Development and Evaluation of Evidence-based Training Material for Promoting the Recommended Behavior in Railway Employees*

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The psychological burden of a passenger whose train schedule is disrupted can be reduced by not only improving and expanding hardware support but also promoting live announcements made by the station staff and conductors concerning the resumption of train services (Yamauchi 2009). However, since predictive information may change or the information may be incomplete, many station staffs and conductors are apprehensive of making announcements concerning the resumption of services as soon as possible. We developed training material in order to reduce this apprehension of station staffs and conductors. Furthermore, we attempted to improve the announcements providing information regarding suspended train services. Railway employees watched a training DVD that we developed during their job training, following which they answered a questionnaire. The results indicated that many employees were interested in the training material, and they gave a high rating for its comprehensibility. Furthermore, the results of another questionnaire conducted one month after watching the DVD showed that the recommended behavior of the group that watched the DVD improved by 13.2 points, as compared to the group that did not watch it. Furthermore, the results helped us identify effective methods for choosing suitable results of survey or experiment on which the training material is based and for explaining appropriately the contents of training material.

Key words: instructional design, evidence, provision of information, predictive information, attitude

1. INTRODUCTION

In urban centers throughout Japan, railways are an important means of transportation. In recent years, however, frequency of service disruptions due to accidents and disasters has increased, posing a serious social problem (Ministry of Land, Infrastructure, Transport, and Tourism, 2008). Passengers facing serious disruptions to services not only experience higher congestion and longer travel times, but also suffer grater psychological burden, including unease and frustration, as they fret about when they will be able to arrive at their destination and when services will restart. The degree at which level of service declines in terms of congestion and travel times is a primary point of evaluation on the task of restoring service schedules called train rescheduling (Tomii et al., 2005), and ways to minimize the degree has been discussed by stakeholders of railway business and researchers in service operation management (Kunimatsu and Hirai, 2009). On the other hand, psychological burden on traveling passengers has not been actively addressed.

Kaiho and Miyamoto (2008) stated that provision of information as a means to mitigate passenger uneasiness, and pointed out that the significance of three points in particular: information awareness support (what is going on?), prediction support (what will happen?), and action support (what should I do?). Yamauchi et al. (2009) conducted a survey targeting travelers facing disruptions and reported that of the three types of information, the greatest demand was for improved announcements on when the train was expected to restart, i.e. related to prediction support. In addition, Yamauchi et al. (2009) conducted a study using hypothetical scenario method with passengers, and demonstrated that the following method of announcing predictive information on service resumption effectively reduced passenger frustration. In the present study, an announcement by the following method is labeled as the recommended action. The recommended action is that informing when the service is expected to resume as early as

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approximately 10 minutes after the service suspension, and announcing any change as it occurs along with its reason; in making these announcements, also convey to passengers that there may be further changes to the information and that such information is released to passengers as soon as it becomes available. It should be noted that information on predicted service resumption refers not only to expected service resumption time but also to whether resumption is predicted.

For a railway employee to take the recommended action, information on predicted service resumption must be obtained in an early stage from the operation control headquarters (command). To that end, the command must communicate with the site where disruption has occurred and multiple other sites that are affected by service changes urgently. In this regard, improving communication transmission device and equipment is effective. However, evoking the recommended action is not easy only with improvements on hardware side such as those because unless those who transmit information find it important to transmit the information on predicted service resumption, the information will not be actively transmitted. A majority of railway employees show a strong tendency to be excessively cautious about releasing predictive and related information as they instead attempt to provide complete information. Yamauchi (2010) conducted a survey research with 679 employees working at stations of A railway company in the Tokyo area, which had been promoting release of information on predicted service resumption in earlier stages, on how information on predicted service operation was released. Results indicated that only approximately 30% of the respondents endorsed “I announce the information that is transmitted by the command promptly to passengers,” while the majority chose “I make announcements only after service resumption is nearly confirmed,” “I make announcements with later estimate times,” and “I refrain from making announcements if there have been multiple changes.” When participants who did not choose the recommended action were asked to state their reasons in a free description format, the majority demonstrated high levels of concerns about possibilities of disrupting passengers even more and generating complaints due to the low accuracy and low frequency of information released from the operation headquarters.

The tendency to be cautious about releasing information on predicted service resumption is not limited to A company in the Tokyo area. According to a survey conducted in 2010 by the Japan Railway Engineers Association (2011) with 18 major railway companies in the Tokyo metropolitan and Kansai areas, both of which have a high density of railway traffic, only 50% of companies in the Tokyo metropolitan area and no company in Kansai endorsed releasing information on predicted service resumption, regardless of the timing of release, in more than 60% of cases of delays of more than 30 minutes.

Passengers in stations and trains obtain information from a variety of information technology devices in addition to aired announcements. However, passengers tend to rely more on aired announcements when there is discrepancy in contents of released information among media (Yamauchi et al., 2009). Thus, in order to reduce the uneasiness and frustration of traveling passengers, it is critical to accomplish the task of improving the release of predictive information by railway employees.

