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Survey on the use of portable audio devices and the users' attitude toward music and environmental sounds

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ABSTRACT

A questionnaire survey on the usage of portable audio devices for university students was conducted to clarify the attitudes of listeners toward music and environmental sounds. The optimum listening level of music was measured in both quiet and noisy conditions to clarify the preferred listening environments of portable audio device users. Furthermore, the effect of listening music on the perception of environmental sounds was examined by a field survey. The questionnaire survey showed widespread and long-term use of portable audio devices among younger generations; they listened to music in various places. Twenty percent of the users typically listened to music for longer than 3 hours. Fifteen percent experienced dangerous situations while listening to music via earphones. Twenty percent felt annoyed by environmental sounds. The reasons for listening to music for these users were mainly to pass time, to refresh the mind, and to mask environmental sounds; however, some also used their portable audio devices to avoid conversation with others. Although the optimum listening level was found to be around 58 dB in a quiet condition, it rose to over 70 dB when environmental sound was present. These results suggest that listening to music via portable audio devices causes difficulty in hearing environmental sounds. The field survey on environmental sounds heard while listening to music via earphones in an outdoor environment suggested that music masked various environmental sounds and losing opportunities to notice pleasant sounds.

Keywords: Portable audio device, Music, Environmental sounds

1. INTRODUCTION

Many people enjoy listening to music in various places via portable audio devices, such as iPods (Apple, USA) or Walkmans (Sony, Japan). However, serious accidents have been reported for users of earphones in public places. Furthermore, listening to music in such way affects the perceptibility of environmental sounds [1]. Risk of damage to hearing organs by loud music via earphones has also been indicated [2]. Finally, such listening habits might affect the relationship between human beings and environmental sounds; that is people might start losing their aesthetic sensitivity to everyday sounds. In the previous studies, portable audio device users' optimum listening level and rise of threshold of surrounding sounds by listening music were shown [1, 3]. However, portable audio device users' attitudes toward music and environmental sounds are not clarified yet [1, 3].

In this study, a questionnaire survey on the use of portable audio devices for university students was conducted to clarify the attitudes of listeners toward music and environmental sounds. The optimum listening levels of music were measured in both quiet and noisy conditions to clarify the preferred listening environments of portable audio device users. Furthermore, a field survey on the perception of environmental sounds while listening to music via earphones was conducted to clarify the effects of listening music on the awareness of environmental sounds.

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2. Questionnaire survey on the use of portable devices

2.1 The aim of the questionnaire survey and respondents

A questionnaire survey on the use of portable audio devices and listeners' attitude toward music and environmental sounds was conducted. The respondents were 72 university students, aged 18 to 26.

2.2 Results

The results of the survey showed that 97% of respondents owned portable audio devices. The most popular device was the iPod, which was owned by 45% of device users. As for the period of possessing devices, 72% of users had used their devices for longer than 5 years, with the type of devices ranging from portable cassette players to Mini Disk (MD) and Compact Disk (CD) players. Furthermore, 34% of device users noted that their mood often changed when they had forgotten to carry their portable audio device with them.

The situations where portable audio devices were used included transit (65: number of responses), work (39) and shopping (19). The types of transit were train (47), bus (48), car (6), bicycle (19) and walking (47).

The purpose for listening to music included to pass time (51), to refresh the mind (56), concentrate (10), to work harder (18), to mask environmental noise (27), to and avoid conversation with others (13).

Figure 1 shows the daily listening durations of portable audio device. While 36% of users listened to music for 1 to 2 hours every day, 13% listened for more than 5 hours.

Figure 2 shows the weekly frequency of portable audio device use; 53% of the users used their devices every day.

Eleven respondents (15%) had experienced dangerous situations while listening to music via earphones; for example, some did not notice approaching bicycles or cars and almost had an accident, while others failed to notice changing traffic auditory signals (Sighted people also rely on auditory traffic signals).

The respondents' answers to the questions on attitude toward environmental sounds showed that 3% felt very annoyed by environmental sounds, while 17% felt slightly annoyed. Moreover, 26% admitted they were losing interest and attention to environmental sounds.

