance	Familiarity
Cluster 1	1.4	4.7	2.9	1.3	4.3	3.8	6.8	6.4
Cluster 2	1.5	3.2	3.2	1.7	7.1	6.3	6.9	6.5
Cluster 3	1.4	3.7	3.8	4.5	5.7	5.4	6.7	6.8
Cluster 4	5.7	5.8	4.5	2.2	2.0	3.7	4.5	6.3

(2) 2013 survey

	Water pollution		***Air pollution***		***Soil contamination***		***Offensive odor***	
	Importance	Familiarity	Importance	Familiarity	Importance	Familiarity	Importance	Familiarity
Cluster 1	5.8	3.2	6.3	3.4	4.5	2.6	2.0	3.5
Cluster 2	6.7	5.5	6.9	5.5	5.8	4.8	2.1	4.3
Cluster 3	6.0	5.3	5.1	5.1	4.6	5. 8	2.1	2.1
Cluster 4	6.6	4.7	6.0	4.5	3.6	3.5	5.2	3.9

	Noise pollution		***Ground subsidence***		***Greenhouse gas***		***Radioactive contamination***	
	Importance	Familiarity	Importance	Familiarity	Importance	Familiarity	Importance	Familiarity
Cluster 1	1.6	5.1	3.9	2.1	6.5	4.8	5.5	5.9
Cluster 2	1.5	5.2	2.8	2.5	4.6	4.7	5.6	6.3
Cluster 3	1. 6	2.4	3. 8	2.4	5.3	5.2	7. 7	6.8
Cluster 4	4.9	5.0	2.8	2.2	2.3	4.4	4.6	6.2

4. DISCUSSION

Radioactive contamination was evaluated as a familiar issue in both surveys. Considering the severe accident at the Fukushima Daiichi Nuclear Power Plant, it is natural that students of Fukushima University should evaluate this item as very familiar. However, the participants in the 2013 survey evaluated the item as less important than those in the 2012 survey. As described above, almost all the participants in the 2013 survey entered the university after that accident: they therefore believed that the contamination level in the city of Fukushima was not a problem for them in choosing that university. The students who entered the university before the accident were of course unable to assess that accident in their choice of university. This fact probably explains the difference in the participants' evaluation of the importance of this item. Thus, the two-dimensional mapping method appears to provide results that appropriately reflect the participants' evaluations.

With regard to *noise pollution*, the majority of the students evaluated this item as unimportant. As noted in the Introduction, public participation is required to solve environmental issues. However, it may be difficult to promote such participation if there is a lack of interest in the issue at hand. Therefore, it is necessary to consider ways of promoting an interest in *noise pollution* among the general public.

A minority of the participants evaluated *noise pollution* as important and familiar. Those respondents likewise regarded *offensive odor* as important and *greenhouse gas* and *radioactive contamination* as unimportant and unfamiliar. It would appear that such participants largely consider issues that they can sense as being important and familiar to them. This suggests that environmental education about the sonic environment, such as the sound education developed by Schafer (4), can play an effective role in creating greater public interest about noise pollution.

5. CONCLUSIONS

This study demonstrates that the majority of ordinary citizens evaluated noise pollution as the least important environmental issue, though familiarity with noise pollution varied widely among the participants. Some respondents did evaluate noise pollution as an important and familiar issue. Those individuals also tended to evaluate odor as an important issue and to evaluate greenhouse gasses and radioactive pollution, which cannot be sensed directly, as unimportant and unfamiliar.

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