A consideration of the relationship between subjective unpleasantness and body surface vibrations induced by high-level, complex low-frequency noise

Yukio Takahashi

Department of Research Planning and Coordination, National Institute of Occupational Safety and Health, Japan. 6-21-1 Nagao, Tama-ku, Kawasaki 214-8585, Japan.

E-mail: takahay@h.jniosh.go.jp

To investigate the relationship between subjective unpleasantness and body surface vibrations induced by high-level, complex low-frequency noise, we carried out two experiments. Body surface vibrations were measured at the right and left anterior chest and the right and left anterior abdomen of male subjects. Subjective unpleasantness was rated on a scale of 1 to 5, and correlated with the vibration acceleration levels (VALs) of the vibrations measured on the body surface. As a result, it was found that the ratings of unpleasantness did, on the whole, significantly correlate with the VALs. In addition, we estimated the frequency-weightings for the VAL to optimize the correlation with the rating of unpleasantness. Based on a reasonable hypothesis, the frequency-weightings estimated in the present study were considered to be consistent with those estimated in our previous study using low-frequency pure tones. The present results support the idea that not only the loudness of a noise, but also the vibrations induced by that noise, contribute to the subjective unpleasantness experienced by persons exposed to high-level low-frequency noise. The effect of vibration should be taken into consideration in evaluating high-level low-frequency noise.

Key words: Low-frequency noise, Complex low-frequency noise, High sound pressure levels, Body surface vibration, Subjective unpleasantness

1. INTRODUCTION

Low-frequency noise, which is noise in the frequency range below 100 Hz, is generated prevalently in living and working environments. In particular, in working environments, various machines such as blowers, exhaust fans, air compressors, large engines and the like generate high-level low-frequency noise, the sound pressure level of which occasionally exceeds 100 dB(SPL) [1-4].

The loudness of low-frequency noise is not particularly high, because human hearing sensitivity deteriorates at low frequencies [5]. Despite the low audibility of the noise, however, it is well known that low-frequency noise induces unpleasantness or annoyance [6-10]. Inukai et al. found that the slopes of equal-unpleasantness contours were very similar to those of equal-loudness contours, thus showing that auditory sensation plays an important role in inducing unpleasantness or annoyance [11]. However, many studies have reported that the A-weighted sound pressure level, which is defined in accordance with the perception of the loudness of noise, results in the unpleasantness or annoyance caused by low-frequency noise or noise with strong low-frequency content to be underestimated [12-14]. The unsuitability of the A-weighted sound pressure level suggests that not only auditory sensation (i.e., loudness) but also other factors contribute to the feelings of unpleasantness or annoyance experienced by persons exposed to low-frequency noise. Inukai and his collaborators reported in another article that human responses to low-frequency noise are primarily influenced by three factors: 'sound pressure', 'vibration', and 'loudness' [15]. According to their results, it can be speculated that various factors related to vibration contribute to the feelings of unpleasantness or annoyance induced by low-frequency noise.

When people are exposed to high-level low-frequency noise, actual body vibrations are induced [16-18]. Although the levels of these vibrations ('noise-induced vibrations') are not especially high, our previous study, in which low-frequency pure tones were used as noise stimuli, suggested that noise-induced vibrations measured on the body surface at the chest or abdomen are closely related to the perception of vibration in the corresponding part of the body [19]. Taking the results by Inukai et al. into account, it was deduced that the noise-induced vibrations primarily contribute to the vibratory sensation, and, through the vibratory sensation or together with other factors, secondarily contribute to inducing unpleasantness in persons exposed to high-level low-frequency noise [20].

However, low-frequency noises generated in real environments are not pure tones, but rather complex noises whose frequency spectra spread over a wide range. Therefore, to confirm the contribution made by noise-induced vibration to subjective unpleasantness, further studies with low-frequency noise stimuli with a variety of frequency spectra are needed. As a first step, we carried out two experiments with high-level, complex low-frequency noises composed of two pure tones, and investigated the relationship between subjective unpleasantness and the body surface vibrations induced by such noises. We then examined the consistency between the present results obtained with complex noises and the previous results obtained with pure tones.

2. METHODS

Two experiments (Experiment 1 and Experiment 2) were carried out in a soundproof test chamber with a capacity of approximately 25 m^3 (3.16 m (W) x 2.85 m (L) x 2.80 m (H)). The background noise in the test chamber was below 30 dB(A), which was not considered to affect the experiments because the low-frequency noise stimuli that we used had sufficiently high sound pressure levels.

Six male subjects (20-27 yr, mean = 24.3, SD = 2.1) participated in Experiment 1. Prior to the experiment, the hearing ability of each subject was confirmed to be normal in the 250- to 8000-Hz range. During the experiment, the subjects wore no hearing protection, so that they could be exposed to low-frequency noise stimuli under normal hearing conditions.

