



## THE CONCEPT OF NOISE ANNOYANCE: HOW INTERNATIONAL EXPERTS SEE IT

R. GUSKI AND U. FELSCHER-SUHR

*Faculty of Psychology, Ruhr-Universität, D-44780, Bochum, Germany*

AND

R. SCHUEMER

*FernUniversität Hagen, Germany*

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The first part of this paper is a review of some definitions of noise annoyance which have been used explicitly or implicitly in major field and laboratory studies in different countries. This analysis shows wide differences. For instance, in some cases annoyance is seen as an outcome of disturbances, in other cases it is seen as an indication of the degree of helplessness with respect to the noise source. The second part is a report of an empirical study in which 68 noise research experts from seven different nations were asked (1) to indicate the main effect of noise, and (2) to rate the similarity between the concept “noise annoyance” and several related concepts. It turned out that (1) noise annoyance is seen as the major effect of noise, (2) that noise annoyance is a multi-faceted psychological concept, including behavioral, and evaluative aspects. Also, (3) the two aspects rated highest in similarity to annoyance are “nuisance” and “disturbance”, (4) although noise annoyance must be related to acoustic variables, acoustic characteristics do not play an overwhelming role in the concept of annoyance and (5) although experts from different languages agree upon the main components of the annoyance concept (e.g., nuisance, disturbance, and unpleasantness), there are some significant differences in the weights English, German, and Japanese speaking experts assign to several components (e.g., to nuisance, interference, irritation, and vexation). Whether these different weights are due to different concepts of annoyance, or due to different connotations of the related words in the respective languages, could not be analyzed with the data at hand.

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### 1. INTRODUCTION

In introducing the International Symposium on Environmental Annoyance, Koelega [1] noted that the term “annoyance” is a core concept in the area of environmental effects, but its meaning varies considerably among experts. Generally, it is seen as a negative evaluation of environmental conditions, but its connotations are rather broad and diverse. The concept is associated with disturbance, aggravation, dissatisfaction, concern, bother, displeasure,

harassment, irritation, nuisance, vexation, exasperation, discomfort, uneasiness, distress and hate. One could enlarge Koelega's list by adding the terms mentioned by Schönplflug [2] as reasons for the annoyance by sounds: somatic damage, covariation with failure, loss of orientation, loss of control, negative evaluation of the source, and high sound levels. In addition, Höge [3] mentions "aesthetic displeasure" as a cause of annoyance, and Guski [4] stressed the conflict between attentional and action demands caused by environmental sound information at one hand, and actions intended by the affected person on the other hand.

This paper gives (1) an overview of theoretical positions with respect to the concept of "noise annoyance" (see also reference [5]), and (2) a report on an empirical study of noise annoyance as seen by international noise experts. The latter seems important in view of the growing international consensus of noise experts to come to an agreement about shared annoyance questions in field studies about noise effects [6].

## 2. DEFINITIONS OF NOISE ANNOYANCE

### 2.1. NOISE ANNOYANCE AS EMOTION

In one of the earliest experimental studies of sounds and annoyance, Laird and Coye [7] referred to Titchener's theory of emotion which states that we do not just accept stimuli as they are, we also experience them affectively, and the affects they produce are called pleasure and displeasure. Thus, annoyance is considered as an elementary affective process related to the source of the stimulation. McKennell [8], Grandjean *et al.* [9], Schuemer-Kohrs and Schuemer [10] as well as Leonard and Borsky [11] reported significant correlations between judgments of noise annoyance and reported fear of aircraft accidents. In a path analysis of their correlational data, the last mentioned authors find annoyance to be a consequence of fear. It should be mentioned that other authors question this interpretation.

### 2.2. NOISE ANNOYANCE AS A RESULT OF DISTURBANCE

Hall, Taylor and Birnie [12] presented a model of noise annoyance which was supported by a large data set and used the reported interference with intended activities as a variable mediating annoyance judgments. In their model, annoyance judgments are secondary reactions, produced by the disturbance of activities (e.g., disturbance of communication), caused by noisy events. Two other concepts come to similar conclusions, but on a quite different basis: (1) Guski [4] considered annoyance as the outcome of a conflict between different affordances—e.g., the conflict between the (degraded) perception–action fit for the intended verbal communication on the one hand and the perception–action fit for unintended actions against the intrusion on the other hand; (2) Kalveram [13] considered annoyance as an effect of a neuronal structure which detects the potential for endangering fitness (in the sense of Darwin); this structure is

thought to respond to the disturbance of intended activities and to evaluate the bargain of eliminating the disturbance in relation to the costs of the elimination.

