

Factors affecting post-evacuation behaviors following an earthquake: A questionnaire-based survey

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Abstract

In order to elucidate the factors that influence the post-evacuation behaviors of university members following an earthquake, this study administered a questionnaire survey to 109 faculty members, graduate students, and undergraduates at a national university in Japan, and investigated the situations in which they were likely to return to their university building. Through face-to-face interviews, the participants were asked to rate the extent to which they would return to their university building, based on 13 situations. The results indicated that they were more likely to return to their building in several situations, including when the building was not severely damaged, when they did not evacuate with their personal belongings, when individuals with disabilities remained in the building, and after the other evacuees began returning to the building. In contrast, their return was more unlikely when the building was severely damaged (due to fire or an accidental gas leak) or when there was a mandatory no-entry order implemented. In addition, the exploratory factor analysis yielded two factors (i.e., Environmental and Disaster severity), while gender differences influenced the use of restroom facilities on campus. The findings of this study provide useful insights into emergency management and planning for building that store and handle hazardous materials.

Keywords: Earthquake, Post-evacuation behavior, University members, Questionnaire survey, Emergency management, Return decision-making

1. Introduction

Major earthquakes in the circum-Pacific area have posed significant challenges to the residents of Japan. For instance, many university buildings in eastern Japan were severely or partially damaged by the 9.1-magnitude Tohoku earthquake in 2011 [1]. Since universities generally include a large number of students, faculty, and staff, it has become increasingly important to prevent casualties, reduce economic losses, and ensure their safety during natural disasters [2]. To achieve these objectives, many Japanese universities have been offering hands-on emergency training to their university members. For example, Kubo et al. [3] indicated that Kogakuin University conducted earthquake drills using the Earthquake Early Warning System, while Koshihara et al. [4] reported that Yokohama National University held emergency drills, including instruction on the use of hand-held fire extinguishers and fire hoses as well as performing smoke evacuations and first-aid exercises. In the case of a major earthquake, all occupants of university buildings must evacuate via designated escape routes. Thus, all university members should actively participate in emergency drills, including instructions on using firefighting equipment and following the designated evacuation routes.

In Japan, the structural integrity of buildings following an earthquake is visually assessed by certified inspectors, known as “Emergency Risk Discriminators” (ERDs or *Ohkyudo-Hantei-Shi* in Japanese), which is similar to the ATC-20 guideline in the United States [5]. In any situation, occupants should not return to an evacuated building until the ERDs ensure that it is completely safe. Hence, as

1 expected, some individuals may attempt to return to a building that is deemed unsafe, even though an
2 assessment by the ERDs has not yet been made.

3 At universities, even if the structural integrity of a building is ensured, there are certain risks in
4 returning to science and engineering buildings since flammable/toxic gases and liquids, biohazardous,
5 and radioactive materials are stored in such facilities. Moreover, even if chemical storage cabinets and
6 compressed gas cylinders are secured, they may become damaged during an earthquake, thus leading
7 to dangerous situations such as fire, suffocation, and poisoning. Hence, returning to evacuated
8 buildings is considered as unsafe action and risk-taking behavior.

9 Against such a background, gaining fundamental insight into the evacuation behaviors of university
10 members following a major earthquake (i.e., “post-evacuation behavior”) is invaluable for reducing
11 casualties and improving crisis management. Although people’s behavior during an emergency can be
12 irrational and complex [6], many experimental and statistical studies have examined pre-evacuation
13 and evacuation behavior. For instance, Liu and Lo [7] conducted face-to-face interviews with victims
14 of high-rise building fires to determine their pre-evacuation responses (e.g., evacuating immediately,
15 dialing 999, informing other people, etc.), while Sherman et al. [8] conducted a questionnaire survey
16 with World Trade Center survivors and found a negative correlation between perceived risks and pre-
17 evacuation actions (e.g., gathering personal items, changing shoes, shutting down computers, etc.).
18 Meanwhile, Cuesta and Gwynne [9] evaluated the pre-evacuation and travel times for school students

(aged 3 to 15 years), while Najmanová and Ronchi [10] focused on the travel and pre-evacuation times of pre-school children. Finally, Gu et al. [11] reported the evacuation behaviors of students (aged 10 to 15 years) through video-image analysis, while Soria et al. [12] found no indication of the “faster-is-slower” effect. Despite these results, limited studies have examined the post-evacuation behavior of those in buildings that store and handle hazardous materials, let alone those of university members [13].