Seven types of low-frequency noise were used as noise stimuli: two pure tones (25 and 50 Hz), and five complex noises composed of the pure tones. The sound pressure levels of the pure tones were 100 dB(SPL), while those of the tonal component in the complex noises were either 90, 95 or 100 dB(SPL), as shown in Table I. The sources of the noise stimuli were WAV-type data generated at a sampling rate of 48 kHz on a PC. The source data for the complex noises were generated by synthesizing two source data for the pure tones with a phase difference of zero degrees. All of the source data were D/A converted through an audio data interface (AD216, Nittobo Acoustic Engineering, Japan). After being power-amplified, they were fed to twelve loudspeakers (TL-1801, Pioneer, Japan) installed in the wall in front of the subject. These loudspeakers reproduced the noise stimuli in the test chamber.

To compensate for the frequency response of the test chamber, the frequency spectrum of the noise stimulus was modified through a digital filter generated by a digital audio convolution processor (CP4, Lake Technology, Australia) before being fed to the loudspeakers [17]. Despite the compensation, we could not reproduce a noise stimulus the frequency spectrum of which was uniform in the entire test chamber. Hence, the measurements of noise-induced vibration were conducted in two sessions so that the frequency spectrum of the noise stimulus could be reproduced as exactly as possible around each location where the noise-induced vibrations were measured. Although the frequency spectrum of the reproduced noise stimulus was not exactly uniform over the entire body surface, the difference in the frequency spectra at different locations of the body was not considered to affect the experiment.

In the first session, the subject stood in the centre of the test chamber and was exposed to the seven types of noise stimuli in random order. The duration of exposure to a noise stimulus was 1 min, and the noise-induced vibrations were measured simultaneously at the right anterior chest (2 cm above the right nipple) and the left anterior chest (2 cm above the left nipple). Using two small and lightweight accelerometers (EGA-125-10D, Entran Devices, USA), each of which was attached at a measuring location by means of double-sided adhesive tape, we detected noise-induced vibrations perpendicular to the body surface. The detected vibrations were low-pass filtered (cut-off frequency = 100 Hz) and amplified by strain amplifiers (6M92, NEC San-ei Instruments, Japan), and were then recorded on DAT (Digital Audio Tape) by a multi-channel data recorder (PC216Ax, Sony Precision Technology, Japan). Between any two exposures, we assigned a 1-minute-long rest period when the subject rated the unpleasantness he had just sensed during the preceding exposure. We defined the unpleasantness as a total unpleasant feeling that included a feeling of discomfort, a feeling of annoyance, a feeling of wishing the noise stimulus to diminish or end, and so on. In addition, we instructed the subject to rate the unpleasantness by taking into account not only hearing sensations but also, if perceived, other types of sensations. The unpleasantness was rated as either 1, 2, 3, 4, or 5 based on whether the unpleasantness was 'not sensed', 'slightly sensed', 'mildly sensed', 'strongly sensed', or 'very strongly sensed', respectively. No reference noise was presented in the rating procedure.

In the second session, noise-induced vibrations were measured at the right anterior abdomen (5 cm below the pit of the stomach and 5 cm to the right of the midline) and left anterior abdomen (5 cm below the pit of the stomach and 5 cm to the left of the midline) of the subject in a standing

Table I. The low-frequency noise stimuli used in this study.

Types	**Combinations and sound pressure levels**	
	25- (or 31.5-) Hz tone	**50-Hz tone**
Pure tones	**100 dB(SPL)**	**-**
	-	**100 dB(SPL)**
complex noises	100 dB(SPL)	100 dB(SPL)
	100 dB(SPL)	95 dB(SPL)
	100 dB(SPL)	90 dB(SPL)
	95 dB(SPL)	100 dB(SPL)
	90 dB(SPL)	100 dB(SPL)

position, and subjective unpleasantness was rated in the same manner as mentioned above.

Off-line analysis by an FFT analyzer (HP3566A, Hewlett Packard, USA) yielded the power spectrum of the noise-induced vibration recorded on DAT. The spectral components at 25 and 50 Hz were transformed to vibration acceleration levels (VALs) defined as

$$VAL = 20 \times \log_{10}(a_{meas}/a_{ref}) \text{ [dB]},$$

where a_{meas} was a measured acceleration (m/s^2 (r.m.s.)) and a_{ref} was the reference acceleration equal to 10^{-6} m/s^2. We then calculated the total vibration acceleration level (VAL_{total}) defined as the power summation of two VALs:

$$VAL_{total} = 10 \times \log_{10}[10^{(VAL1/10)} + 10^{(VAL2/10)}] \text{ [dB]},$$

where VAL1 was the VAL of the 25-Hz component in the noise-induced vibration, and VAL2 was the VAL of the 50-Hz component. It was expected that the measured VAL contained not only the component of noise-induced vibration but also the component of inherent vibration that originated in the vital activities of the body. In the above transformation, however, we did not separate the inherent vibration from the total vibration measured, because the inherent vibration may also contribute to the subjective unpleasantness.