### 2.3. NOISE ANNOYANCE AS ATTITUDE

Although there are different definitions of “attitude”, most psychologists consider an attitude to be a consistent system of cognitions about a certain topic, and all cognitions share the property of evaluation: i.e., they contain a definitive position on the continuous scale between “good” and “bad”. Even if one does not have personal knowledge of a topic, one mostly has an attitude about it, sometimes derived from socio-cultural traditions, sometimes by mere associations with the name of the topic.

With each revision of his celebrated book about the effects of noise on man, Kryter (see, e.g., reference [14]) enriched his concept of noise annoyance: in the first edition, annoyance judgments were related to the personal information contained in the sound; in the second edition, annoyance was treated mainly with respect to attitude surveys; and in the third edition annoyance was treated mainly as an attitude, influenced by interference of activities and personal sound information. The systematic variation of annoyance judgments with the quality of verbal information about the source of the sound, as seen in data from Jonsson and Sörensen [15], are often taken as an indication of noise annoyance as an attitude.

### 2.4. NOISE ANNOYANCE AS KNOWLEDGE

There are several experimental demonstrations showing that very similar annoyance judgments are obtained with real sounds and mere verbal descriptions of sound situations (see, e.g., references [16, 17]), and the last author considered annoyance as the result of an interaction between a stimulus and a person in a certain situation. In his concept, annoyance is greatly influenced by the “conceptual knowledge” of sounds in a certain situation: e.g., the general effects of aircraft sounds on learning or sleeping. Even if one asks a person to judge his/her actual annoyance at this very moment, one will get a judgment which is influenced by the general knowledge about sound effects.

### 2.5. NOISE ANNOYANCE AS A RESULT OF RATIONAL DECISIONS

Fidell [18] considered annoyance judgments of residents to be the result of rational decisions which involve several variables: e.g., the actual physical noise load, information about earlier noise loads in the area, the sensibility of intended activities with respect to disturbance, and costs and benefits of different results of decisions. Fidell does not believe that respondents will decide rationally in each circumstance, but he says they balance one thing against another, they weigh different circumstances of their situation, and this will contribute to the well known fact that the degree of individually reported annoyance varies only moderately with the physical noise load.

### 3. AN INTERNATIONAL SEMANTIC STUDY WITH NOISE ANNOYANCE EXPERTS

The purpose of the study was twofold: (1) the authors wanted to explore similarities and differences in the meaning of the term “noise annoyance” between noise experts from different languages (respective cultures); (2) one wanted to know whether “noise annoyance” is the most serious effect of environmental noise, as seen by the experts, and which other effects are noted spontaneously as severe effects of noise.

#### 3.1. METHOD

There are different methods for the assessment of meaning of terms; the most common methods are (a) free verbal description, (b) the semantic differential, and (c) similarity rating. Kuwano *et al.* [19] used the semantic differential in a study on the concepts of “loudness”, “noisiness”, and “annoyance” with student groups in Japan, Great Britain, and Germany. They reported big differences between languages with respect to the first two concepts, but considerable similarities with respect to “annoyance” (cf. also [20]). The method of similarity rating was selected in order to avoid some of the problems connected with the other two: e.g., classifying free verbal responses, and finding opposite terms on the same verbal dimension. From a literature study and discussions with experts, 38 terms related to annoyance were selected, and the expert subjects were asked to rate the degree of similarity between “noise annoyance” and each of the 38 terms. For the rating, they used a graphical 7-point scale, containing the words “not at all” and “very strongly” at the respective extreme points. The terms used for the similarity rating are listed in Table 1. Note that some of the terms (e.g., “vomiting”) do not seem to be plausible candidates for high similarity with “noise annoyance”. They were included because the same rating instrument will be used in a comparable study on odour annoyance in the future.

The expert subjects were given the following questions.

1. Which kind of environmental noise effect do you think to be the most essential, in view of your expertise in noise effects? Please, scale the degree of similarity between **your** effect and the concepts used in the scientific literature (as listed in Table 1, with “annoyance” added).

2. Scale the degree of similarity or nearness of the concept **noise annoyance** to other concepts, situations, or effects (as listed in Table 1).

