Comparisons of vehicle horn use in urban areas of Japan

Masayuki Takada¹,*, Honatsu Murasato² and Shin-ichiro Iwamiya¹

¹Department of Communication Design Science, Faculty of Design, Kyushu University, 4–9–1 Shiobaru, Minami-ku, Fukuoka, 815–8540 Japan
²Department of Acoustic Design, School of Design, Kyushu University, 4–9–1 Shiobaru, Minami-ku, Fukuoka, 815–8540 Japan

(Received 20 December 2013, Accepted for publication 21 May 2014)

Abstract: In Japan, drivers frequently use their vehicle horn as a signal in various situations such as when passing each other. Furthermore, pedestrians are honked at by drivers. Such horn use may create noise problem for people nearby. Therefore, a questionnaire survey was carried out to ascertain the current circumstance of vehicle horn use in Kanto and Kansai of Japan, while a similar survey was previously carried out in Fukuoka. Respondents were asked about the latest or last-remembered case of horn use in various situations of being drivers and pedestrians. With regard to an experience of being honked at by another driver, the questionnaire included questions relating to the aim of horn use, the timing pattern of the horn, and the respondent’s psychological reaction. The results revealed that drivers’ brief and frequent vehicle horn use to express gratitude or gain another’s attention in various places from narrow lanes to main roads was similar among the three surveyed areas including Fukuoka. Long honks and horn use to gain another’s attention or to alert another to danger remarkably aroused negative psychological reactions in pedestrians. No significant difference in the manner of the driver’s horn use was found among the three surveyed areas.

Keywords: Vehicle horn, Timing pattern, Driver, Pedestrian, Psychological reaction, Urban area

PACS number: 43.50.Qp, 43.66.Lj [doi:10.1250/ast.35.309]

1. INTRODUCTION

In Japan, car drivers communicate in various ways such as flashing their lights (when yielding the right of way), gesturing, and using the horn. These methods seem to have been developed by drivers themselves and have become widely adopted among drivers throughout Japan [1]. The Japanese Road Traffic Law states that a vehicle horn should be used only in an emergency or in dangerous locations where there is a signpost promoting horn use, such as on a blind curve [2]. Nevertheless, the use of the horn has been one of the major means to communicate with other drivers; e.g., when expressing gratitude in a situation that a driver yields to another driver or that a driver is given the right of way on a narrow road. Furthermore, a vehicle horn is often used to warn pedestrians that the car is approaching them from behind. Such horn use violates the above-mentioned law. The Japanese Safety Standard for Road Transportation Vehicles stipulates that the standard for the noise level (i.e., the A-weighted sound pressure level) of a vehicle horn as measured in front of the vehicle should be 93–112 dB [3]. Thus, there is concern that the effects of a vehicle horn on people outside the vehicle including pedestrians and residents who are living in neighborhoods with narrow roads may be serious.

To investigate the above-mentioned issue concerning vehicle horn use, questionnaire surveys were conducted in Fukuoka, Japan [4]. The questionnaire results revealed that vehicle horns were frequently used to express gratitude or to gain another’s attention. The previous survey also reported negative psychological impacts on not only drivers but also others (i.e., pedestrians), and mentioned a need for a new method or device to facilitate driver communication and replace the present use of vehicle horns. There may be, however, differences in vehicle horn use among local areas in Japan. No such difference has been identified in related research or surveys. If there are such differences, it should be discussed whether the proposals or countermeasures for the vehicle horn use in the previous studies [4,5] are applicable to the circumstances of vehicle horn use in other areas. Therefore, questionnaire surveys similar to that in the previous study
were carried out to ascertain the current circumstance of vehicle horn use in the Kanto and Kansai areas of Japan, and the obtained results were then compared with results of the previous survey conducted in Fukuoka, Japan.

2. OUTLINE OF SURVEY

The present survey used a form similar to that used in the previous study [4], which was modified from a form proposed by the ASJ for social surveys on noise problems [6].