About the attitude toward music, 13% of respondents frequently listen to music to mask ambient noises, while 33% often did it. Music seems to be listened for not only enjoying but easing environmental sounds.

2.3 Discussion

These results illustrate the widespread, long-term and frequent use of portable audio devices among the younger generation. For such users, listening to music via earphones is a daily behavior, which may be a factor in their losing interest and lacking of attention to environmental sounds.

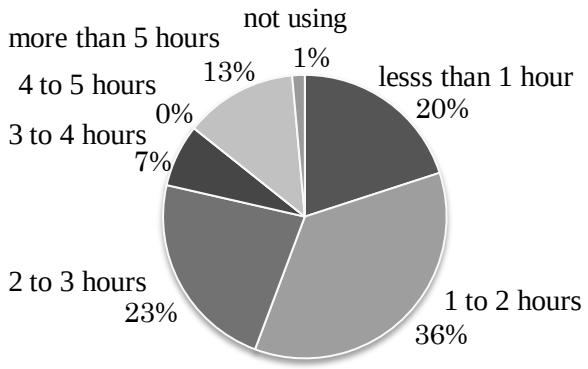

Figure 1 – Daily listening durations of portable audio devices.

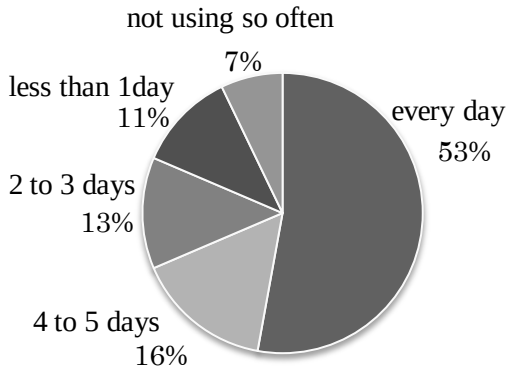

Figure 2 – Weekly frequency of portable audio device use.

3. Measurement of optimum listening levels of music via headphone

3.1 Experiment and respondents

The optimum listening level of music via headphones was measured by a method of adjustment in quiet and noisy conditions. The participants were 10 students with normal hearing, aged 22 to 26 years old, all of whom were respondents of the questionnaire survey.

3.2 Stimuli

The sound stimuli were six music excerpts (approximately 90 s in length) from commercial CDs. The details on the stimuli are shown in Table 1.

Table 1 – Six music used as sound stimuli

Tune number	Title	Artist	Genre of music
1	Sonata for two pianos	Mozart	Classical
2	Poker Face	Lady Gaga	American Pop
3	Polyrhythm	Perfume	Japanese Pop
4	Canon	Pachelbel	Classical
5	Only You	KEVIN LYTTLE	Reggae
6	Have a nice day!	KREVA	HIP-HOP (Japanese)

3.3 Method

The participants adjusted the volume of an iPod to what they considered to be the optimum listening level for enjoying each tune. They listened to sound stimuli via open-air type headphones (SENNHEISER HD580). After adjusting the volume, L_{Aeq} (equivalent continuous A-weighted sound pressure level) for each stimulus was measured using artificial ear (Brüel & Kjær Type4153) and a sound level meter (Brüel & Kjær 2260 Investigator). In the noisy conditions, the headphone amplifier (audio-technica AT-HA66) was connected to iPod because the optimum listening levels were expected to be raised.

3.4 Listening condition

The experiments were conducted in both quiet and noisy conditions. The noisy conditions included two types of noise conditions: traffic noise and train noise. The noises were presented from a loudspeaker (JBL Studio monitor 4412A) located 1.5 m from the participant' listening position. The loudspeaker was connected to an amplifier (YAMAHA XM4180). Noises were inputted from a personal computer. The ambient noise level was 33 dB (A-weighted sound pressure level) for the quiet condition, 63 dB and 73 dB for the two traffic noise conditions, and 73 dB for the two train noise conditions (one including a public announcement and the other without such an announcement) [4]. These sound pressure levels of noises were measured for 2 minutes at the participant' listening position using a sound level meter (Brüel & Kjær 2238 Mediator).