3. Indicate some personal demographical data and the professional relations with noise effects research.

#### 3.2. EXPERTS AS SUBJECTS

Who is an expert? One could define at least two classes of experts: (1) the residents affected by noise, and (2) the scientists who study noise effects. Since it seems less feasible to study experts on the first class, we asked the latter. As a criterion for being an expert, the responsibility for at least one empirical study on noise annoyance was selected. In German speaking countries, one tried to cover every expert from the authors’ knowledge of the literature. In Australia,

TABLE 1  
*List of variables related to related to annoyance*

English	German	Japanese
anger	Ärger	ikari
dislike of source	Abneigung geg. Verursacher	kiinsha ni tai sulu hankan
displeasure	Mißfallen	fuman
dissatisfaction	Unzufriedenheit	fumanzoku
disturbance	Störung	bôgai
exasperation	Verzweiflung	yake ni naru
fear	Furcht	oscore
disquiet	Beunruhigung	shinpai
financial loss	Wertminderung	kin yûjô no sonshitsu
high intensity	hohe Intensität	kyôretsu
interfering w. intend. act.	n. m. beabs. Tätigk. verträgl.	ito suru katsudô to oriawanai
irritation	Reizung	shigeki
helplessness	Machtlosigkeit	muryoku
nuisance	Ärgernis	meiwaka
stress	Stress	sutoressu
terrible	scheußlich	hidoi
uneasiness	Unbehagen	fuan
unpleasantness	Unangenehmheit	fukaisa
vexation	Verärgerung	kutsû
disgust	Ekel	mukatsuki
sickness	Übelkeit	hakike
very frequent occurrence	große Auftretenshäufigkeit	hinpan ni okoru
unpredictability	Unvorhersehbarkeit	yosô dekinai
resignation	Resignation	akirame
frustration	Frustration	furasutolêshon
distraction	Ablenkung	kibarashi
health risk	Gesundheitsrisiko	kenkôjô no risuku
rage	Wut	gekido
aggression	Aggression	katto sulu
escape tendency	Fluchttendenzen	tôhikeikô
getting on one's nerves	auf die Nerven gehen	shinkei ni sawaru
tension feelings	Anspannungsgefühle	kinchôkan
aversion	Aversion	hankan
certain noise character	best. Geräuscheigenschaften	tokutein o sôon (to kusasa)
feelings of impairment	Beeinträchtigungsgefühle	bôgaikan
irritability	Gereiztheit	iradachi
repulsion	Abscheu	ken'ô
vomiting	Erbrechen	ôto
... (other, please indicate) ...		sono ta, tsumari

France, Japan, The Netherlands, Sweden, UK and the USA, first well-known experts were mailed asking for names and addresses of further colleagues in their respective nations. Altogether, 90 addresses were received and contacted asking for collaboration, and a total of 68 experts were both willing to complete the answer sheets and fulfilled the criterion of being an expert.

The covering letter was written either in English or German, and the response sheets were translated into the respective languages before mailing them. The translations were done by a professional service in Germany; some comments by our Japanese colleagues revealed that the translation of the term “distraction” to the Japanese language used the reflexive form (in the sense of “I try to distract myself”) instead of the passive form (“I get distracted”) which is commonly meant in the other languages. Therefore, this item was dismissed from data analysis.

### 3.3. RESULTS

#### 3.3.1. *Description of expert subjects*

Among the total of 68 answers, 23 were from German speaking countries, 12 from Japan, 9 from Australia, 8 from the USA, 7 from The Netherlands, 5 from France, 3 from Sweden, and 1 from the UK. The median age of the experts is 51.3 years; 82.5% were male; the median duration of noise research was 22.5 years; 27% described their profession as “acoustics”, 25.4% “psychology”, 12.7% “psychoacoustics”, 12.7% “acoustics and social science”, 11.1% related to “social science”, and 9.6% related to “medicine”. The main type of research was “field study” (41.9%), followed by “laboratory study” (32.3%), and 25.8% indicated both field and lab studies. The number of noise studies in which the experts were involved ranged from 1 to 100, yielding a median of 10.4 studies.

#### 3.3.2. *Main noise effects*

*Foreword:* for the purposes of this paper, the variables scaled by the experts with regard to their respective similarity to the criterion concept are written in capital letters. The first (open) question showed Annoyance to be the main effect of environmental noise (50.8%), followed by Disturbance (32.3%), Anger (7.7%), Restrictions of Welfare (4.6%), Stress (3.1%), and Other (1.5%); see Figure 1. It should be noted that asking for “the most essential” environmental noise effect does not specify the frame of reference (e.g., essential for a person’s health, essential for society, or essential in the scientific literature). Therefore, there is no easy way of interpreting the answers. But in view of the ongoing scientific discussion about the importance of somatic effects of noise, it is impressive to see that 83% of the experts see Annoyance and Disturbance to be the most essential noise effects—no specific somatic effect was mentioned.