The questionnaire comprised questions similar to those in the ASJ form. For example, there was a question related to satisfaction with the environment in which the respondents live, a question concerning sounds that respondents hear in their daily lives at home and their responses to the sounds (i.e., whether they found a sound to be annoying), and questions on personal attributes (e.g., age, gender, occupation, and family structure). Respondents were asked to rank their satisfaction with aspects of the environment, such as convenience of transportation, amount of greenery and public facilities on a five-step categorical scale. Concerning sounds heard at home, the questionnaire included questions on the nature of the annoyance felt by respondents in response to hearing a vehicle’s horn, the time when the respondents heard a vehicle’s horn and the respondents’ coping behaviors.

As the main questions of the present survey, questions regarding vehicle horns were included. Respondents were asked about the latest or last remembered instance of (1) their own horn use and (2) their experiences of being honked at by another driver in various situations when driving. They were also asked about (3) their experiences of being honked at by a pedestrian (i.e., while walking). With regards to (1) a driver’s own horn use and (2) a driver’s experience of being honked at by another driver, the questionnaire sought details such as the time, place, traffic volume, aim of horn use, and timing pattern of the horn honking. In the question concerning the object of (1) the driver’s own horn use, the item “motorcycle” was added to the items of the similar question in the former questionnaire, because several responses of this item were obtained in the free description questions of the previous survey. Moreover, respondents were asked about their psychological reactions when honked at by another driver. With regards to (3) a pedestrian’s experience of being honked at by a car driver, respondents were asked about the driver’s reason for using the horn, the timing pattern of horn honking, and their psychological reaction to the honking. In the question concerning the psychological reaction of (2) the driver’s experience of being honked at by another driver and (3) the pedestrian’s experience of being honked at, the item “comfortable” was added to the items of the similar question of the previous survey for the same reason mentioned above. For almost all questions, respondents selected one of multiple possible choices, as described by Tables 3 to 5.

The present survey was carried out in two areas of Kanto and Kansai. Participants in the Kanto survey mainly lived in Tokyo and its neighboring prefectures, such as Kanagawa, Saitama, and Chiba. In the survey of Kansai, participants lived in Osaka, Hyogo, and Nara. In the previous survey [4], people passing in front of the satellite office of Kyushu University near a railway station were requested to participate. Students of the same university also participated. In the present survey, the questionnaire was directly sent by post to participants who were requested to participate and agreed to participate. We also requested the local employment agencies for elderly people in Tokyo and Kobe to recruit elderly participants and to distribute questionnaires to them. Participants were asked to fill out the questionnaire at home. Additionally, a questionnaire survey was conducted at Seikei University, Tokyo. In this case, we asked participants to complete their responses at the venue. All of the respondents who were requested to participate agreed to participate in the present survey.

Rates of responses concerning personal attributes are given in Table 1. One hundred and forty-one males and 72 females (66.2% and 33.8% of the total of 213 respondents, respectively) in their twenties to seventies participated in

| Category               | Group A (213 respondents) | Group B (183 respondents) |
|------------------------|---------------------------|---------------------------|
| Gender                 |                           |                           |
| male                   | 66.2                      | 45.9                      |
| female                 | 33.8                      | 54.1                      |
| teens                  | 0.0                       | 4.9                       |
| twenties               | 40.4                      | 36.6                      |
| thirties               | 11.7                      | 4.9                       |
| forties                | 6.6                       | 7.1                       |
| fifties                | 6.1                       | 7.7                       |
| sixties                | 16.4                      | 17.5                      |
| seventies              | 18.3                      | 21.3                      |
| eighties and over      | 0.0                       | 0.0                       |
| no answer              | 0.5                       | 0.0                       |
|                        |                           |                           |
| Age                    |                           |                           |
| self-employed person   | 1.9                       | 3.8                       |
| salaried worker        | 21.1                      | 14.2                      |
| independent professional| 2.3                       | 0.0                       |
| full-time housewife    | 8.5                       | 10.9                      |
| part-time worker       | 6.6                       | 13.1                      |
| student                | 38.5                      | 31.7                      |
| person without a regular occupation | 14.1 | 23.0 |
| other                 | 5.2                       | 3.3                       |
| no answer              | 1.9                       | 0.0                       |
the Kanto survey (Group A). In the Kansai survey (Group B), 84 males and 99 females (45.9% and 54.1% of the total of 183 respondents, respectively) in their teens to seventies participated. In both surveyed areas, respondents mainly comprised salaried workers, students and people without a regular occupation; these were the major occupational groups. Table 2 gives rates of responses by age group for each method of questionnaire survey for each of the two surveyed areas.