Focusing on attitude, which could be considered to mediate selection of actions in humans, the present study was designed to demonstrate and propose a strategy to promote attitude change (learning) with a training material that explained results of surveys and experiments on passenger needs, such as above, as evidence to evoke the recommended action in railway employees. In addition, it was intended to test the effectiveness of the proposed strategy with a training that utilized a material that was developed for the present study.

2. SIGNIFICANCE OF THE STUDY

It is conceivable that in order for railway employees to voluntarily select the recommended action, acquiring affirmative attitude toward the recommended action is effective. In the area of instructional design, attitude is defined as internal states that affect the choice of personal actions regarding object, persons, and events (Gagne, 1985), and classified as an ability in affective domain (Krathwohl et al., 1964), separate from other abilities to be learned. According to Gagne et al. (2005), instructional strategies to establish desired attitudes greatly differ from what is applied in learning of intellectual skills and linguistic information, and include: (1) application of effects of classical conditioning and reinforcement contingency, and (2) modeling
(Bandura, 1977) applying the mechanism of vicarious reinforcement based on observational learning (Bandura, 1969). Additionally, the method of (3) presenting and promoting learning of peripheral information that supports attitude formation, such as knowledge and skills to act on attitudes, is believed to be effective (Japan Society for Educational Technology, 2000).

In regard to Method (3), its effectiveness has been demonstrated in the area of educational technology, for example, in research on the formation of information ethics (Tamada and Matsuda, 2004). In social psychology and traffic engineering also, research studies on attitude and behavior change have examined intervention effect of information presentation. For example, Fujimoto (2001) examined desirable driving attitudes in driver education, and Takebashi and colleagues (2011) and Abrahamse and colleagues (2005) examined attitudes on energy saving behavior. Taniguchi and Fuji (2006) examined attitudes to incoming traffic control, while Aoki and colleagues (2003) dealt with attitudes toward public projects.

However, the content presented in these research studies varied, and it is possible that it depended on the characteristics of attitudes that were studied in each study. Therefore, it is important to examine the type of presented information that is of effect on learning affirmative attitudes to the recommended action for railway employees as in the present study.

Attitudes that have been examined in the above cited previous studies can be largely grouped into two based on the characteristics of the definitions. One group views attitudes definitively as appraisal of results of each behavior. The other examines a wider range of attitudes that include, for example, “gentle attitudes to the environment” and “safe driving attitudes,” and target at more general attitudes. In researching the former, reasoned action theory (Fishbein and Ajzen, 1975) and planned behavior theory (Ajzen, 1991), which address the decision making process from attitude to behavior, or a theory that expands them (Fujii, 2003) are commonly presumed. Selection of a definition of attitude seems to be contingent also on whether the ultimate goal of learning is evoking specific behavior or choosing appropriate behavior based on the attitude to be acquired. In the present research, the ultimate goal of learning was for railway employees to be able to choose the recommended action, and thus, the definition of attitude of appraisal of results of each behavior was selected.

There seem to have been few studies in educational psychology that examined strategies to teach affirmative attitudes using training materials concerning attitudes defined this way. For example, in research into training on information ethics, the ultimate goal of learning is not evoking specific behavior. Instead, goals are often to discover or gain knowledge to induce rules from problem cases and to learn the framework to make judgment on information ethics from multiple perspectives for improved knowledge and practical attitudes. Therefore, few studies had examined learning of affirmative attitudes including techniques to evoke specific behavior. The present study was designed, in contrast, to examine learning of affirmative attitudes and technical ideas to evoke actual behavior.

3. IDEAS TO FACILITATE EVOKING BEHAVIOR

It was critical for the training material to be developed for the present study to include the effect to evoke the instructed behavior in reality, or persuasiveness, in addition to comprehensibility of instructional contents. Persuasion has been frequently examined in social psychology (for review, see Fukada, 2002). However, these studies did not include training material development, and it is important to propose methods to enhance persuasiveness of teaching materials from the standpoint of material development to accumulate knowledge base. From this point of view, Shimada (2009) examined a disaster prevention manual on the call–to–action effect of probability information based on past cases and predictions by specialist. Results demonstrated that the content of probability information prompted a cognitive process in which sense of trust and security was increased as it evoked the behavior and enhanced persuasion. In addition to probability information, recently in Japan, there is a stronger tendency to emphasize explanations based on evidence, as in evidence–based treatment and education (Kaiho, 2007). This can be interpreted as a form of desire to respond to act voluntarily after persuaded. Nonetheless, it does not follow that evidence–based explanation is as emphasized in employee education in general businesses yet, and railway business is not an exception. Thus, to develop a training material applying evidence–based explanations for employee education in businesses and test its effectiveness
is of significance to be applied education and training in businesses and organizations in the future.

In developing a training material applying evidence-based explanations, it will be convenient if there are guidelines or methods on selection of evidence and ways to convey it, but accumulation of findings on the matter is not sufficient. Thus, in the present study, the following procedure was planned to obtain knowledge in this area.

First, a method for selecting the evidence to be used in the training material was proposed. In Study 1, a trial version of a training material was developed using the evidence that had been selected based on the method and areas for improvement were identified. In Study 2, a training material was developed using DVD after addressing the areas and implemented in a training setting to test its effectiveness.