In Experiment 2, we used complex low-frequency noise stimuli in which a 25-Hz tone was replaced with a 31.5-Hz tone (Table I). Six male subjects, who were not the same subjects used in Experiment 1, participated. Their ages ranged from 19 to 25 yrs (mean = 22.8, SD = 2.1). The other experimental methods were the same as in Experiment 1.

Statistical analysis was performed using a statistics software package (SPSS for Windows 12.0J, SPSS Japan, Japan), and a p-value less than 0.05 was adopted as the criterion for statistical significance.

The protocol of this study was approved in advance by the Research Ethics Committee of the National Institute of Industrial Health, Japan (at present, the National Institute of Occupational Safety and Health, Japan), and informed consent was obtained from each subject before the measurements were taken.

3. RESULTS

The characteristics of the body surface vibrations measured in Experiment 2 have already been reported in another article [17]. It was found that the body surface vibrations at 31.5 and 50 Hz were induced approximately independently of each other, and that each vibration component (e.g., 31.5-Hz vibration) was induced approximately as a linear function of the sound pressure level of a corresponding noise component (e.g., the 31.5-Hz tonal component), regardless of the sound pressure level of another noise component (e.g., the 50-Hz tonal component). No clear difference was found between the VALs measured on both sides of the body. Similar characteristics were found in the 25- and 50-Hz vibrations measured in Experiment 1. Among three kinds of measured vibration components (25-, 31.5- and 50-Hz vibrations) induced by pure tones at 100 dB(SPL), the VAL of the 50-Hz vibration was the highest one, and that of the 25-Hz vibration was the lowest at both measuring locations (the chest and the abdomen).

Figure 1 shows the rating scores of subjective unpleasantness (mean + SD) obtained in Experiment 1. To examine the differences between the two ratings (the unpleasantness rated in the first session and that rated in the second session) corresponding to the same type of stimulus, Wilcoxon's signed rank test

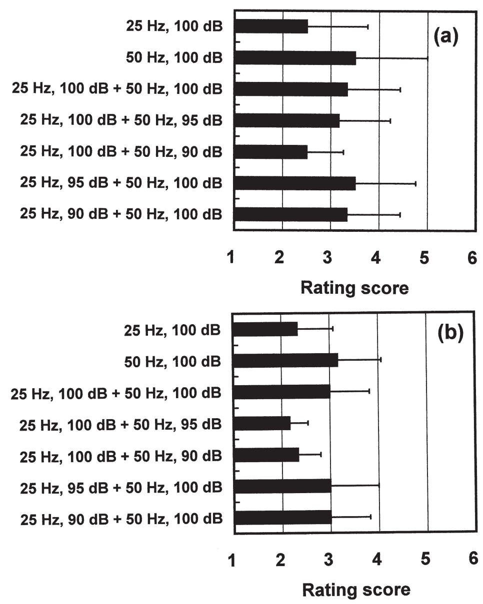

Figure 1. Subjective unpleasantness (mean ± SD) rated (a) in the first session and (b) in the second session in Experiment 1.

was performed. However, no statistically significant difference was found between the rating scores for all types of noise stimuli. The unpleasantness tended to be highly rated during exposure to the noise stimulus that contained a 50-Hz tone. A similar tendency was also found in the unpleasantness rating in Experiment 2.

Figure 2 shows the correlation between the mean ratings of the unpleasantness and the mean VAL_{total} values of the noise-induced vibrations measured in Experiment 1. The correlations obtained in Experiment 2 are shown in Fig. 3. In these figures, the two VAL_{total} values measured on the right and left sides of the body are plotted against a single rating score. This is done for two reasons: (1) no clear difference was found between the VALs of noise-induced vibrations measured on both sides of the body, and (2) it was considered that the noise-induced vibrations on both sides of the body were equally significant for inducing the unpleasantness. The solid line incorporated into the figure is a regression line calculated with all the data plotted. The correlation coefficients calculated for these correlations are summarized in Tables II (for Experiment 1) and III (for Experiment 2). The correlations in Figs. 2 and 3 were found to be statistically significant ($p<0.01$), except in one case (at the abdomen in Experiment 2).

For comparison, we also correlated the mean ratings of the unpleasantness with the sound pressure levels (SPL), the A-weighted sound pressure levels (SPL_A), and the loudness levels (LL) of the low-frequency noise stimuli. The loudness levels were calculated according to the definition in the recent version of ISO 226 [21]. In Tables II and III, the correlation coefficients calculated for the SPL, the SPL_A, and the LL are also listed. The correlation coefficients for the VAL_{total} were clearly larger than those for the SPL, and were, on the whole, comparable to those for the SPL_A and the LL. Because the SPL_A and the LL are representative values of the effect of the 'loudness' sensation, these results support the hypothesis that not only the loudness of low-frequency noise but also noise-induced vibration contributes to the subjective unpleasantness experienced by persons exposed to high-level low-frequency noise.