### Table 2 Rates of responses (%) by age group for each method of recruitment for the questionnaire survey.

| Category         | Group A (213 respondents) | Group B (183 respondents) |
|------------------|---------------------------|----------------------------|
| Venue            |                           |                            |
| (University)     |                           |                            |
| teens            | 0.0                       | —                          |
| twenties         | 39.4                      | —                          |
| thirties         | 3.3                       | —                          |
| forties          | 1.9                       | —                          |
| fifties          | 5.2                       | —                          |
| sixties          | 0.5                       | —                          |
| seventies        | 0.0                       | —                          |
| eighties and over| 0.0                       | —                          |
| no answer        | 0.0                       | —                          |
| Request to       |                           |                            |
| the local        |                           |                            |
| employment       |                           |                            |
| agencies for     |                           |                            |
| elderly people   |                           |                            |
| teens            | 0.0                       | 0.0                        |
| twenties         | 0.0                       | 0.0                        |
| thirties         | 0.0                       | 0.0                        |
| forties          | 0.0                       | 0.0                        |
| fifties          | 0.0                       | 0.0                        |
| sixties          | 0.0                       | 0.0                        |
| seventies        | 0.0                       | 0.0                        |
| eighties and over| 0.0                       | 0.0                        |
| no answer        | 0.0                       | 0.0                        |
| Post             |                           |                            |
| teens            | 0.0                       | 4.9                        |
| twenties         | 0.9                       | 36.6                       |
| thirties         | 8.5                       | 4.9                        |
| forties          | 4.7                       | 7.1                        |
| fifties          | 0.9                       | 7.7                        |
| sixties          | 0.0                       | 0.0                        |
| seventies        | 0.0                       | 0.5                        |
| eighties and over| 0.0                       | 0.0                        |
| no answer        | 0.5                       | 0.0                        |

3. RESULTS

In the results for Kanto, there were 110 drivers among the respondents. Of these drivers, 75 drivers had experiences of using a horn while driving (Group A1, driver’s own horn use). Eighty-eight drivers had experienced being honked at by another driver (Group A2, driver’s experience of being honked at). Moreover, 151 of the respondents had experienced being honked at while walking (Group A3, pedestrian’s experience of being honked at). On the other hand, there were 107 drivers among the respondents in Kansai. The numbers of drivers who had used a horn while driving (Group B1), drivers who had experienced being honked at by another driver (Group B2), and people who had experienced being honked at while walking (Group B3) were 79, 88, and 106, respectively. The simply totaled results focusing on the manner of vehicle horn use and the effects of horn use on drivers and pedestrians are presented in Tables 3 to 5.

#### 3.1. Aim of Vehicle Horn Use

According to Table 3, more than half the drivers in both the Kanto and Kansai groups who themselves had used a horn while driving had done so to gain another’s attention or alert them to danger. There were also drivers who had used a vehicle horn to express their gratitude (21.3% of Group A1, 13.9% of Group B1).

In the survey results for the reason that another driver used the horn in Table 4, nearly half of the respondents had been honked at to gain their attention while driving (i.e., they were drivers) (response rates of “to gain another’s attention” were 47.7% in both Groups A2 and B2). On the other hand, nearly 20% of drivers had been honked at for the purpose of expressing gratitude. Similar horn uses were found in the previous survey results for Fukuoka [4]. Tables 3 and 4 of the present survey and the results of the previous study reveal that drivers often use their vehicle horns to express gratitude.

There were fewer respondents who had experiences of being honked at to express gratitude while walking than respondents who had similar experiences while driving (see Table 5; 5.3% of Group A3, 7.5% of Group B3). Around 70% to 80% of respondents had been honked at to gain their attention or to alert them to danger (the summed rates of “to gain another’s attention” and “to inform of danger”
were 79.5% in Group A3 and 69.8% in Group B3, respectively).