Therefore, the main objective of the present study is to elucidate the factors that influence university members to return to their building following a mandatory earthquake evacuation. For this purpose, a questionnaire-based survey was administered to 109 members of a national university in Japan. According to the theory of planned behavior (TPB), a behavioral intention is formed in combination with *attitude toward the behavior*, *subjective norm*, and *perceived behavioral control* [14]. In earlier related studies, Gollwitzer conceptualized the implementation intention [15]. The implementation intention framework is the if-then plans—if situation X occurs, then I will perform goal directed response Y [16]. Through face-to-face interviews, the respondents were simply asked to rate the extent to which they would return to their building (i.e., return intention), based on thirteen hypothetical situations. The findings will be important for preventing casualties at universities in the future.

2. Methods

2.1 Participants

Study participants consisted of 109 university members (faculty members, graduate students, and fourth-year undergraduates) in the Department of Chemistry of a national university in Japan. The reason this particular department was chosen was that, since chemical laboratories generally store and handle hazardous materials, they pose greater risks than other university buildings. All 109 participants were occupants of the chemistry building, which is an earthquake-resistant building.

2.2 Procedures and data collection

The questionnaire survey was conducted on December 2, 2016, achieving a high response rate (in this case, 100%). It is important to note that, although a major earthquake may strongly influence certain ratings and values, none occurred in Japan between November and December 2016.

Previous studies of natural disasters (e.g., earthquakes, typhoons, hurricanes, and tsunami) examined the primary reasons that individuals did not evacuate or returned to their respective buildings/homes. For instance, Smith and McCarty [17] found that the main reasons for choosing not to evacuate during a hurricane (i.e., shelter-in-place) were “I thought that I could ride it out,” “I had no place to go,” and “I had no transportation.” Horney and MacDonald [18] pointed out that evacuees’ decision-making was based on the evacuation behaviors of their friends/neighbors, while other reasons typically included “I did not realize the danger” [19, 20], “It was night” [21], and “I went back to the

building to recover my bag” [22].

Based on these findings, the present study constructed a questionnaire-based survey, which included a total of 16 questions (see Table 1). In order to discourage ambiguous responses, the participants were asked to base their responses on a six-point Likert scale [23], ranging from 1 (not at all likely) to 6 (very likely), with the exception of two socio-demographic questions: gender (Q15) and the university membership category (Q16), i.e., undergraduate/graduate/faculty.

At the beginning of the survey, the following was presented, “*You just left your chemistry building with the other occupants following a major earthquake.*” Under what conditions would you want to return to your chemistry building?” Then, they were asked to respond, based on the following 13 situations: In cold weather (Q1); In rainy weather (Q2); When you left the building without your personal belongings (Q3); When you left the building without your laboratory research data (Q4); When people with disabilities remained in the building (Q5); When you want to use the restroom facilities (Q6); When the other evacuees begin returning to the chemistry building (Q7); At night (Q8); When the chemistry building has NOT been severely damaged (Q9); When the chemistry building has been severely damaged (Q10); When the chemistry building is on fire (Q11); When a gas leak has occurred in the chemistry building (Q12); and When the ERDs do not allow you to return to the chemistry building (Q13). Note that, in the questionnaire used in this study, we did not present respondents with detailed situations for each questionnaire item; for instance, rainfall intensity (light

rain/heavy rain, Q2). This is because increasing the situations inevitably results in the increase question numbers, perhaps burdening the respondents.

The next question focused on the level of fear: “How much do you fear that a major earthquake will occur when you are in the chemistry building?” (Q14). An earlier study by Trumbo et al. [24] pointed out that an individual’s perceived risk is a factor that directly affects his/her evacuation behavior, while Slovic [25] reported that fear is a major predictor in risk perception. Finally, the participants were presented with two socio-demographic questions about gender (Q15) and their university membership category (Q16), respectively.

2.3 Data analysis

There was no missing data in this study and the mean values of the participants’ responses were calculated to evaluate the likelihood of returning to the chemistry building in each situation. Before performing the factor analysis, we confirmed that no variables were strongly correlated with other variables ($> .90$) [26]. Although some distributions were skewed, there were no notable ceiling and floor effects, which were defined as $(M + SD) > 6$ and $(M - SD) < 1$ [27], respectively. Here M and SD denote the mean and standard deviation values of the data, respectively. In addition, an explanatory factor analysis (with robust principal axis factoring) was conducted to determine the underlying latent factorial structures of the participants’ post-evacuation behavior. The number of factors was

determined using the Cattell's scree test and Kaiser–Guttman rule (i.e., eigenvalue of >1). In general, the latter rule should be used for sample sizes of >250 [26], even though it can unnecessarily increase the number of factors [28]. However, as noted below, both criteria initially extracted two underlying factors.