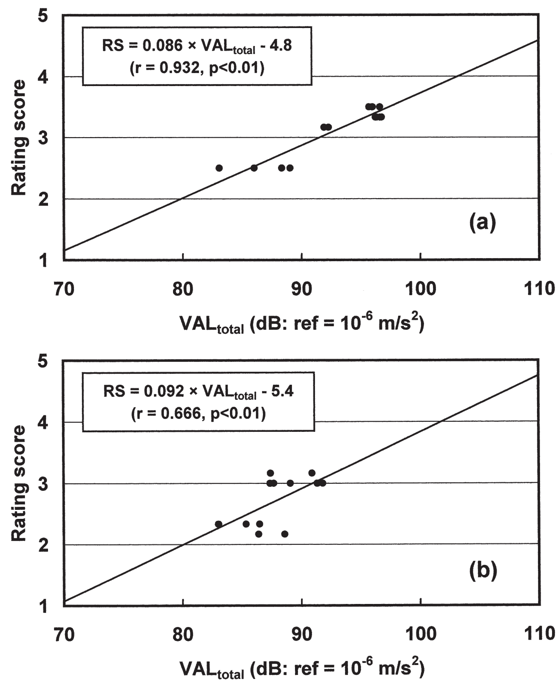

Figure 2. The correlation between the mean rating score (RS) of subjective unpleasantness and the mean VAL_{total} of the body surface vibration measured (a) at the chest and (b) at the abdomen (Experiment 1).

Table II. The correlation coefficients calculated for the correlations between the mean rating scores of unpleasantness and the mean VAL_{total} values, the sound pressure levels, and the loudness levels in Experiment 1

	Weightings	**Correlation coefficients**	
		Chest	**Abdomen**
Val_{total} vs. unpleasantness	None	0.932**	0.666**
	'Best-fit'	0.932**	0.732**
SPL vs. unpleasantness	None	0.356	0.192
	A	0.940**	0.793*
LL vs. unpleasantness	–	0.950**	0.806*

**p<0.01, *p<0.05

Table III The correlation coefficients calculated for the correlations between the mean rating scores of unpleasantness and the mean VAL_{total} values, the sound pressure levels, and the loudness levels in Experiment 2

	Weightings	**Correlation coefficients**	
		Chest	**Abdomen**
Val_{total} vs. unpleasantness	None	0.872**	0.227
	'Best-fit'	0.893**	0.340
SPL vs. unpleasantness	None	0.627	0.121
	A	0.848*	0.282
LL vs. unpleasantness	–	0.784*	0.236

**p<0.01, *p<0.05

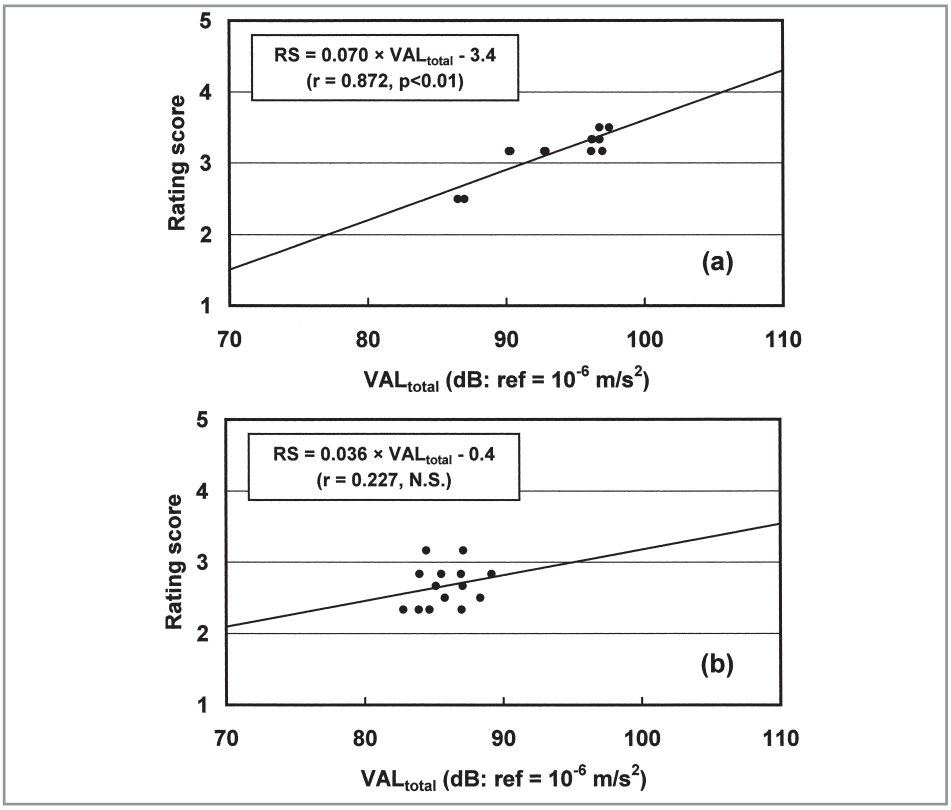

Figure 3. The correlation between the mean rating score (RS) of subjective unpleasantness and the mean VAL_{total} of the body surface vibration measured (a) at the chest and (b) at the abdomen (Experiment 2).