4. METHOD TO SELECT EVIDENCE

For railway employees to take the recommended action, information on predicted service resumption must be obtained from the command from early stages. However, the command is not always able to release information on predicted service resumption in earlier stages at times, which hinders employees from selecting the recommended action solely voluntarily. Therefore, it was determined to limit the goal of the training material to be developed in the present study within the scope of employee discretion, and set at being able to take the recommended action if information on predicted service resumption is obtained from the operation headquarters.

Theory of reasoned action was applied, which aims to predict social behavior, to examine the psychological process to selecting the recommended action. The difference between this and its expansion, planned behavior theory, is that while the scope of the former is limited to behaviors under volitional control, the latter may be used to explain social behaviors that are not under volitional control (Ajzen, 1987). As stated earlier, as the target behavior of the training material can be considered to be under volitional control, theory of reasoned action theory was applied in this research.

According to this theory, behavior is determined directly by behavioral intention, which is determined by attitude toward behavior and subjective norm about behavior. Attitude toward behavior can be defined as an overall, positive and negative evaluation on outcomes of a behavior, and subjective norm can be defined as an overall evaluation on whether the behavior is expected to be taken. Attitude is based on two forms of cognitive evaluation about various anticipated outcomes: expectancy about probability that the behavior produces particular outcomes (subjective probability) and evaluation about the degree of importance of each outcome (value). Sum of the product of the two about each outcome provides attitude toward behavior. Subjective norm is based on the cognitive evaluation about what sorts of expectations significant others have of one’s behavior. It consists of perceptions of expectations of significant others about the behavior and level of motivation for the actor to respond to each expectation. Sum of the product of the two for each expectation forms subjective norm.

In the present study, based on the conceptualization that education and training as an opportunity to redress perception that forms attitude and subjective norm that are considered to affect evoking behavior, a model was proposed in which the recommended action is evoked by training that utilized the training material through the process delineated in Figure 1. This model, as does the theory of reasoned action, assumes that behavior is determined by behavioral intentions, which are determined by attitude toward behavior and subjective norm. The model emphasizes that outcomes of the recommended action are positively evaluated overall (cost–benefit analysis) to increase the positive attitude toward the recommended action. Incidentally, this cost–benefit analysis accounts for public benefit and cost of the recommended action to passengers, in addition to private benefit and cost to the employee who takes the recommended action. This model presumes that affirmative attitude toward the recommended action is promoted through clarified and modified recognition of cost–benefit analysis that has been less clear by evidence–based explanations about the following three points: (a) knowing significance and effect of the recommended action; (b) knowing measures to avoid negative effects through applying the recommended action and their effect; and (c) lowering perceived probability of negative effects of the recommended action.

Subjective norm about behavior was considered to increase through communication of serious attitude of the company to training participants by
5. STUDY 1: DEVELOPMENT OF TRAINING MATERIAL AND EVALUATION

5.1. Purpose and Methods

The purpose of Study 1 was to select evidence based on the proposed evidence selection method, develop a training material, and implement the material in a training setting to test its effectiveness. The following two points were also examined: (1) differential effectiveness across areas of where trainees were located, which was considered to affect effect of the training material; and (2) effective ways to provide evidence–based explanation. To understand persuasion effect of the training material and areas to be improved, survey was conducted pre- and post–training with the employees who participated in the training.

In addition, interviews were conducted with facilitators of the training.

5.2. Development of Trial Version of Training Material

5.2.1 Material Application Setting, Medium, and Facilitator

Training material was developed on the assumption that it would be used in a 1-hour training for employees who staff stations or are conductors of trains. Microsoft PowerPoint was selected as a medium for its applicability in the locations where the material was expected to be used. The PowerPoint presentation was developed in collaboration with the education specialist of B branch of A railway company which had agreed to use the material.

Education managers from the field served as facilitators because slide training materials required someone who explained.

5.2.2 Selection of Evidence and Content of Slides

Findings and data that were considered to promote cognitive evaluation on (a), (b), and (c) of the model (Figure 1) were extracted from Yamauchi et al. (2009). Some of the findings and data that were not easily comprehensible were simplified.

In addition to evidence, background and development of obtaining evidence and a summary of company policy for enhanced subjective norm as a message were described on the slides. A total of 13 slides were created. Table 1 displays summaries of the slide contents. Figure 2 displays examples of evidence presented in the slides. The figure summarizes results of survey study with passengers who experienced service disruption about how many minutes later they
thought information of predicted service resumption would be announced by reasons of service disruption. Summaries of results of surveys and experiments with passengers such as this were used as evidence in the training material. Relationships between individual evidence used and subjective perceived evaluation on (a), (b), and (c) are described in the table.

Incidentally, using the data from a survey about release of information on predicted service resumption that showed approximately 30% of station employees of A company was discussed as an evidence to promote (a). Showing these data was expected to facilitate understanding of the significance of the recommended action by clarifying the discrepancy between the passenger needs for information and services provided by railway businesses. On the other hand, this information would emphasize the negative aspect of the organization. Use of these data was discussed with A company, and it was determined to be discussed again after a certain degree of effect was demonstrated.