In order to test whether the meaning of Disturbance is different from the meaning of Annoyance, the data from those 21 experts who called Disturbance to be the main effect of noise was taken: their 36 similarity ratings for Disturbance (task 1) were compared with the respective similarity rating for Annoyance (task 2), and subjected to Wilcoxon Signed Ranks Tests. It turned out that only 3 of the possible comparisons were significantly different: Certain Sound Characteristics ( $Mdn = 4.20/5.09$ ,  $p = 0.013$  for Disturbance/Annoyance, two-tailed), Dislike of Source ( $4.50/5.25$ ,  $p = 0.018$ ), and, of course, Disturbance ( $6.76/6.29$ ,  $p = 0.013$ ). From these data, one can conclude that the meaning of Disturbance is very similar to that of Annoyance.

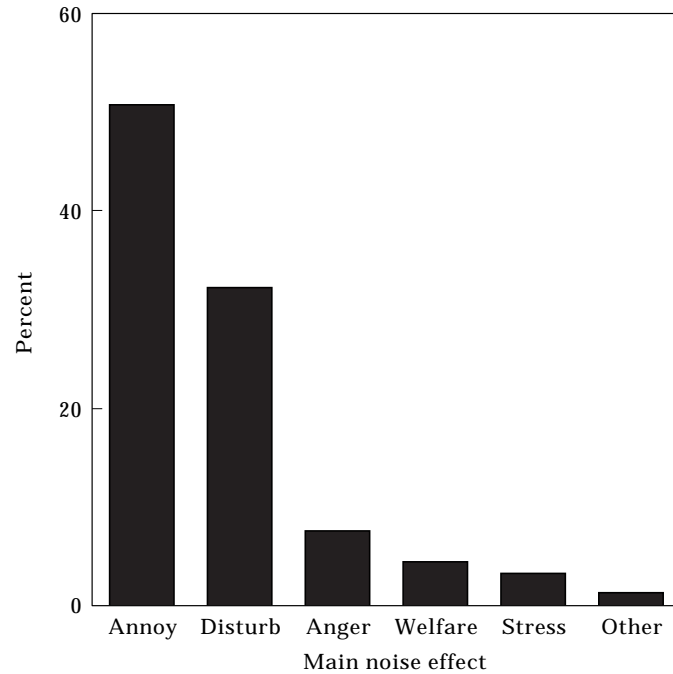


Figure 1. Main effect of environmental noise, as seen by 68 noise experts.

### 3.3.3. *General meaning of Annoyance*

For the total of 68 experts, the univariate analyses of the similarity judgments between 37 of the items in Table 1 and Noise Annoyance—“Distraction” was discarded because of an incorrect translation into Japanese—showed skewed frequency distributions for most of the ratings. Therefore, non-parametric measures of the central tendency and of covariation were preferred. The results (see Figure 2) show that the term Noise Annoyance is highly associated with: Nuisance, Disturbance, Unpleasantness, Getting on one’s nerves, Interfering with intended activities, and Irritation, to name but those variables which got median values above 5.5. The term is least associated with Vomiting, Disgust, and Sickness.

A different way of describing those concepts that experts see most clearly related to annoyance is to look for the variables that most experts rate highest (i.e., 6 or 7) on the similarity scale. This cutting point was selected in analogy to the well-known cutting point used for “highly annoyed people” in community noise studies. This analysis shows that (a) there is no variable which all experts agree upon being most similar to annoyance, (b) Nuisance, Unpleasantness, and Disturbance come closest, if one just looks at the percentage of experts rating 7, and (c) Nuisance, Unpleasantness, and Getting on one’s nerves come closest, if one considers the percentage of experts rating 6 or 7 (see Table 3). It should be noted that none of the 3 variables relating to acoustic characteristics (High intensity, Certain sound characteristics, and Unpredictability) gets more than 40% of the experts rating either 6 or 7 on the similarity scale.