The present study also performed a factor analysis using promax (oblique) rotation, which allowed for correlations between the factors, thus providing reasonable and realistic representations of the factors in question. For the explanatory factor analysis, it eliminated one variable (Q5) in order to obtain interpretable and meaningful results. Overall, the items with factor loadings of $> .40$ were retained and Cronbach's alpha was calculated to assess internal consistency. Finally, to test the differences in the rating values between the males and females, *t*-tests were conducted for each situation. All of the statistical analyses were run on SPSS software (Ver. 21), with a significance level (α) of $\alpha = .05$.

3. Results and discussion

3.1 Participants' characteristics

As shown in Table 2, the majority of the 109 respondents were males ($n = 76, 69.7\%$), while 30.3% were females ($n = 33$). In addition, approximately one-third ($n = 33, 30.3\%$) consisted of fourth-year undergraduates in chemistry, two-thirds were graduate students in chemistry and related programs (n

= 66, 60.6%), 4% were doctoral students in chemistry ($n = 4$), and 5.5% were faculty members in chemistry ($n = 6$).

3.2 Scores and relationships among the variables

[Table 3](#) presents the mean values and standard deviations for the variables. As shown in [Section 2.2](#), these rated scores ranged from 1 to 6, and those who provided the larger values chose to return to the building. In cold weather (Q1), the mean value was $M = 2.00$ ($SD = 1.13$). Among the 109 participants, approximately 43% and 32% rated the likelihood of returning as “1” and “2,” respectively, while the mean value in rainy weather (Q2) was $M = 2.34$ ($SD = 1.33$). These results clearly demonstrate that the majority of the participants would not choose to return to the chemistry building under these conditions.

When asked about evacuating without their personal belongings (Q3), the mean value was more than three ($M = 3.39$, $SD = 1.43$). Interestingly, approximately 20% of the participants provided a rating of 5 or higher, with 40.4% giving a rating of 4. In developed countries, the penetration rate of mobile phones is extremely high. In particular, as reported by Ishii [\[29\]](#) and Ko et al. [\[30\]](#), the Japanese use mobile phones on a daily basis and young people mainly use smartphones for communicating with friends/family and searching for information. Since mobile phones are one of the “must-have” items for the majority of students, they will, without a doubt, return to the chemistry building to retrieve

1 such devices.

2 In situations where people with disabilities remained in the building (Q5), the rated value was M
3 $= 3.25$, which is a reasonable result. As reported by Kobes et al. [31], some people will return to help
4 non-ambulatory people or family members, even if the building is damaged. In situations where the
5 other evacuees begin returning to the chemistry building (Q7), the rated value was also more than
6 three ($M = 3.27$). It has been shown that the evacuation behavior of neighbors has a strong impact on
7 one's evacuation decisions. For instance, Stein et al. [32] conducted a questionnaire survey of 651
8 people in eight counties in the United States and found that they are more likely to evacuate with most
9 of their neighbors.

10 Ratings for return when the chemistry building was not severely damaged (Q9) revealed that a
11 mean value was $M = 3.12$ ($SD = 1.48$), with 44% of the participants providing a rating of 4 or higher
12 (4: 22%, 5: 19%, 6: 3%). Hence, as expected, such individuals would attempt to return to the building,
13 even when an assessment by the ERDs had not yet been made. Interestingly, an unexpected finding
14 was that, despite no free-standing roadside public toilets on the university campus, the mean value did
15 not exceed 3 (Q6, $M = 2.23$, $SD = 1.34$) in situations where the individuals wanted to use the restroom
16 facilities.

17 In situations Q10 to Q13, the mean values of Q10 (the building is severely damaged), Q11 (the
18 building is on fire), Q12 (accidental gas leak), and Q13 (no-entry order) were determined to be $M =$

1 1.47, $M = 1.17$, $M = 1.16$, and $M = 1.35$, respectively. This clearly indicates that the majority of the
2 participants had a negative opinion of such severe situations. More specifically, the majority of the
3 responses were “1” (Not at all likely) (Q10: 66.1%; Q11: 89.0%; Q12: 89.9%; Q13: 75.2%).