### 5.2.3 Facilitators and Instructions for Facilitators

Training for station employees and train conductors was conducted for approximately 15 trainees on multiple days, and thus, multiple facilitators were needed. To ensure that there was no significant difference in instructional method and guidance ability, teaching guidelines (one A4-sized page) for facilitators was developed. The education manager of each location provided instructions for facilitators based on the teaching guidelines.

### 5.3. Training Implementation

Training using the slide materials was implemented for railway employees whose responsibilities included airing announcements for passengers in four locations of B branch of A railway company between July and October in 2009. In this railway company, it had been instructed to announce information on predicted service resumption with the recommended action.

Eleven facilitators conducted the training. Two out of the four locations were within 50 km from the urban area (near–suburbs), and the remaining two locations were located between 50 and 70 km from the urban area (suburbs). It was considered that the recommended action was more difficult to take in near–suburbs than in suburbs, and thus, two areas were included. Results from the two areas were compared to consider generalizability of the results. There are more services in near–suburbs compared to suburbs, with a higher proportion of commuter passengers, and as a result, punctual services were highly desired by the passengers. Therefore, number of complaints from passengers tends to be generally larger, even after considering the difference in parameter, requiring greater efforts in addressing disruption. Thus, it was anticipated that in near–suburbs than in suburbs, fewer employees took the recommended action, and the training showed less effect.

### 5.4. Survey Research

#### 5.4.1 Methods

Survey was conducted with training participants 1 month prior to the training (pretest),

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**Table 1. Summaries of the slide contents.**

<table>
<thead>
<tr>
<th>Slide No.</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Title</td>
</tr>
<tr>
<td>2</td>
<td>Strong demands of providing information on when the train was expected to restart (a)</td>
</tr>
<tr>
<td>3</td>
<td>Alternative source other than announcements (a)</td>
</tr>
<tr>
<td>4</td>
<td>Greater tendency to trust information delivered in public announcements (a)</td>
</tr>
<tr>
<td>5</td>
<td>Announcements timing (a)</td>
</tr>
<tr>
<td>6</td>
<td>Methods of survey and experiments</td>
</tr>
<tr>
<td>7</td>
<td>Passengers’ expectation time to restart (c)</td>
</tr>
<tr>
<td>8</td>
<td>Passengers acceptability of uncertain information (c)</td>
</tr>
<tr>
<td>9</td>
<td>The relationship between passengers’ behavior and information (a)</td>
</tr>
<tr>
<td>10</td>
<td>The relationship between passengers uneasiness and information (a)</td>
</tr>
<tr>
<td>11</td>
<td>Usefulness of the recommended action (a)</td>
</tr>
<tr>
<td>12</td>
<td>Expressions which can help reduce passenger anxiety or confusion (b)</td>
</tr>
<tr>
<td>13</td>
<td>Summary (a)(b) (c)</td>
</tr>
</tbody>
</table>

The letters in lower case in brackets correspond to the three examples of evidence-based explanation in the flow diagram in Fig. 1.
immediately after the training (posttest), and 2 months after the training (follow-up test) to understand the effects of the training material. A questionnaire with approximately 20 items was administered each time. In this report, the following are analyzed: Item 1 (methods to announce information on predicted service resumption), which was asked in pretest and follow-up test, and Item 2 (behavioral willingness), 3 (Difficulty in understanding), 4 (interest), and 5 (needs for evidence on information accuracy), all of which were asked in posttest. Details of each item and response methods were as follows.

Item 1: Announcement Behavior Participants were asked to self-evaluate methods to announce the information on predicted service resumption in the past 1 month by choosing one that best described out of six (1) Generally did not announce; 2) Announced when it was nearly certain; 3) Refrained from announcing when there had been multiple changes; 4) Announced later times than in the information from the operation headquarters; 5) Announced the information from the operation headquarters verbatim; and 6) other) Response 5 was the announcement behavior that was closest to the recommended action.

Items 2 to 5 asked the degree at which the item content applied with the identical six response choices from “1) Does not apply at all” to “6) Applies very much.” Content of each item was as follows.

Item 2: Behavioral Willingness
The training increased my willingness to announce information with the method from Response 5 (Recommended Action).

Item 3: Difficulty in Understanding
Data and numbers presented in the training material were difficult to understand.

Item 4: Interest in Training
I was interested in the training using the material.

Item 5: Needs to Announce Information on Accuracy
I was interested in learning about accuracy of information on predicted service resumption from the operation headquarters.

5.4.2 Results and Discussion
Responses from 590 participants (near-suburbs: 387; suburbs: 203) in all three surveys were analyzed.

(1) Announcement Behavior (Item 1)
Figure 3 displays the percentage of respondents choosing Response 5 (Recommended Action) for Item 1 in pretest and follow-up test by area. For pretest and follow-up test, \( \chi^2 \) test was performed on data for each area, resulting in no significant difference. Next, difference between frequencies between pretest and follow-up test by area was calculated, yielding 6.0 for near-suburbs and 10.1 for suburbs. McNemar test showed that these were both significant (\( p<.01 \)), indicating that training with slide materials is effective in evoking recommended action regardless of areas.