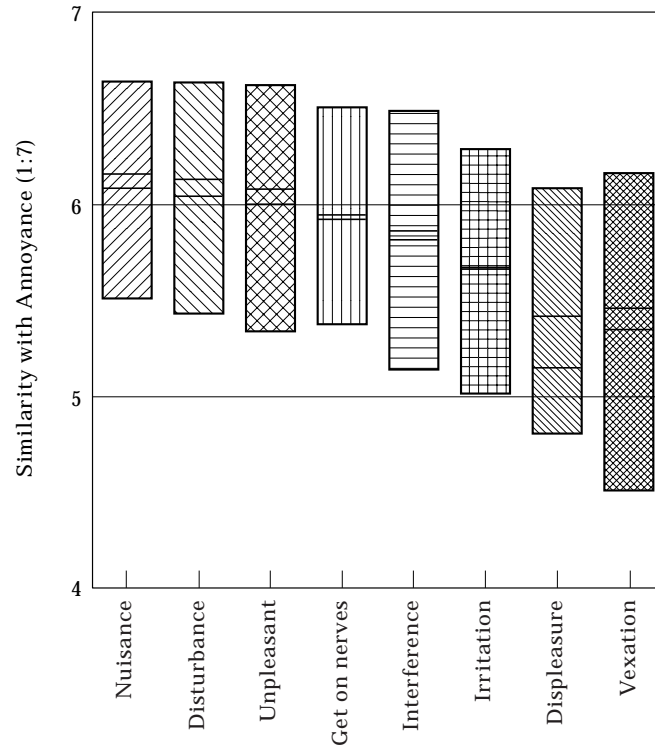


Figure 2. Medians and 25/75 percentiles for 8 variables rated highest in similarity to annoyance by 68 experts from 7 countries.

#### 3.3.4. Covariation between similarity judgments

Since the present list of items contains many variables looking rather similar at first view (like Irritation and Irritability), it seems worthwhile to analyze the statistical covariation between the variables (i.e., the consistency between raters) before looking for similarities and differences between different groups of experts (e.g., from different nations). One simple way of looking for covariations would be to compute correlation coefficients (e.g., Spearman's  $\rho$ ) between all variables for the whole group of experts, but these coefficients would be restricted because of the restricted range of raw scores, especially in those cases, where experts agree upon scoring rather high or rather low. High correlation coefficients would only show up between variables which experts do not agree upon too much. Therefore, the 10 most significant variables were converted to dichotomous secondary variables, using 0 for all raw scores below 6, and 1 for raw scores 6 or 7, and computed chi-square analyses. The results are shown in Table 4, indicating the percentage of experts scoring high on pairs of secondary variables.

This analysis shows that there are rather few pairs of variables which are consistently and above chance scored high or low by the experts; among these, the variable Getting on one's nerves is prominent and covaries with Interference, Irritability, and Vexation. In addition, Dissatisfaction and Displeasure,



TABLE 2  
*Median and 25/75 percentiles of the similarity ratings with annoyance*

Item	Median	Percentile		Item	Median	Percentile	
		25	75			25	75
Anger	5.27	2.2	5.6	Dislike of source	5.00	3.8	6.1
Displeasure	5.61	4.7	6.4	Dissatisfaction	5.30	3.7	6.2
Disturbance	6.13	5.2	6.8	Exasperation	3.07	1.7	5.0
Fear	2.56	1.4	3.9	Disquiet	3.81	2.3	5.2
Financial loss	3.00	1.6	4.8	High intensity	4.46	2.7	5.7
Interfering w.i.a.	5.86	4.9	6.7	Irritation	5.67	4.9	6.5
Helplessness	4.46	2.6	5.6	Nuisance	6.16	5.3	6.8
Stress	5.49	4.4	6.4	Terrible	3.79	1.8	5.2
Uneasiness	4.33	2.5	5.8	Unpleasantness	6.09	5.1	6.8
Vexation	5.47	4.2	6.4	Disgust	1.78	1.0	3.3
Sickness	2.0	1.1	4.3	V. freq. occur.	3.37	1.7	5.1
Unpredictability	3.96	2.4	5.1	Resignation	3.37	2.2	4.8
Frustration	5.19	3.6	6.0	Distraction	4.67	2.0	6.1
Health risk	4.03	2.4	5.2	Rage	4.04	2.4	5.3
Aggression	4.40	2.2	5.6	Escape tendency	3.08	1.9	4.4
Get. on nerves	5.93	5.2	6.7	Tension feelings	5.03	3.9	5.9
Aversion	5.12	3.8	6.1	Cert. sound char.	4.87	3.3	5.9
Feel. impairment	5.48	3.3	6.6	Irritability	5.60	4.4	6.4
Repulsion	2.67	1.5	4.5	Vomiting	1.21	1.0	1.8

Interference and Disturbance, and Irritability and Unpleasantness show a systematic covariation (chance probability less than 1%). These data suggest that even those variables which are rated high in similarity to annoyance are not synonyms and covary just moderately in the whole group of experts.

### 3.3.5. Similarities and differences between expert groups

This section is concerned with exploring (a) groups defined by language (or culture), and (b) groups defined by the scientific approach (laboratory versus field studies).