3.2. Timing Pattern of Vehicle Horn Use

Concerning the timing pattern of horn honking, most drivers who honked their vehicle horn while driving used short honks such as a single short honk or two short honks (onomatopoeically represented by “puQ” and “puQ puQ,” respectively), as shown in Table 3. On the other hand, respondents who had an experience of being honked at while driving (i.e., drivers of Groups A2 and B2, Table 4) and walking (i.e., pedestrians of Groups A3 and B3, Table 5) reported that the other driver had used not only a single honk or two short honks but also one long honk (onomatopoeically represented by “puuu”) (drivers: 33.0% of Group A2, 28.4% of Group B2; pedestrians: 33.1% of Group A3, 20.8% of Group B3).

3.3. Psychological Reaction When Honked at

Regarding the psychological reaction to vehicle horn use (see Tables 4 and 5), the largest category of driver responses was an apologetic feeling for blocking another driver’s way in each area (40.9% of Group A2, 31.8% of Group B2). However, the numbers of pedestrians having a similar reaction were not so large (24.5% of Group A3, 12.3% of Group B3). On the other hand, in terms of respondents having negative psychological reactions such as finding the horn use to be “startling,” “noisy,” or “irritating,” the response rates for pedestrians were higher than those for drivers (the sums of the three items “startled,” “sensation of noisiness,” and “irritated” were 33.0% of Group A2, 44.3% of Group B2, 58.9% of Group A3, and 65.1% of Group B3).

Regarding sounds heard by the respondents at home, 113 respondents in Group A (Kanto survey) and 117 respondents in Group B (Kansai survey) reported hearing vehicle horns, and 18 and 13 respondents in the respective areas were actually annoyed by the horn sound.

4. DISCUSSION

4.1. Relationships between Questionnaire Items Concerning Vehicle Horn Use

The driver’s use of the vehicle horn seems to be affected by various factors such as traffic conditions, the target of the horn use and the driver’s intention. The type of horn honking may differ according to the driver’s intention. Moreover, it is natural that a driver’s psychological reaction should depend on the type of horn honking.
and another driver’s intention. To analyze the relationships between the questionnaire items, such as that between the aim of horn use and the type of horn honking and that between the aim of horn use and a driver’s or pedestrian’s psychological reaction, the questionnaire results were cross tabulated between variables. Statistical testing using Cramer’s $V$ [7], a statistic measuring the strength of association between nominal variables, was carried out to reveal the significant relationships between the questionnaire items. In the following discussion, we mainly focus on the significant relationships among the object, the aim of driver’s own horn use and the type of horn honking, and those among another driver’s aim of horn use, the type of horn honking and a driver’s or pedestrian’s psychological reaction for each of the two surveyed areas.

(1) Driver’s own horn use

- Object and aim of horn use (Group A1: $V = 0.392^{**}$, Group B1: $V = 0.363^{**}$, Fig. 1)

- Aim of horn use and the timing pattern of horn honking (Group A1: $V = 0.264$, ns, Group B1: $V = 0.372^{**}$, Fig. 2)

Figure 1 illustrates relationships between the object and the aim of horn use in both of the two surveyed areas ($p < 0.01$ for the results in both areas; hereafter, $p < 0.01$, $p < 0.05$, and “not significant” are denoted ‘’***,’’ ‘’*’’ and “ns,” respectively). The figure shows that drivers directed their horn use towards other drivers to express their gratitude for the right of way being yielded by the other driver, to gain another’s attention, and to alert the other driver to danger. Furthermore, a vehicle horn was also honked at pedestrians and cyclists to gain their attention, and to alert them to danger. These results were similar in both the present surveyed areas and Fukuoka, where the previous survey was carried out [4].

Figure 2 illustrates relationships between the driver’s aim of horn use and the timing pattern of horn honking (left: result for Group A1, right: result for Group B1).
were often used along narrower roads such as narrow lanes and one-lane roads. These results were similar in both the present surveyed areas and Fukuoka. In the result for Group A1 (Kanto), long honks (i.e., one long honk) were sometimes reported along wider roads such as two-lane roads and main roads. Although similar horn honking was reported in the previous survey of Fukuoka, it was hardly found in the present survey of Kansai.

