Listening Difficulty Tests on Broadcast Announcements for Passengers at Stations

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Information announcements are broadcasted in concourses and other places in railway stations. Good speech transmission quality is necessary to ensure that the announcements are understood by station users. Methods to evaluate the speech transmission quality can broadly be divided into two: one is a physical method to measure quality by using test signals and the other is a subjective method using test subjects. Both methods require monitoring loud test announcements. It is difficult to measure the speech transmission quality by the subjective method during business hours at stations or other public venues as a large number of test subjects are required. Thus, the subjective method has rarely been used to evaluate the speech transmission quality at stations. Fortunately, however, we had a chance recently to perform subjective evaluation tests with subjects at concourses and underground platforms at stations as explained below.

A means to evaluate the speech transmission quality by the subjective method is to measure the listening difficulty. The methodology used required the evaluation of the announcements heard by a number of test subjects using a four-stage scale from “not difficult to listen” to “extremely difficult to listen.”

We implemented the listening difficulty tests at the following six locations in four stations in the Tokyo district.

(1) Underground platform, station A
(2) Underground platform, station B
(3) Underground concourse, station B
(4) Ground concourse, station C
(5) Ground concourse, station D
(6) Ground ticket barrier, station D

Among these test locations, (1) and (6) are furnished with sound absorption work on the ceiling and surrounding walls, while others are not. The test points (1), (2), (3) and (5) are in large spaces, while (4) and (6) present medium-sized configurations.

For the sound source, we used actual broadcast announcements (automatic) at (1), (2) and (3) (stations A and B) and read a message for testing at other test locations (stations C and D), as there were few broadcast announcements at these stations.

The stations A and B had 15 test subjects (7 males and 8 females, average age 35.1 years) each. Stations C and D had 14 test subjects (6 males and 8 females, averaged age 31.9 years). At each location, the test subjects were all subjected to the test simultaneously, while standing at a point horizontally 3 m distant from the speaker-projection point on the floor (Fig. 1).

Figure 2 shows the relation between the listening difficulty and the sound level of passenger information broadcasting. (Note that 100% listening difficulty indicates extreme hearing difficulty, with easier hearing occurring at the lower percentage numbers.) The graph indicates that listening difficulty has a minimum value at the sound level of 68 to 74 dB. The listening difficulty tends to increase at sound levels higher than 85 dB, though it must be noted that only the data at the test location (2) (underground platform, station B) are available for these higher sound levels. The data suggests that there may be an optimum volume for the broadcast announcements to minimize the listening difficulty.

See Fig. 3 for the relation between the listening difficulty and the signal to noise (S/N) ratio. The listening difficulty is somewhat lower at test location (1), the underground platform, station A, and higher at the test location (2), the underground platform at station B. On the whole, the higher the S/N ratio is, the lower the listening difficulty becomes. At test locations (1), (3), (4), (5) and (6), the listening difficulty is close to 0% (easy to hear and understand) at an S/N ratio of approximately 5 to 12 dB. This suggests that there may not be any significant differences in the listening difficulty relative to the spatial size of the test location or the existence/non-existence of sound absorption work.

This study has clarified the relation between the sound level of broadcast announcements and the S/N ratio to minimize the listening difficulty. It also provided useful knowledge to improve the transmission quality of the information broadcasting at railway stations.

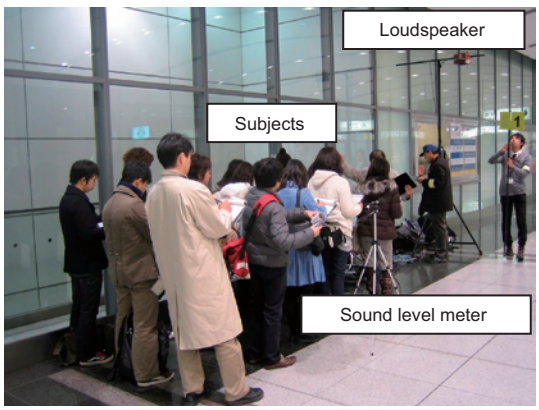

Fig. 1 Listening difficulty test

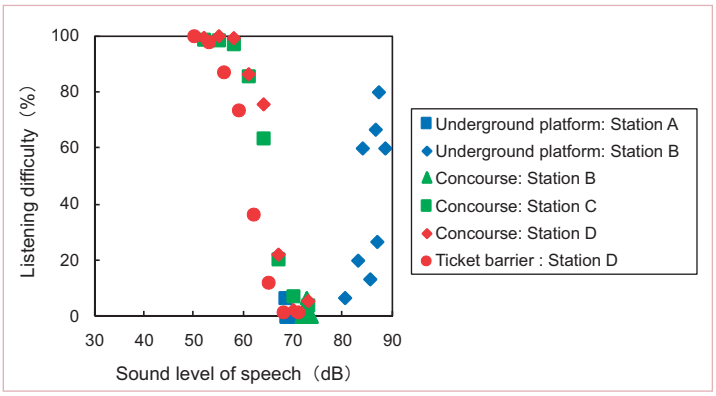

Fig. 2 Relation between sound level of speech and listening difficulty

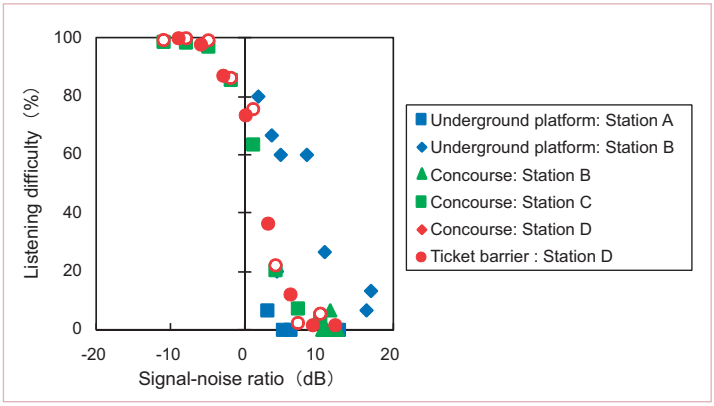

Fig. 3 Relation between signal-noise ratio and listening difficulty