3.3.5.1. Language groups. The similarity judgments of all experts related to annoyance were subjected to different non-parametric procedures (Mann-Whitney U, Wilcoxon, and Kolmogorov-Smirnow tests), testing for differences between groups of experts. First, possible differences between Australian and US experts were explored. It turned out that just one of the tests applied revealed a significant difference: Australian experts rate Distraction somewhat more related to Annoyance than US experts do ( $p < 0.05$ ). Since this was the only variable where a slight difference appeared, and since Distraction does not belong to the main variables identified in section 3.3.3, the Australian and US data were combined for further tests. In addition, the data of the single UK expert was added to the English speaking group of experts.

TABLE 3  
*Percentage of experts rating 6 or 7 on the similarity scale*

Variable	Score 6	Score 7	Score 6+7
Nuisance	37.3	37.3	74.6
Unpleasantness	34.3	35.8	70.1
Get. on one's nerves	40.9	27.3	68.2
Disturbance	30.3	34.9	65.2
Interference with act.	29.9	31.3	61.2
Irritation	43.9	16.7	60.6
Irritability	43.3	16.4	59.7
Displeasure	43.9	15.2	59.1
Vexation	42.2	13.6	55.8
Dissatisfaction	40.3	10.4	50.7

*N* = 68 experts. Only the 10 variables are shown which get more than 50% in the two top similarity scores.

The total group of experts was divided in 3 major subgroups, defined by language: there are 18 English, 12 Japanese, and 23 German speaking experts. In order to test similarities and differences, Kruskal–Wallis H-tests were run between these 3 groups. It turned out that 24 of the 37 variables show statistically significant differences between the groups, 4 of them belonging to the 10 main variables defined in section 3.3.3. The medians of these variables are depicted in Figure 3, and a concise description is given in Table 5.

Table 5 indicates that 6 of the 10 main variables are rated in a similar way in all 3 language groups, but there are 4 significant differences: the greatest is connected with the variable Vexation: German experts rate Vexation higher than the other two language groups, and the English rate it lower. The variable Nuisance is rated highest by Japanese experts, compared with English experts, who rate it lowest. The English experts rate Irritation higher than the other language groups. Finally, there is a tendency of German experts to rate Disturbance higher than the other language groups do. Another way of looking at similarities and dissimilarities between languages is to analyze the percentages

TABLE 4  
*Percentages of experts scoring high (6 or 7) on pairs of variables*

Variable	Unpl	Nerv	Dist	Intf	Irit	Irib	Disp	Vex	Diss
Nuisance	56*	53	50	45	49*	49*	46	46*	38
Unpleasant (unpl)	–	51*	47	44	44	50**	47**	38	38
Get on nerves (nerv)	–	–	51*	49**	43	47**	40	44**	35
Disturbance (dist)	–	–	–	49**	37	41	40	40	34
Interference (intf)	–	–	–	–	40	41	37	40*	34
Irritation (irit)	–	–	–	–	–	40	40*	34	34
Irritability (irib)	–	–	–	–	–	–	40*	37	34
Displeasure (disp)	–	–	–	–	–	–	–	34	41***
Vexation (vex)	–	–	–	–	–	–	–	–	18
Dissatisfaction (diss)	–	–	–	–	–	–	–	–	–

*N* = 68 experts. \*:  $p$  (chi-square) < 0.05; \*\*:  $p$  > 0.01; \*\*\*:  $p$  < 0.001.