Considering the results obtained in the present and previous surveys [4], a tendency of a driver’s horn use common to the three areas was that drivers briefly honked their horn to express gratitude or to gain another’s attention in various places. As mentioned, such uses of the horn are basically against the Japanese Road Traffic Law, which prohibits horn use except in emergencies or in dangerous locations that have a signpost allowing horn use such as on a blind curve [2].

(2) Driver’s experience of being honked at by another driver

- Another driver’s aim of horn use and the timing pattern of honking (Group A2: $V = 0.421^{**}$, Group B2: $V = 0.327^*$, Fig. 3)
- Another driver’s aim of horn use and the respondent’s (driver’s) psychological reaction when honked at (Group A2: $V = 0.454^{**}$, Group B2: $V = 0.537^{**}$, Fig. 4)

According to Table 4, there were a small number of respondents (i.e., drivers) who did not comprehend the other driver’s aim of horn use when honked at (8.0% of 88 drivers in Group A2, 5.7% of 88 drivers in Group B2). Therefore, the majority of drivers understood the other driver’s intention in using the horn. Relationships are thus discussed in the following.

Figure 3 presents the significant relationships between another driver’s aim of horn use, as guessed by the respondent (i.e., driver), and the timing pattern of the honking when drivers were honked at (left: result for Group A2, right: result for Group B2).

Fig. 3 Relationship between another driver’s aim of horn use and the timing pattern of the honking when drivers were honked at (left: result for Group A2, right: result for Group B2).

![Graph](image1)

Another driver’s aim of horn use

![Graph](image2)

Another driver’s aim of horn use

Fig. 4 Relationship between another driver’s aim of horn use and the driver’s psychological reaction when honked at (left: result for Group A2, right: result for Group B2).

![Graph](image3)

Another driver’s aim of horn use

![Graph](image4)

Another driver’s aim of horn use

According to Table 4, there were a small number of respondents (i.e., drivers) who did not comprehend the other driver’s aim of horn use when honked at (8.0% of 88 drivers in Group A2, 5.7% of 88 drivers in Group B2). Therefore, the majority of drivers understood the other driver’s intention in using the horn. Relationships are thus discussed in the following.

Figure 3 presents the significant relationships between another driver’s aim of horn use, as guessed by the respondent (i.e., driver), and the timing pattern of the honking. Drivers, in many cases, interpreted short honks of the horn as an expression of gratitude or an attempt to gain their attention. One long honk was mainly interpreted as seeking to gain their attention. These interpretations were similar among the three areas including Fukuoka [4]. On the other hand, there were also cases that a long honk was interpreted as alerting the respondent to danger in Group A2 (Kanto result) and venting anger in Group B2 (Kansai result). For the most part, these interpretations are similar to the aims of the respondent’s own horn use, as shown in Fig. 2.

The significant relationships between another driver’s aim of horn use, as guessed by the respondent (i.e., driver), and the respondent’s psychological reaction when honked at are shown in Fig. 4. Drivers mainly felt sorry for blocking another driver’s way when interpreting another
driver’s horn use as an attempt to gain their attention. On the other hand, drivers’ negative psychological reactions such as being startled, feeling that the sound was noisy, or being irritated were also aroused by similar horn use. These tendencies were found in the previous survey [4]. Although drivers in the previous survey mainly had no particular feeling when honked at for expressing gratitude, drivers in both of the present surveyed areas sometimes had no particular feeling or felt comfortable in response to hearing another driver’s horn use for a similar intention. Such difference resulted from adding the questionnaire item of pedestrian’s psychological reaction when honked at.

Fig. 5 Relationship between car driver’s aim of horn use and the timing pattern of the honking when pedestrians were honked at (left: result for Group A3, right: result for Group B3).

Fig. 6 Relationship between car driver’s aim of horn use and the pedestrian’s psychological reaction when honked at (left: result for Group A3, right: result for Group B3).