(2) Behavioral Willingness, Difficulty to Understand, Interest in Training, Needs to Announce Accuracy of Information (Items 2 to 5)
Regarding the four items that were asked in follow-up test, percentage of respondents who chose “Applies somewhat,” “Applies,” or “Applies very much” were calculated by area, and \( \chi^2 \) test was conducted for each area. Results are displayed in Table 2. No significant difference was found between areas for all four items, indicating that regardless of areas, the training material increased willingness to announce, explanation method needed to be improved, it was

<table>
<thead>
<tr>
<th>Item</th>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Near-suburbs</td>
</tr>
<tr>
<td>Behavioral willingness</td>
<td>58.7</td>
</tr>
<tr>
<td>Difficulty in understanding</td>
<td>22.9</td>
</tr>
<tr>
<td>Interest in training</td>
<td>55.3</td>
</tr>
<tr>
<td>Needs to announce information on accuracy</td>
<td>77.0</td>
</tr>
</tbody>
</table>

Table 2. Regarding the four items (Behavioral willingness, Difficulty to understand, Interest in training, Needs to announce accuracy of information), percentage of respondents who chose “Applies somewhat,” “Applies,” “Applies very much”
likely that training using materials were accepted with high interest, and that needs for evidence on accuracy of information were high.

5.5. Interview with Facilitators
5.5.1 Methods
Interview with Facilitators reviews about response of the participants and reactions to the training material were conducted with two managers who conducted the training explaining the material in two locations in the near–suburbs area.

5.5.2 Results
Interviews with the two demonstrated that response of the employees who participated in the training was generally favorable to the training and material, they were highly interested in evidence–based explanation which was not part of conventional training, and that they expressed greater levels of conviction about instructions. Summaries of reactions to and opinions about the material identified three primary areas needing improvement: (1) reduce variability in facilitation of facilitators; (2) improve ease of understanding and increase liveliness; and (3) add evidence on information accuracy. There was no evidence in the material that was judged to be unnecessary.

5.6. Study 1 General Discussion
Based on the survey and interview studies, it was concluded that training that included evidence–based explanation to promote cognitive evaluation of three types of (a), (b), and (c) as displayed in Figure 1 was very likely broadly accepted by railway employees regardless of areas, and that that was expected to produce some level of effect in evoking behavior. Additionally, it was concluded that to improve the effectiveness of the material further, it was needed to add some evidence to promote perceived probability of negative effect of recommended action (c), improve ease of understanding on explanation of evidence, and reduce the variability in abilities in facilitation among facilitators.

Because effectiveness of the trial version of the material was demonstrated, an approval to use evidence on announcement by railway employees, which was expected to promote cognitive evaluation of (a): understanding effectiveness and significance of the recommended action was obtained from A company.

The model (Figure 1) shows methods to clarify and modify perception about cost–benefit analysis on outcomes of the recommended action. Cognitive evaluation of (a) is expected to modify overly low evaluation of benefit of the outcomes of the recommended action, while (b) and (c) are expected to modify overly high evaluation of cost of the outcomes of the recommended action. By adding the evidence that relates to (a) and (c) to the training material to be developed next, it was anticipated that cognition regarding cost–benefit analysis of outcomes of the recommended action was modified to be more precise, promoting affirmative attitude to the recommended action.

6. STUDY 2: DEVELOPMENT OF MATERIAL AND EVALUATION

6.1. Purpose
Study 2 was designed to develop training material addressing areas for improvement, implement it in actual training settings, and test its effectiveness. Similarly to Study 1, survey was conducted before and after the training to examine the effect of the material. Validity of the proposed model (Figure 1) about the process of training material evoking the recommended action was examined.

6.2. Development and Characteristics of Training Material
Addressing the areas for improvement resulting from Study 1, a training material entitled “Toward Improved Emergency Aired Announcement Better Responding to Passengers’ Psychological Needs” was developed. Material was converted from slides to DVD in format to be able to reflect the improvement more properly. Playback time was 34 minutes. Illustrations and recordings used in the material were provided by external contractors. Improvements were made in the following manner.

6.2.1. Additional Evidence
To the DVD material, two pieces of evidence were added to enhance the cognitive evaluation of (a) understanding the effectiveness and significance of the recommended action, and (c) lowering perceived probability of negative effects of the recommended action from the model (Figure 1). One added piece of evidence to enhance the above (c) was data summarizing the discrepancy between the predicted time of service resumption released by the operation headquarters and actual time of service resumption in the past 1 year, showing the accuracy of information. The intention of adding this information was to
highlight the accuracy of the information that they (railway employees who viewed the material) release, and more specifically, that the information was of higher accuracy than they might have thought. The other piece of added information concerned data from a survey conducted with station employees of a Company about announcement of information on predicted service resumption to enhance the above (a). As stated in 5.2.2, by clarifying of the discrepancy between passenger needs for information and services provided by railway company employees, it was intended to promote understanding of the significance of the recommended action.