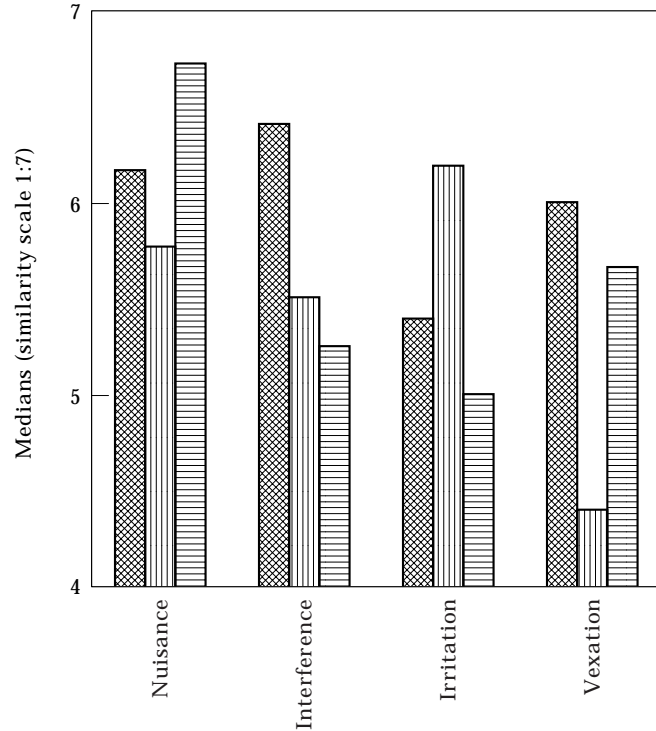


Figure 3. Median similarity ratings for “Annoyance” by experts from 3 languages. All 4 variables are significantly different between languages. Key: ▨, German; ▩, English; ▪, Japanese.

of experts in each language scoring high (6 or 7) on the 10 main variables—comparable to the approach taken in section 3.3.4. chi-square tests with these secondary variables show only two statistically significant differences between language groups: Vexation and Irritation ( $p < 0.001$ ). In view of the problems

TABLE 5  
Statistics for 10 main variables in 3 languages

	German		English		Japanese		<i>p</i> (K–W)
	<i>Mdn</i>	<i>Quart</i>	<i>Mdn</i>	<i>Quart</i>	<i>Mdn</i>	<i>Quart</i>	
Nuisance	6.17	5.4/6.8	5.77	5.1/6.5	<b>6.73</b>	6.2/7.0	0.006***
Unpleasant	5.91	4.8/6.8	6.08	5.0/6.8	6.64	6.1/7.0	0.082
Get on nerves	6.17	5.4/6.8	5.82	5.1/6.7	6.30	5.6/6.9	0.386
Disturbance	6.60	6.0/7.0	6.08	5.3/6.8	6.13	5.3/6.8	0.094
Interference	<b>6.41</b>	5.5/7.0	5.50	4.3/6.3	5.25	3.7/6.5	0.025*
Irritation	5.40	4.5/6.3	<b>6.19</b>	5.5/6.8	5.00	3.8/5.8	0.004***
Irritability	5.73	4.9/6.5	5.30	3.6/6.2	6.22	5.4/6.8	0.098
Displeasure	5.56	4.6/6.3	5.82	5.0/6.6	5.71	4.8/6.5	0.705
Vexation	<b>6.00</b>	5.3/6.6	4.40	3.3/5.4	5.67	5.1/7.0	0.001***
Dissatisfact	5.38	4.1/6.3	5.33	3.8/7.0	4.67	3.1/5.9	0.629

$n_{\text{German}} = 23$ ;  $n_{\text{Japan}} = 12$ ;  $n_{\text{English}} = 18$ . \*\*\*/\*\*\* = *p* for diff.  $< 0.05/0.01/0.001$  (Kruskal–Wallis).

associated with multiple statistical tests, the differences should be interpreted with caution, but the data show at least two variables which have strong relations to annoyance and are weighted differently by the experts from 3 language groups.

3.3.5.2. Laboratory versus field experts. Twenty experts described themselves as working mainly in the laboratory, 26 said they were mainly working in field studies, and 16 as working in both. In looking for similarities and differences between the lab and field research groups, the 3 data sets were subjected to Kruska–Wallis H tests (see Table 6). It turned out that lab, field, and lab + field experts have very similar views on many of the main variables of noise annoyance, but there are two statistically significant differences: experts of laboratory studies weigh Unpleasantness significantly higher than the other experts do, and lab and lab + field experts weigh Disturbance higher than field experts do. But there is a problem that hinders the interpretation of these differences: the lab research subgroup generally tends to give somewhat more extreme responses: i.e., higher responses for variables which are scored high in similarity with Annoyance, and lower responses for variables which are scored low. Thus, it may well be that the differences between lab and field experts with respect to the two variables as elements of the noise annoyance concept are due to different response styles.

#### 4. DISCUSSION

In this paper judgments of noise annoyance experts are taken as a source of information about the meaning of noise annoyance. It may well be that residents affected by noise would have given slightly different answers—answers which are more closely related to a local noise situation (like living near an airport or living near a highway). Therefore, our study does not claim complete