3.5 Results

The average optimum listening levels (L_{Aeq}) and their standard deviations for each tune for each noise condition are shown in Table 2. A two-way analysis of variance was applied to the data. The effect of the ambient noise condition was statistically significant ($F(4,36) = 38.8$, $p < 0.01$). The effect of tune and the interaction between ambient noise and tune were not statistically significant. All the differences in average optimum listening levels between the quiet conditions and the other noise conditions were found to be statistically significant ($p < 0.01$) by Tukey's HSD (Honestly Significant Differences) test. The differences in listening levels among the four noise conditions were not statistically significant for any pairs. These results indicate that listening to music via portable audio devices may interfere with the ability to hear environmental sounds. Music might mask the environmental sounds necessary to inform users of dangerous situations, furthermore, some participants in this experiment were found to listen to music at very high volume levels. Such users might have a risk damaging their hearing organs.

3.6 Discussion

The optimum listening levels of music were over 70 dB when noise existed. Hara et al. reported that the threshold of pure tone (0.25 kHz ~ 8 kHz) was raised to over 70 dB when listening to rock or popular music via earphones in about 70 dB [1]. In addition, Zwicker et al. reported that when the pure tone was masked by broadband noise in 50 dB, the threshold of pure tone was raised to about 70 ~ 80 dB [5].These reports indicated that the portable audio device users' threshold for environmental sounds might be raised when they listened to music in noisy conditions. When portable audio device users adjust the volume of their devices to mask the ambient noises, not only noises but also environmental sounds informing necessary information would be inaudible.

Table 2 – Average optimum listening levels and standard deviations (L_{Aeq}: dB)

	Tune 1	Tune2	Tune3	Tune 4	Tune 5	Tune 6	Ave.
Quiet condition	57.9 (9.1)	60.2 (10.1)	62.4 (9.5)	56.9 (8.2)	56.0 (10.9)	54.7 (11.2)	58.0
Traffic noise (63 dB)	72.8 (5.3)	71.4 (6.4)	72.5 (6.3)	70.5 (6.3)	71.8 (6.1)	69.8 (7.2)	71.1
Traffic noise (73 dB)	74.0 (5.6)	71.4 (6.7)	75.2 (6.8)	72.6 (6.3)	73.2 (6.1)	72.8 (6.4)	73.2
Train noise with announcement	71.6 (6.4)	71.2 (6.2)	73.9 (7.6)	71.5 (6.7)	71.6 (6.7)	71.6 (5.8)	71.9
Train noise without announcement	73.7 (6.2)	71.2 (7.0)	74.0 (7.2)	73.4 (5.5)	73.4 (6.3)	71.4 (7.4)	72.9

4. Survey on the awareness of environmental sounds when listening to music

4.1 Purpose and participants of the experiment

The purpose of this experiment was to clarify the effect of listening to music on the awareness of environmental sounds in the field. Listening to music is expected to reduce awareness to environmental sounds by the masking effect. The participants were 10 students, aged 21 to 26 years old, all of whom were the respondents of the questionnaire survey. Five participants also attended in the experiment of measuring optimum listening levels.

The participants walked along a given route in outdoor with and without portable audio devices. After the walking, perception of environmental sounds was surveyed.

4.2 Walking route

The walking route was around Oohashi campus of Kyushu University in Fukuoka city and the walking time was about 20 minutes. The walking route included a sidewalk of a six-lane road, a river-side footway, a road in a quiet residential area and a lane in a construction site.

4.3 Experimental conditions

Condition 1: In this condition, participants listened to music using their owned portable audio devices while they walked along the given route. The participants could select their favorite music and listen to them with desirable sound volume. The participants listened to music via open-air type headphone (SHENNHEISER HD580).

Condition 2: The walking route was the same to condition 1, but the participants do not listen to music while walking.