6.2.2. Improved Evidence-Based Explanation

The following procedures were applied to increase the effect of the training material utilizing evidence-based explanation.

(1) Explanation Valuing Experience, Uneasiness, and Questions of Trainees

In the trial version of training material in Study 1, facilitators unilaterally explained evidence to the trainee. Unilateral persuasion tends to generate psychological reactance effects, which is a form of psychological resistance (Brehm, 1966). In narrative-based medicine (NBM; Saito and Kishimoto, 2003) as well, it is said to be necessary to, while valuing medical and scientific evidence, empathically listen to narratives of patients as their experience of illness to tie them to diagnosis and treatment. Hence, the training material in DVD took the form of conversations of three characters: researcher who explains evidence and two station employees who are explained to (junior and senior). The style of bilateral communication in which uneasiness, questions, and experiences that are shared among many trainees are addressed by the station employees in the material (Figure 4(a)), to which the researcher expressed understanding while providing evidence-based explanation was expected to constrain the psychological reactance effects (Figure 4(b)). Furthermore, by including a researcher in the material who explained the evidence, facilitators needed for the trial version of the material in Study 1 were no longer needed, thereby eliminating possible differences in abilities in explanation and presentation.

(2) Ideas to Increase Ease of Understanding

According to Kaiho (2010), principles to increase ease of understanding include activation of knowledge, optimal distribution of intellectual attention resources, and application of settings. Thus, to activate trainees’ knowledge, material was structured in four chapters based on the contents. Title and primary content of each chapter are summarized in Table 3. By providing an advance organizer (Ausubel, 1960) with chapter titles and a table of contents at the beginning of the material, information can be easily tied with the existing knowledge structure of the trainees, and it was expected to easily become meaningful.

For the trainees to be able to distribute their attention resource optimally, it was important to make expressions of the material lively. To this end, quizzes and summaries were inserted and settings were switched to reduce monotony. They were also expected to facilitate knowledge organization and memory retention.

Moreover, meta explanation about background and aims of developing and applying the training material, in addition to material content, was expected to boost the ease of understanding.
Therefore, aims of material development and application were appended at the end of the material.

6.2.3. Selection of Medium

Slides using Microsoft PowerPoint and DVD were discussed as media of training because of their compatibility with these ideas and applicability in the locations where implementation of the training material was being considered. Since a training material of a higher quality was desired from the practical viewpoint, the format of DVD was selected because it would allow greater degrees of freedom and operability regarding use of movies and sounds.

6.3. Material Application in Education and Training

A total of 325 employees whose responsibilities include announcement airing at 11 stations (near–suburbs area) of five branches of A Railway Company participated in the training with the DVD material. The employees who received training are labeled participants.

Training was provided in each station. Effort was made so that selection of stations was not biased in relation to station size. The reason that only stations in near–suburbs area were included was that promotion of the recommended action was considered to be a more urgent issue in these stations as they were utilized by greater numbers of passengers compared to stations in suburbs, and as passenger demand for punctual services was greater.

6.4. Method

Similarly to Study 1, survey was conducted three times before and after the training utilizing the material. Pretest was conducted 1 month prior to the training, posttest immediately after the training and follow–up test 2 months after the training. A questionnaire with approximately 20 items was administered each time. The same questionnaire was used for pretest and follow–up test.

(1) Item Contents and Response Methods

Following seven items were analyzed: (1) announcement method; (2) announcement willingness; (3) ease of understanding of the explanation; (4) interest in material; (5) attitude; (6) subjective norm; and (7) behavior intention. Data for Items 2 to 4 were collected from posttest, while responses to other items were collected from pretest and follow–up test.

Participants were asked to respond to Items 2 to 7 using a 6–point scale (1: Does not apply at all to 6: Applies very much). Items 1, 2, and 4 addressed the same contents and response methods as in Study 1. Items 3 to 7 addressed the following contents:

Item 3: Ease of Understanding on the Explanation

Explanations on data and numbers presented in the material were easy to understand

Item 5: Attitude

Airing announcement with the instructed method (the recommended action) is desirable

Item 6: Norm Awareness

The instructed method (the recommended action) must be followed in airing announcement

Item 7: Behavioral Intention

I intend to air announcement with the instructed method (the recommended action)

(2) Control Group

Survey was conducted with 129 employees from six stations who did not participate in the training twice approximately coinciding with pretest and follow–up test using the same questionnaire. This was intended to help describe the effects of the training material in more detail, considering the possibility that the recommended action was evoked by a factor external to the training.
material. The group that did not participate in the training is called the control group.

6.5 Results and Discussion

Out of 331 respondents who responded to all the three surveys, 290 respondents (168 participant group; 122 control group) who endorsed having had opportunities to announce information on predicted service resumption at 1 month after the training were included in the analysis. Only a part of respondents were included because if there had been no opportunity to announce information on predicted service resumption after training, it was not possible to ask questions about announcement behavior.