In general, a psychological response such as unpleasantness is frequency-dependency related to a physical stimulus such as vibration. In our previous study using low-frequency pure tones [20], we roughly estimated a 'best-fit' frequency-weighting for the VAL to optimize the correlation between the VALs and the ratings of subjective unpleasantness. As a result, the slopes of the 'best-fit' frequency-weightings were determined to be -8.5 dB/oct. at the chest and -3.0 dB/oct. at the abdomen. 'Best-fit' frequency-weightings for the $VAL_{total,}$ values in the present study were estimated by the same method as used in the previous study. We set the correction at 50 Hz to be 0 dB and varied the slope of the 'best-fit' frequency-weighting between -20 and +20 dB/oct. in a 0.5-dB/oct. step. In assessing the slope of -6.0 dB/oct., for example, the corrections for the VALs were +6.0 at 25 Hz, +4.0 dB/oct. at 31.5 Hz and 0.0 dB/oct. at 50 Hz. As a result, in Experiment 1, the slopes of the 'best-fit' frequency-weightings were estimated to be -0.5 dB/oct. at the chest and +6.5 dB/oct. at the abdomen (Fig. 4). In Experiment 2, on the other hand, we obtained a slope of -9.5 dB/oct. at the chest and a slope that was larger than +20.0 dB/oct. at the abdomen (Fig. 5). The slopes of the 'best-fit' frequency-weightings estimated in the previous study (-8.5 dB/oct. for the chest and -3.0 dB/oct. for the abdomen) are also shown in Figs. 4 and 5.

As shown in Figs. 4 and 5, no clear maximum appeared in the trace of the correlation coefficient, which indicated that the estimations of the 'best-fit' frequency-weightings in the present study were not conclusive. In addition, the 'best-fit' frequency-weightings estimated in the present study seemed to be, as a whole, inconsistent with those estimated in the previous study. However, all of the traces of the correlation coefficients had a common and remarkable feature. The correlation coefficient was small when the frequency-weighting was negative and relatively steep (close to -20 dB/oct.). However, it began to increase rapidly as the frequency-weighting came close to 0 dB/oct., then became large and almost constant when the frequency-weighting was positive and relatively steep (close to +20 dB/oct.). This common feature suggested that only the 50-Hz vibration contributed to the correlation coefficient when the frequency-weighting became positive and quite steep, and that the dominant effect of the 50-Hz vibration veiled the maximum that could have potentially appeared in the trace of the correlation coefficient. A slight maximum appeared at-9.5 dB/oct. in Fig. 5(a), supporting this speculation. In addition, for all four cases shown in Figs. 4 and 5, the slopes estimated for pure tones (in the previous study) were located around a 'transition' or 'edge' region where the correlation coefficient was changing from a small value to a large and nearly constant value. The 'transition' or 'edge' region might have been the maximum, without the dominant effect of the 50-Hz vibration. Thus, it was considered reasonable to hypothesize that the 'best-fit' frequency-weighting for complex low-frequency noise stimuli should be determined when the contribution made by the 50-Hz vibration to the correlation coefficient is not yet dominant. And, based on this reasonable hypothesis, the 'best-fit' frequency-weightings estimated for complex noises (in the present study) were approximately consistent with

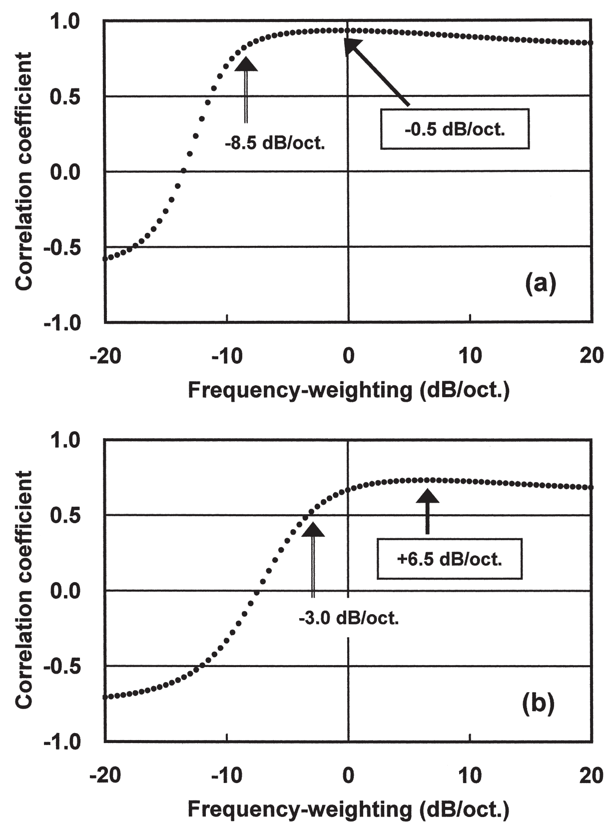

Figure 4. *The trace of the correlation coefficient in estimating the 'best-fit' frequency-weighting for the VAL_{total} measured (a) at the chest and (b) at the abdomen (Experiment 1). The value shown in the rectangle is the slope of the 'best-fit' frequency-weighting estimated in the present study, while the other value is that estimated in the previous study (Ref. [20]).*