The significant relationships between the car driver’s aim of horn use, as guessed by the respondent (i.e., pedestrian), and the timing pattern of the horn honking are shown in Fig. 5. Pedestrians frequently interpreted short honks, such as a single short honk or two short honks, as an attempt to gain their attention. Such vehicle horn use was also found in the Fukuoka survey [4]. It is remarkable that, according to the result for Group A3, many pedestrians were subjected to a long honk to gain their attention or to alert them to danger.

Regarding the effects of horn honking on pedestrians, Fig. 6 illustrates the significant relationships between a driver’s aim of horn use and the psychological reaction of the pedestrian when honked at. The figure shows that pedestrians mainly interpreted the driver’s horn use as for gaining their attention or to alert them to danger (also see Table 5, “to gain another’s attention”: 51.7%, “to inform of danger”: 27.8% of 151 respondents in Group A3; “to gain another’s attention”: 53.8%, “to inform of danger”: 16.0% of 106 respondents in Group B3). Such horn use directed towards pedestrians frequently aroused negative psychological reactions such as the pedestrian finding the horn use startling, noisy, or irritating, or the horn use invoked no particular feeling or an apologetic feeling for blocking the car driver’s way. Similar results were found in the previous survey for Fukuoka [4].

On the other hand, the relationship between the timing pattern of the horn honking and the respondent’s (pedestrian’s) psychological reaction when honked at was not statistically significant (note that no figures are presented).
Because pedestrians are exposed to a horn sound with a noise level higher than 90 dB near a vehicle, they will often have negative psychological reactions to any kind of timing pattern of the horn honking.

4.2. Difference in a Driver’s Vehicle Horn Use among Surveyed Areas

From qualitative comparisons of the relationships of vehicle horn use between the two presently surveyed areas in the previous section, some differences were found; e.g., Fig. 5 shows that pedestrians in Group A3 were more frequently subjected to a long honk to gain their attention or to alert them to danger than pedestrians in Group B3. To examine the difference in a driver’s vehicle horn use among the surveyed areas quantitatively, a chi-square test was carried out for each of the cross-tabulated results for several relationships: the relationship between the object and the driver’s aim of horn use (Fig. 1) and the relationship between the driver’s aim of horn use and the timing pattern of the honking (Fig. 2) in the results of (1) their own horn use; the relationship between another driver’s aim of horn use and the timing pattern of horn honking (Fig. 3) in the results of (2) the driver’s experience of being honked at; and the relationship between car driver’s aim of horn use and the timing pattern of horn honking (Fig. 5) in the results of (3) a pedestrian’s experience of being honked at. The present tests included the corresponding results for the previous survey of Fukuoka [4]. Accordingly, the differences in horn use among the three areas were analyzed. In the tests of the relationship between the object and the driver’s aim of horn use (Fig. 1), results of the “motorcycle” item in Groups A1 and B1 were excluded, because this item was not included in the questionnaire items of the previous survey [4] and there were few responses of this item in the present survey (see Fig. 1).

As a result, the statistical tests revealed no significant difference in vehicle horn use for the above-mentioned relationships (the object and the aim of horn use of (1): \( \chi^2 = 29.7, d.f. = 38, \text{ns}; \) the driver’s aim of horn use and timing pattern of (1): \( \chi^2 = 36.0, d.f. = 68, \text{ns}; \) another driver’s aim of horn use and timing pattern of horn honking of (2): \( \chi^2 = 71.6, d.f. = 82, \text{ns}; \) the car driver’s aim of horn use and timing pattern of horn honking of (3): \( \chi^2 = 72.8, d.f. = 82, \text{ns}. \) These results show that, from the viewpoint of means of communication between drivers, the manner of vehicle horn use is similar among the three areas in which surveys were carried out.  

5. CONCLUSIONS

The present survey found that drivers’ brief and frequent vehicle horn use to express gratitude or gain another’s attention was similar in the surveyed areas of Kanto and Kansai as well as Fukuoka. Long honks and horn use to gain another’s attention or to alert another to danger often aroused negative psychological reactions in listeners. These reactions were more remarkable for pedestrians.