TABLE 6  
*Statistics for laboratory, field and lab/field experts*

	Laboratory (L)		Lab/Field (LF)		Field (F)		<i>p</i> (Kr.–Wall.)
	<i>Mdn</i>	<i>Quart</i>	<i>Mdn</i>	<i>Quart</i>	<i>Mdn</i>	<i>Quart</i>	
Nuisance	6.35	5.6/6.9	5.70	4.8/6.6	6.24	5.3/6.9	0.287
Unpleasant	<b>6.65</b>	6.1/7.0	6.00	5.2/6.7	5.67	4.7/6.5	0.007***
Get on nerves	6.29	5.5/6.9	5.83	5.2/6.6	5.83	5.1/6.6	0.258
Disturbance	6.36	5.3/7.0	<b>6.43</b>	5.8/7.0	5.53	4.4/6.5	0.023*
Interference	6.14	5.2/6.9	6.18	5.1/6.9	5.71	4.9/6.5	0.432
Irritation	5.73	5.1/5.5	5.50	4.8/6.2	5.86	4.8/6.6	0.595
Irritability	5.77	5.0/6.5	5.56	4.3/6.4	5.56	4.4/6.4	0.747
Displeasure	5.85	5.1/6.6	5.58	4.8/6.3	5.63	4.6/6.5	0.645
Vexation	5.86	5.1/6.5	4.67	2.8/6.1	5.43	4.3/6.3	0.164
Dissatisfact.	5.73	4.3/6.5	5.22	3.7/6.1	5.13	3.6/6.0	0.312

$n_{\text{Lab}} = 20$ ;  $n_{\text{Field}} = 26$ ;  $n_{\text{L/F}} = 16$ . *Quart* = 25/75 percentile. \*/\*\*\* = *p* for diff. < 0.05/0.01 (Kruskal–Wallis).

generalizability. On the other hand, one expects noise research experts to look from a bird's eye viewpoint on noise annoyance, answering more globally, and embracing different noise situations at the same time.

In view of these precautions, the authors' data show that noise annoyance is a multifaceted concept, covering mainly (1) immediate behavioural noise effects aspects, like Disturbance and Interfering with intended activities, and (2) evaluative aspects like Nuisance, Unpleasantness, and Getting on one's nerves. The latter seem to contain negative evaluations of the noise source as well as a feeling of tension and little power in answering the stress. The 10 aspects of annoyance identified in this paper to get more than 50% in the two top similarity scores seem not to be used interchangeably: there are only few pairs of the main variables which get high scores by the same experts. Other aspects seem to be less important, e.g., Health risks, Disgust, and Fear. It should also be noted that annoyance is not closely related to acoustic characteristics of a certain situation, like High Intensity, Unpredictability, and Very frequent occurrence. This sheds a critical light on attempts to define an "unbiased annoyance" purely by means of acoustical variables (see, e.g., reference [21]). Although it is evident that noise annoyance judgments do covary with acoustical variables in community noise studies, the concept of noise annoyance is not just reflecting acoustic characteristics. Noise annoyance is a psychological concept which describes a relation between an acoustic situation and a person who is forced by noise to do things he/she does not want to do, who cognitively and emotionally evaluates this situation and feels partly helpless. This seems to be true for several nations and languages.

On the other hand, there are significant differences between languages, which may either stem from the way languages are constructed (e.g., the somewhat more action-related form of the Japanese way of speaking compared with the somewhat more object-related form of indogermanic languages), or may stem from the different assessment of identical aspects of the noise annoyance concept (e.g., the high weight of Nuisance for Japanese experts, the high weight of Irritation for English speaking experts, and the high weight of Interference and Vexation for German experts), or they may be due to different meanings of similar terms in different languages. The present study was not able to solve this puzzle. However, it should be noted that the semantic analyses of Kuwano, Namba, and Schick [19] showed a tendency of Japanese students to see the Japanese concept of annoyance somewhat more related to "dirty" than German and English students did. This could be interpreted as partial support for the tendency of Japanese experts to stress the nuisance aspect of annoyance. Anyway, the present data indicates that experts from different languages partly stress different facets of noise annoyance, and one expects that their subjects do the same. This should be kept in mind while comparing noise annoyance data from different languages.

This difference should also be considered while working on future annoyance questionnaires. If any suggestion could be made from the present data at all, the authors propose to be as explicit as possible in phrasing the questions: that is, to ask about both the disturbance and the evaluative aspects. If there is just time

and space for only one general question, one proposes to mention both the disturbance and the nuisance aspects in one single question, as far as this question is meant to result in a global annoyance score which could be compared between languages. A possible phrase in English could be “Thinking about the last 12 months or so, when you are here at home, how much would you say the noise from (. . noise source . .) bothers or annoys you?” This is the proposal made by Fields [6]. A possible phrase in German would change “bother” for “disturb”, and other languages would have to look for their respective terms. If time allows for more questions, the authors propose to let subjects rate the different aspects of annoyance in separate questions, at least for the disturbance and evaluative aspects.

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