4 [Table 4](#) presents the zero-order correlations among the variables. Due to space limitations, the
5 results of the relationship among Q14 (fear) and Q16 (university membership category) are briefly
6 addressed as follows. University membership category (Q16) positively and significantly correlated
7 with Q13 (no-entry order, $r = .35$, $p < .001$). This means that the undergraduates were more unlikely
8 to return to the chemistry building in situations where the ERDs did not allow them to reenter the
9 building; conversely, even if a no-entry order was implemented, the faculty members generally
10 reentered the building. This may be attributed to the self-judgment of the faculty members; additional
11 research is required to determine the factors that influence their behavior. Meanwhile, Q14 (fear) had
12 no significant correlation with any of the other items. From an academic researcher’s perspective, the
13 research data is significant and hence, it is expected that the university membership category (Q16)
14 positively correlates with Q4 (evacuate without research data). However, although a positive
15 correlation was found between Q16 and Q4, it was not significant ($r = .12$, $p = .20 > .05$).

16 Risk perception in natural disaster is generally a key predictor of disaster evacuation behavior [\[33\]](#).
17 For instance, Whitehead [\[34\]](#) conducted a telephone survey with individuals affected by Hurricane
18 Bonnie and found that those who perceived higher risks were more prone to evacuate. Likewise, Vitek

and Berta [35] found that individuals with higher perceived risk levels exhibited higher evacuation rates. However, as described above, the correlation matrix revealed that Q14 (fear) had no significant correlation with any of the other items. Thus, the fear item was not employed in the factor analysis.

3.3 Factor analysis

In general, Cattell's scree test can be used to determine the factor number from the inflection point in the scree plot, where the eigenvalues are plotted against the corresponding number of factors. Based on both the scree test depicted in Fig. 1 and the Kaiser–Guttman rule, the preliminary factor analysis clearly extracted two underlying factors, thus explaining 47.0% of the total variance.

Table 5 presents the factor loadings of the final scores. No items with factor loadings of more than 0.40 were found among the two factors. In general, if the Kaiser–Meyer–Olkin (KMO) value, which varied from 0 to 1, is $\geq .70$ and the p -value for Bartlett's test for homogeneity of variances is $< .05$, then the analysis is considered to be suitable [36]. In the present study, the KMO measure of sampling adequacy provided a KMO value of .77 and Bartlett's test of sphericity was $\chi^2 [66, 109] = 556.8, p < .001$, suggesting good suitability. The subsequent explanatory factor analysis revealed that latent Factor 1 consisted of 8 items, while Factor 2 contained 4 items, indicating that each factor retained three or more items with factor loadings of $> .40$. As seen the table, the data given in the factor analysis provided simple structure and suitable interpretability.

Factor 1 included Q1 (in cold weather), Q2 (in rainy weather), Q3 (evacuate without personal belongings), Q4 (evacuate without research data), Q6 (need for restroom facilities), Q7 (the other evacuees began returning to the building), Q8 (at night), and Q9 (building is not severely damaged). Since the extracted Factor 1 related to weather conditions and personal situations, it was designated as the “*Environmental*” factor ($M = 2.59$, $SD = 0.89$). Moreover, Cronbach’s alpha measures internal consistency, which varies from 0 to 1. In general, values of $<.60$ are considered as unsatisfactory, whereas values of $>.70$ are regarded as satisfactory [37]. In the present study, Cronbach’s alpha for Factor 1 was .83, clearly indicating high reliability. Factor 2 encompassed Q12 (accidental gas leak), Q11 (building is on fire), Q10 (building is severely damaged), and Q13 (delayed assessment by the ERDs). This factor was designated as the “*Disaster severity*” factor ($M = 1.28$, $SD = 0.52$). For Factor 2, Cronbach’s alpha was .80, implying good reliability. Overall, the observed correlation between the *Environmental* and *Disaster severity* subscales was positive and low ($r = .36$) even though statistical significance was found ($p < .001$).

3.4 Gender differences

In this section, the gender differences in participants’ post-evacuation behavior are statistically examined. As previously reported by Parsizadeh et al. [38], females generally have a higher perceived risk than males, and gender is a key factor in human behavior during earthquakes. Goltz and Bourque

[39] demonstrated that females tend to take cover during earthquakes, while Prati et al. [22], who studied human behavior during the 2012 Northern Italy earthquakes, highlighted the inappropriate behavior of males during earthquakes. However, the present study revealed no significant difference between the male and female participants, except for Q6 (need for restroom facilities; approaching significance ($p = .07$), see Table 6). This may be because females generally hesitate to relieve themselves in public or in secluded woods/bushes [40]. This result strongly suggests that portable toilets should be installed to prevent the females from returning to the chemistry building in the events of a disaster.