(1) Change in Behavioral Intention to Take Recommended Action

Figure 5 displays mean responses to Item 7 for the two groups in pretest, posttest, and follow-up test (for control group, pretest and follow-up test only because posttest was not conducted). Incidentally, responses of those who chose "6: other" for Item 1 were excluded from the analysis (same in analysis of (4)). Responses were converted to scores 1 to 6 in the order of response choices.

First, two-way analysis of variance (ANOVA; mixed design) was conducted on means from pretest and posttest responses. Results showed a significant main effect of training participation ($F(1, 262) = 19.54, p<.05$) and an interaction effect of training participation and survey time point ($F(1, 262) = 3.31, p<.05$). There was no significance difference between pretest and follow-up test means in the control group, but in the participant group, mean from the follow-up test was significantly higher compared to pretest ($t(158) = 4.98, p<.05$).

Results of one-way repeated-measures ANOVA on means from pretest, posttest, and follow-up test in the participant group demonstrated a significant main effect ($F(1,262) = 19.55, p<.05$). Multiple comparisons (Bonferroni method) revealed significant differences between pretest and posttest as well as pretest and follow-up test ($p<.05$ each). Based on these results, it can be concluded that behavioral willingness toward the recommended action is heightened by the DVD, and that the effect that is demonstrated at immediately following the training carries over until 1 month after the training as well.

(2) Change in Announcement Behavior

Frequency of Response 5 (Recommended Action) to Item 1 in pretest and follow-up test in participant and control groups were computed. Figure 6 summarizes the results. Results of $\chi^2$ tests showed that frequencies at pretest were not significantly different between the groups. However, at follow-up test, participant group demonstrated a significantly higher frequency than the control group ($\chi^2(1) = 5.20, p<.05$), supporting the effect of participating in the training.

Differences in frequencies between pretest and follow-up test in absolute value were 0.0 for the control group and 11.3 for the participation group. Results of $\chi^2$ tests revealed a significant difference only in the participant group ($\chi^2(1) = 28.18, p<.05$).

Compared to pretest for the trial version of the training material from Study 1, frequencies at pretest were higher in both groups. It may be attributed to the effect of the notice to promote
announcing information on predicted service resumption that was circulated throughout the company after the training using the trial version.

(3) Announcement Willingness, Ease of Understanding, and Interest in Material

Responses to three items from the posttest (announcement willingness, ease of understanding, and interest in material) were analyzed.

Combining "applies somewhat," "applies," and "applies very much," 92% endorsed increased willingness to take the recommended action because of the training, considerably higher than the result with the trial version in Study 1 (58.7%). These are indicative of higher effect of the DVD material compared to the trial version in increasing announcement willingness.

Combining "applies somewhat," "applies," and "applies very much," 89% found explanations on data presented in the training material easy to understand. Because difficulty to understand was asked about the explanation in the trial version, requiring caution in comparing results, but compared to 22.9% finding the trial version difficult to understand, it is likely that the DVD version was improved in terms of ease of understanding.

Similarly, 96% were interested in the material, higher than 55.3% (near-suburbs) about the same item on the trial version. Nevertheless, the DVD version showed movies produced with professional illustrators and voice actors, making the version of higher quality when compared to the trial version. It is possible that these factors contributed to ease of understanding, evaluation on interest in material, and effect in evoking behavior. Therefore, it is necessary to understand the volume of its effect in the future. However, if applied, because the same level of quality is obtained as the DVD version that was developed, the effect of the developed material can be considered to meet the usable level of quality.

(4) Examination on Effect Process of Material

To examine whether the recommended action was promoted in reality by the DVD version of the training material through the process depicted in Figure 1, a structural equation mode (SEM) was performed after absolute values of the difference scores from pretest and follow-up test about Items 1, and 5–7. AMOS 18.0 was used for analysis with maximum likelihood estimation method for parameter estimation. Data from 273 respondents (162 from participant group; 111 from control group) that did not include any missing data were rendered for analysis. The variable of "education and training using material" was considered to be a binary variable between "participated in training" or "not." Item 1 was scored by assigning points between 1 and 5 to the five response choices in the order except for "6: other." For Items 5 to 7, 1 point was assigned to "1: does not apply at all" and 6 points to "6: apply very much" on the 6-point scale (χ²(10) = 363.41, p<.01, CFI = .99, AGFI = .97, RMSEA = 0.04). Lagrange Multiple Test (LM test) was conducted about the initial model, and after eliminating nonsignificant path and the path from training using material to subjective norm, a model with high goodness-of-fit to data (χ²(10) = 363.41, p<.01, CFI = .99, AGFI = .97, RMSEA = 0.04). Figure 7 displays the final model along with standardized path coefficients. Incidentally, all the path coefficients in the model were found to be statistically significant at the level of 1%. Furthermore, proportion of variance explained for behavioral intention was .56, which is relatively high, and proportions of variance explained by variables determining behavioral intention were relatively high. Table 4 represents descriptive
Table 4. Descriptive statistics of variables in the final model

<table>
<thead>
<tr>
<th></th>
<th>Attitude</th>
<th>Subjective norms</th>
<th>Behavioral intention</th>
<th>Recommended action</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SE</td>
<td>M</td>
<td>SE</td>
</tr>
<tr>
<td>Control (N=111)</td>
<td>.14</td>
<td>1.34</td>
<td>.07</td>
<td>1.04</td>
</tr>
<tr>
<td>Participant (N=162)</td>
<td>.62</td>
<td>1.28</td>
<td>.32</td>
<td>1.00</td>
</tr>
</tbody>
</table>

statistics of variables in the model. The following were concluded from Table 4 and Figure 7.