those estimated for pure tones (in the previous study), though the 'best-fit' frequency-weightings for complex noises could not be clearly determined. This consistency also lent support to the idea that the noise-induced vibration contributes to inducing a feeling of unpleasantness in persons exposed to high-level low-frequency noise.

In Tables II and III, the correlation coefficients for the correlation between the mean rating scores of unpleasantness and the mean $VAL_{w,\ total}$ values are also listed for comparison. Here, the $VAL_{W,\ total}$ represents the VAL_{total} to which the 'best-fit' frequency-weighting is applied. Application of the 'best-fit' frequency-weighting made no remarkable change in the correlation coefficient.

4. DISCUSSION

The rating of subjective unpleasantness was made on a scale of 1 to 5 in the present study, while a scale of 1 to 3 was used in our previous study [20]. Because of this difference, any comparison of the absolute values of the rating of subjective unpleasantness obtained in the present and previous studies was invalid. A comparison of the absolute values of the correlation coefficient was also not valid. However, the 'best-fit' frequency-weighting was estimated by optimizing the correlation between the ratings of unpleasantness and the VAL_{total} values of noise-induced vibrations. Therefore, the 'best-fit' frequency-weighting depended less significantly on the rating scale than the rating score itself or the correlation coefficient. This is the reason we used

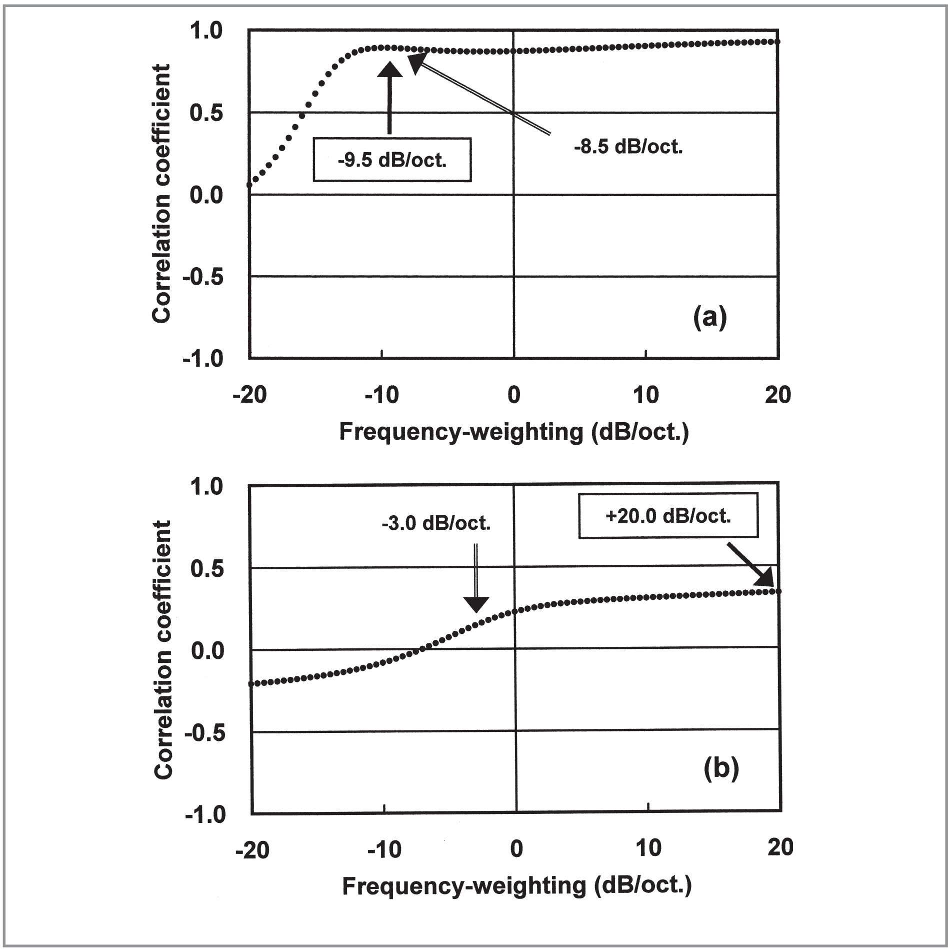

Figure 5. The trace of the correlation coefficient in estimating the 'best-fit' frequency-weighting for the VAL_{total} measured (a) at the chest and (b) at the abdomen (Experiment 2). For the two values shown in the figure, see the Fig. 4 caption.

the 'best-fit' frequency-weighting characteristic to examine the consistency between the present and previous results.