Furthermore, drivers briefly honked in various places from narrow lanes to main roads. Such horn use was reported in situations where drivers expressed thanks for being given the right of way by another driver. Accordingly, as pointed out in the previous survey, in neighborhoods with narrow roads where a driver needs to give way to another driver, residents may be continually annoyed by frequent horn honking. In the questions concerning sounds heard by the respondents at home, many respondents reported hearing vehicle horns (113 respondents in Group A and 117 respondents in Group B). Among them, there were respondents who were actually annoyed by the horn sound, although their numbers were less than that in the previous survey (18 and 13 respondents in the respective areas in the present survey).

The results obtained in the present and previous surveys for the current circumstances concerning drivers’ vehicle horn use and its effects on drivers and pedestrians were similar, for the most part, among the three surveyed areas. As detailed above, although a vehicle horn is installed in a vehicle for safety, there were frequent negative psychological responses from pedestrians when drivers using their horn. If the current system of the vehicle horn is continued, it may be necessary to modify the acoustic property of vehicle horn sound to reduce the negative effects on pedestrians, as discussed in a previous experimental study [5].

However, as also stated in the previous survey [4], any modification of the vehicle horn sound will not completely solve the current issue that use of the horn arouses negative psychological reactions in pedestrians, because in the current states of vehicle horn use, pedestrians often hear vehicle horns with a high sound level (i.e., 93–112 dB [3]) near a vehicle while walking not only when the vehicle horn use is directed at them to attract their attention and inform of danger (see Table 5 and Figs. 5 and 6), but also when they are not the objects of vehicle horn use (i.e., the vehicle horn use is directed towards another driver). Therefore, at least it is to be desired that people outside the vehicle do not hear the use of the vehicle horn to communicate with other drivers. As a countermeasure to reduce the adverse effects of a vehicle horn on people outside the vehicle, a new device to facilitate driver communication to replace the present vehicle horn use, for example, a radio communication system in the car compartment that presents auditory signals with timing patterns similar to those of a vehicle horn towards another driver may be available, because the manner of vehicle horn honking is quite similar among the three areas in which surveys were carried out.
horn use is a common means of communication between drivers in the surveyed areas. Furthermore, we again emphasize the need to enlighten drivers about the impacts of vehicle horn use in an effort to keep horn use to a minimum.

The present survey did not employ a procedure to eliminate measurement bias (e.g., the random sampling procedure of respondents). Therefore, it is necessary to check whether the survey results are affected by sampling bias.

ACKNOWLEDGMENTS

The authors would like to thank all participants for their participation in the present survey. They are also grateful to Prof. Takeo Hashimoto, Prof. Shigeko Hatano and other staff at Seikei University for their help with the survey. This study was supported by Grants-in-Aid for Scientific Research (Nos. 22615028 and 25560005) from the Japan Society for the Promotion of Science.

REFERENCES

[1] K. Tanaka, A. Sato and Y. Kakimoto, “A study on car communication,” Bull. Jissen Women’s Univ. Fac. Hum. Life Sci., 43, 104–113 (2006) (in Japanese).
[2] Ministry of Land, Infrastructure, Transport and Tourism (amended in 2014), Japanese Road Traffic Law, Chap. 3, Sect. 10, Art. 54.
[3] Ministry of Land, Infrastructure, Transport and Tourism (amended in 2012), Safety Standard for Road Transportation Vehicles, Chap. 2, Art. 43.
[4] M. Takada, Y. Fukuda and S. Iwamitu, “Questionnaire survey on vehicle horn use and its effects on drivers and pedestrians,” Acoust. Sci. & Tech., 34, 187–196 (2013).
[5] M. Takada, A. Takeno and S. Iwamitu, “Effects of vehicle horn acoustic properties on auditory impressions and the interpretation of reasons for horn use by other drivers,” Noise Control Eng. J., 58, 259–272 (2010).
[6] S. Namba, S. Kuwano, J. Kaku, K. Kuno, M. Sasaki, H. Tachibana, A. Tamura, Y. Mishina, T. Yano and I. Yamada, “Proposal of fundamental items for social survey on noise problems,” Acoust. Sci. & Tech., 31, 124–128 (2010).
[7] H. Cramer, Mathematical Methods of Statistics, Asian text ed. (Princeton University Press, Princeton, 1966), Chap. 30.