DVD version of the material was found to be of direct effect in promoting attitude, as hypothesized in the initial model. However, direct effect was not observed regarding subjective norm, and it can be considered that only indirect effect of .10 (=.18 multiplied by .55) by way of attitude is in effect. Although the initial model hypothesized that linguistic message of the material directly promoted subjective norm, results did not support this hypothesis.

The effect of viewing and listening to the material on promoting positive attitude to the recommended action was found to be relatively small as indicated by path coefficient of .18 (unstandardized coefficient was .48). It is possible that the value is smaller because the coefficient is associated the path from a binary variable to a quantitative variable. An effect size (standardized mean difference between two group in this case), which is an index that does not depend on measurement unit (Haebara, 2002), was found to be .48. According to the criteria for effect sizes by Cohen (1988), this amounts to be a medium level of effect. Since criteria for effect sizes vary depending on areas of research, their interpretation requires caution, but generally, training using the DVD version of the material can be considered effective in promoting affirmative attitude to the recommended action among railway employees.

Additionally, it was found that training using the DVD version was effective in evoking the recommended action as a result of promoting affirmative attitude to the recommended action and thereby promoting behavioral intention and subjective norm.

Overall, it can be concluded that although the initial model (Figure 1) must be modified by eliminating the path from training to subjective norm, evidence selection and evidence communication methods that were proposed in the present study were valid and contribute to promotion of the recommended action.

However, in the SEM that was conducted in the study, the cognitive evaluation of (a), (b), and (c) (Figure 1) were not treated as measured variables, and thus, relationship among the three cognitive evaluations, which are considered to affect cost–benefit analysis of outcomes of the recommended action, and levels of effect of each evaluation on attitude to the recommended action were not understood in detail. In the future, additional research is warranted about efficacy and validity of attitude change when the three cognitive evaluations were accounted for, for example, experimental research controlling for the kind of evidence included in the material.

Furthermore, the extent to which factors other than the three cognitive evaluation of (a), (b), and (c) are in effect in the psychological process in which the DVD material improves attitude toward the recommended action must be researched in the future in order for similar materials to be developed.

7. CONCLUSIONS AND FUTURE IMPLICATIONS

The present study pointed out the importance of promoting announcement of information of predicted service resumption by railway employees, in addition to improvement and expansion of hardware, to mitigate uneasiness of passengers who experience schedule disruption of railways. Subsequently, an educational and training material was developed through two steps to promote announcement by improving attitudes in employees that inhibited announcement of predictive information with evidence–based explanation. When its effectiveness was tested through an actual training, the DVD version of the training material developed in the present study was found to be highly regarded by railway employees and promote the recommended action. Furthermore, in the present study, findings about evidence selection and explanation methods were obtained.

1) Evidence Selection Method
In order to improve attitude to the behavior that a training material instructs, it is effective that to select evidence to facilitate three cognitive evaluations: (a) understanding the significance and effectiveness of the instructed behavior; (b) knowing measures to avoid negative effects of the instructed behavior; and (c) lowering perceived probability of the negative effects of the instructed behavior.

2) Communication Method for Evidence–Based Explanation
It became evident that persuasion effect was
heightened when trainees’ experience as well as associated questions and uneasiness were addressed and sympathized while evidence-based explanation is provided. Moreover, to improve ease of understanding of explanations, it was shown to be effective to add chapter structure and table of contents, inserting quizzes and summaries, and adding explanations about aims of training material development.

These findings are expected to be useful in introducing materials utilizing evidence-based explanations to education and training in businesses and organizations in the future. However, some questions remain unanswered by the present study. The following are some of the topics to be examined in future research.

First, relationships among the cognitive evaluation of the three points (a), (b), and (c) (Figure 1), which could be considered to affect cost–benefit analysis of outcomes of the recommended action and degree of its effect on attitude to the recommended action were not understood in detail. In the future, it is warranted to examine the efficacy and validity of including cognitive evaluation of the three by, for example, providing evidence-based explanation regarding (a), (b), and (c) individually to test the effect of each.

Second, the present study did not seek to examine effects of quality of illustration and sound associated with DVD material and effects of movie on effectiveness of training materials. This can be examined, for example, by experimentally creating materials with satisfying number and communication method of evidence and comparing outcomes.

Third point refers to generalizability of the findings of the present study. In the future, it is necessary to examine whether the findings from this study are valid in behaviors other than announcement of information on predicted service resumption.

Fourth point is in regard to the targeted effect of a material. In the present study, the focus was placed on evaluation of employees about the training material and change in announcement behavior. However, the ultimate goal of the training material is reduction of frustration in railway passengers. Hence, by examining the extent at which passenger frustration could be reduced by the material, effectiveness of the material can be understood in more detail.

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