Based on the reasonable hypothesis that 'best-fit' frequency-weighting should be determined when the contribution made by the 50-Hz vibration to the correlation coefficient is not yet dominant, the 'best-fit' frequency-weightings estimated for complex noises (in the present study) were considered to be consistent with those estimated for pure tones (in the previous study). The consistent results obtained by three independent experiments (one previous experiment using pure tones and two present experiments using complex noises) support the idea that not only the loudness but also the noise-induced vibration contributes to the subjective unpleasantness of persons exposed to high-level low-frequency noise. In other words, our results suggest that not only auditory perception through the hearing organs but also mechanoreception of body surface vibrations contributes to the perception of unpleasantness by persons exposed to high-level low-frequency noise.

However, it should be noted that the unpleasantness in the present study was induced not only by noise-induced vibrations, but also by auditory sensations, because the sound pressure levels of the low-frequency noise stimuli were sufficiently higher than the standardized hearing threshold levels [5, 22]. When persons are exposed to high-level low-frequency noise, noise-induced vibration and auditory sensation occur simultaneously. This is a feature specific to high-level low-frequency noise, and, hence, it is difficult to distinguish the partial psychological effects caused by noise-induced vibration alone from the total psychological effects caused wholly by high-level low-frequency noise. One possible approach for solving this problem is to conduct experiments in which deaf persons are exposed to low-frequency noise. Yamada et al. exposed normal,hearing and deaf persons to low-frequency noise stimuli and measured the threshold of sensation of low-frequency noise [23]. As a result, they found that the deaf persons sensed low-frequency noise at frequencies within the 10-160 Hz mainly by perceiving vibration in the chest. The average sensation threshold of the deaf person was at a minimum (approximately 90 dB(SPL)) at 63 Hz and rapidly increased as the frequency decreased. In addition, the normal-hearing persons could also sense low-frequency noise by perceiving vibration in the chest, though the threshold of the normal-hearing persons was lower than that of the deaf persons. Landström et al. also investigated the perception threshold level of deaf persons and normal-hearing persons by using low-frequency noises within the range of 4-25 Hz [24]. They also found that both deaf persons and normal-hearing persons could sense low-frequency noise by perceiving vibration in their bodies. These two studies did not investigate the relationship between subjective unpleasantness and the body vibrations. However, it is reasonably considered that unpleasantness can be induced when the body vibration is perceived as being sufficiently strong. Therefore, these previous findings do not contradict our idea that noise-induced vibrations primarily contribute to vibratory sensation, and, through the vibratory sensation or together with some other factors, secondarily contribute to inducing unpleasantness in persons exposed to high-level low-frequency noise.

According to the results of Yamada et al., the sensation threshold of deaf persons was about 30-40 dB(SPL) higher than the hearing threshold of normal-hearing persons [23]. Landström et al., on the other hand, reported that the sound pressure levels needed for perceiving vibration were approximately 20 dB(SPL) above the hearing threshold levels [24]. It can be derived from these findings that noise-induced vibration contributes to the perception of low-frequency noise only at high sound pressure levels. Therefore, it is reasonably speculated that the noise-induced vibrations at high sound pressure levels contribute to the subjective unpleasantness that is experienced. At sufficiently lower sound pressure levels, the contribution made by noise-induced vibration to the unpleasantness may disappear, because the levels of noise-induced vibrations are expected to be lower than those of vibrations inherent in the human body. In addition, the contribution of noise-induced vibration to the subjective unpleasantness is expected to be dependent on frequency. More detailed studies using low-frequency noise stimuli in a wider range of sound pressure levels and frequencies are needed.

CONCLUSIONS

We investigated the relationship between subjective unpleasantness and body surface vibrations induced by high-level, complex, low-frequency noise. Based on the reasonable hypothesis that a 'best-fit' frequency-weighting should be determined when the contribution made by the 50-Hz vibration to the correlation coefficient is not yet dominant, it was found that the 'best-fit' frequency-weightings estimated in the present study were consistent with those estimated for low-frequency pure tones. Our present results suggested that not only auditory perception through the hearing organs but also the mechanoreception of body surface vibrations contributes to the perception of unpleasantness by persons exposed to high-level low-frequency noise. The effect of vibration should be taken into consideration in evaluating high-level low-frequency noise.

However, the present study was conducted under limited experimental conditions, including a narrow range of higher sound pressure levels of the noise stimuli. To confirm the results reported in this paper and to verify the range of frequency and sound pressure levels in which noise-induced vibrations effectively contribute to inducing unpleasantness, more detailed studies are needed.

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WHOSE FAULT IS THE ANNOYANCE?