4.4 Instruction of experiment

To avoid the participants to pay intentional attention to environmental sounds, participants were given a fake purpose of the experiment, which was "you are going to participate in a survey of the effect of music on the pleasure while walking."

4.5 Questionnaire

After the walking in condition 1 and 2, the questionnaire sheets were given to the participants as “the questionnaire on the walking.” The questionnaire started with the dummy questions about the walking, such as “Did you enjoy the walking?” Then, the real questions continued, such as “List the sounds that you heard while walking.” After the participants listed the sounds, they were instructed to select loud sounds, quiet sounds, favorite sounds and dislike sounds from the sound list if they had such sounds in the list.

4.6 Results

The number of listed sounds after the walking in condition 2 (walking without listening to music) was more than those in condition 1. Especially, the number of natural sounds such as "sound of wind" and "bird chirping" increased in condition 2. The sound list as loud sounds, quiet sounds, favorite sounds and dislike sounds in condition 1 and condition 2 are shown in Table 3. The number of parentheses shown in tables indicates the number of responses.

Table 3 – Sounds listed as loud sounds, quiet sounds, favorite sounds and dislike sounds

Condition 1 : walking with listening to music

Loud sounds	Quiet sounds	Favorite sounds	Dislike sounds
Sound of cars (9)	Sound of bicycles (1)	Sound of stepping on dead leaves (1)	Sound of cars (3)
Sound of motorbikes (1)	Talking voices (1)	Talking voices (1)	Sound of motorbikes (1)
Airplane noise (1)	Sound of river (1)	Airplane noise (1)	Construction noise (1)
Construction noise (1)		Bird chirping (1)	Talking voices (1)

Condition 2 : walking without listening to music

Loud sounds	Quiet sounds	Favorite sounds	Dislike sounds
Sound of cars (3)	Wind-induced foliage sound (3)	Wind-induced foliage sound (5)	Sound of cars (3)
Car horn (1)	Sound of bicycles (1)	Bird chirping (5)	Braking noise of bicycles (2)
Airplane noise (1)	Sound of train (1)	Sound of wind (4)	Car horn (1)
Sound of a gas station (1)	Sound of sweeping with a broom (1)	Sound of stepping on dead leaves (1)	Sound of a gas station (1)
Sound of a metalwork studio (1)	Sound of water drain (1)	Sound of river (1)	Sound of the outdoor unit of air conditioner (1)
Construction noise (1)	Sound of weaving machines (1)	Talking voices (1)	Sound of weaving machines (1)
Talking voices (1)	Talking voices (1)	Airplane noise (1)	Construction noise (1)
Sound of wind (1)	Footsteps (1)		Helicopter noise (1)
	Sound of river (1)		Talking voices (1)
	Sound of wind (1)		Footsteps (1)
	Bird chirping (1)		

4.7 Discussion

In condition 2, especially the number of sounds listed as quiet sounds was increased. This result indicates that the existence of music seems to cause difficulty of being aware of quiet sounds. Furthermore, most of the sounds listed as quiet sounds were also listed as favorite sounds. The portable audio device users might miss hearing the sounds that were evaluated as "favorite sounds" when they listen to music in outdoor. However, the number of sounds listed as dislike sounds was also increased in condition 2. Music masked not only quiet sounds and favorite sounds but dislike sounds.

5. CONCLUSIONS

The results of questionnaire survey illustrated widespread, long-term and frequent use of portable audio devices. The portable audio devices have become an integral accessory in the daily lives. However, some of the portable audio device users have experienced dangerous situations. Some of them feel annoyance from environmental sounds. Some of them admitted having lost an interest in environmental sounds.

The adjusted optimum listening levels of music were high enough to mask environmental sounds necessary for safety. Consequently, such listening situations might be a factor causing dangerous accidents. Highest level of listening level might increase risk of hearing damage.

The survey of noticeable environmental sounds when walking outdoor showed the decrease of rate of awareness of the environmental sounds evaluated as quiet and favorite when listening to music. This tendency suggests the possibility that the portable audio device users are losing opportunities to notice pleasant environmental sounds, such as sounds that signal the changing of the seasons.

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