Club DNA, in Regent Street, Rugby was fined £5,000 with £944 costs by Rugby magistrates after admitting breaking the Environment Protection Act. The charge was brought by the council after they received a 'number' of complaints from residents regarding late night noise at the venue. The council's Environmental Health Division has now requested a review of the club's 24 hour licence. The council claimed that complaints over the venue's noise had continued over 'months', and despite efforts from the police and the council, the club's management had failed to address the problem. However, manager Den Hau said: "The police themselves have told us it's the council's fault. They give out grants for people to live above shops in this area. If they want to encourage people to live in the town, they should give them sound proofing."

INTELLIGENCE-LED POLICING

Scottish police are to be armed with a new tool in the ongoing battle against alcohol-fuelled antisocial behaviour including noise – lollipops. Tayside Police hope late-night drinkers in Argus will be too busy sucking on sweets to disturb the peace with late-night singing, swearing and shouting as they move from pubs to clubs. It is hoped the idea will help to combat anti-social behaviour in Montrose, where residents have complained for some time. Inspector Athol Aitken said: "People on a night out deserve to enjoy themselves in a safe environment. Equally, the rights of people who live in the area and do not want to have their privacy shattered must also be upheld." The scheme is the result of the Argus Drugs and Alcohol Team (DMT), a partnership between Tayside Police and Angus Council.

NO-ONE ANYWHERE LIKES AN AIRPORT…

Residents around the new Suvarnabhumi Airport in Thailand say they want to move away from the unbearable noise and urge Airports of Thailand (AOT) to negotiate with them regarding payments to relocate or Bt1-million compensation for each home to be made soundproof. The residents – together with the King Mongkut's University of Technology Lat Krabang – appealed for the company to solve the noise and environmental problems before the airport's opening on September 28, and vowed to set up a movement to pressure the company. Living just one kilometre away from the runway, residents already know from trial flights that they will be affected by the roar of jet engines as aircraft take off and land, resident Suradech Benjakul said. Suradech said residents needed the company to discuss with them the problems following the airport's opening, when they will have to endure an aircraft arrival or departure every two minutes. At this stage AOT apparently lacked clear solutions and had no interest in talking with them, he said. "We want the expropriation payment to be the current market price, or compensation – possibly Bt1 million to each home – for ceiling and wall renovations as well as air-conditioner installation to reduce the impact of the noise," Suradech said.

ITHACA ORDINANCE

Some Ithaca residents got a rude awakening over the weekend 9-10 September as Tompkins County Sheriff's deputies enforced the Town of Ithaca's new noise ordinance in the South Hill area. From Friday to Sunday, a special patrol of deputies ticketed 10 residents, including one who was allegedly playing drums at 1:30 a.m., and shut down parties. The patrol is dedicated to curbing noise violations—called "unreasonable noise" under the new ordinance. The noise law is new, however, and it gives law enforcement the authority to issue tickets without a citizen's complaint. By canvassing locations of the most frequent complaints, deputies target noise and stop it. "The new law enables us to more effectively deal with the problem of noise and the large, loud gatherings that have occurred traditionally in the South Hill area of Ithaca said Tompkins County Sheriff Peter Meskill. "If we witness the noise, we can simply deal with it." The noise is mainly from parties. As Captain Dresser of the Sheriff's office says: "If we find a location that's exhibiting an unreasonable amount of noise, we ticket the residents," he said. "We can't ticket 200 people, but we can target the people who are hosting the events. That means the party's over."

NEW SAE STANDARD FOR AIRPORT NOISE MANAGEMENT

Managing the impact of aircraft noise on surrounding communities is an ongoing and sometimes challenging task for airports. Increasing air traffic is causing some airports to expand facilities, add flights and extend operating times well into the late evenings/early mornings. To do this, airports and policymakers need to understand how these airport operations will impact the surrounding communities. A new standard from SAE International helps to make that task easier by establishing guidelines for monitoring such noise. The SAE Aerospace Recommended Practice "(ARP) 4721-1 — Monitoring Aircraft Noise and Operations in the Vicinity of Airports: System Description, Acquisition and Operation," establishes standards for:

- Placement of microphones
- Guidance on components
- Installation and administration of permanent systems
- Guidance on analysis of data collected.
- Testing methods and validation of data for permanent and portable systems

SILENCE OUTSIDE COURT!

The Bombay high court has directed the police to curb noise pollution around court complexes in the city and suburbs. Hearing a public interest litigation filed by a city advocate Uday Shah, Justices R M Lodha and Justice S A Bobde have asked the deputy commissioner of police (traffic) to ban honking near courts and put up adequate signage. Shah said that the incessant honking and high noise levels had made it difficult for the judges and lawyers to hear each other in the courtrooms. Areas around courts, schools and hospitals are silence zones according to the Noise Pollution Rules of 2000. During the daytime, 50 decibels is the maximum noise level permitted in a silence zone. The judges have noted with dismay that despite their orders in 2003 to curb noise pollution around the high court, a report has revealed that the noise levels were as high as 70-75 decibels. Assistant government pleader Niranjan Pandit said honking was banned around the HC and police had been stationed to catch offenders. Pandit also told the court that a noise decibel measuring meter had been installed at the high court.