4. Limitations and suggestions

This study includes several limitations, the first of which is related to the participants. More specifically, although the sample size was moderate ($n = 109$), all of the participants were limited to faculty members, graduate students, and fourth-year undergraduates at a national university in Japan. As reported by Koshiba et al. [41], knowledge of the flash points of commonly-used organic solvents (e.g., ethanol, acetone, and diethyl ether) is significantly lower in first-year chemistry undergraduates than in chemistry graduates. In other words, first-year undergraduates have less knowledge of regard to material hazards than graduates. In addition, the sample sizes of doctoral student and faculty groups were small, which may not provide sufficient statistical power. Thus, since their ratings and values

may vary, further research is necessary to confirm that the results of this study can be generalized to other students and other countries.

Secondly, other psychological models were not fully considered during this survey, such as Protection Motivation Theory (PMT) on adaptive and maladaptive behavioral intentions [42] and the Protective Action Decision Model (PADM) [43]. In addition, this questionnaire survey did not ask about knowledge of emergency procedures and past earthquake experience. In general, past direct disaster experience is an important predictor of evacuation behavior. For example, Gozu et al. [44] found that there are significant differences in the evacuation behavior of people with and without recent natural disaster experience. As noted above, it should be acknowledged that this survey was not administered to victims of a recent major earthquake; however, needless to say, the majority of Japanese people have experienced at least one major earthquake during their lifetime.

Third, as shown in Table 1, study participants were not asked to indicate their reentering fear but asked to rate the general fear of earthquake. Finally, this study assumed that each situation was independent from others for the sake of simplicity. However, in practice, some situations may be dependent upon other situations. For instance, if Q10 (building is severely damaged) and Q11 (building is on fire) occur simultaneously, then the university members would be less likely to return to the chemistry building. In contrast, in some combined situations (e.g., Q1 (in cold weather), Q2 (in rainy weather), Q4 (evacuating without research data), and Q7 (the other evacuees began returning to

the building)), university members would be more likely to reenter the building. Hence, future research is required to investigate their behavior in combined situations. Hence, further work is needed to generalize evacuation behavior determined by return decisions and intentions in the case of a major earthquake.

As presented in [Table 3](#), this survey revealed that, if the chemistry building is not severely damaged and the assessment by the ERDs is delayed, then the university members may attempt to return to the building with other people. Therefore, it is of utmost importance to post the optimum number of ERDs at a university in order to assess the structural integrity of buildings as soon as possible. More importantly, returning to the university buildings should be absolutely restricted by the university authorities until the safety of university members is ensured. Finally, [Table 6](#) implies that females are more likely to return to the building than males when they need to use the restroom facilities (Q6). Such result is clearly consistent with the finding of Zakaria et al. [[45](#)] that more females tend to visit toilets than males in a post-emergency situation. The findings presented in this study strongly suggest that portable toilets should be installed immediately following a major earthquake on a university campus.

To our knowledge, few studies have been hitherto available on such return decisions immediately after a major earthquake in the related literature; therefore, the major originality of the present study is to focus on the post-evacuation behavior following a large earthquake. Hence, despite the limitations

discussed above, the present study provides new insights into the decisions and intentions to return to an unsafe building immediately after a major earthquake, which will contribute to the development of an effective emergency management plan for industrial facilities, public buildings, as well as university buildings that store and handle hazardous materials.

5. Conclusions

The focus of this study was to elucidate the factors that influence university members' post-evacuation behavior following a major earthquake. To achieve these objectives, a questionnaire survey was administered to members of the Department of Chemistry at a national university in Japan, after which the following results were obtained:

1. When university members do not evacuate with their personal belongings (Q3), when people with disabilities remain in the chemistry building (Q5), when the other evacuees begin returning to the chemistry building (Q7), and when the chemistry building is not severely damaged (Q9), the mean ratings were >3 , clearly indicating that they are likely to return to the building. In contrast, the mean values of Q10 (building is severely damaged), Q11 (building is on fire), Q12 (accidental gas leak), and Q13 (no-entry order) were $M < 1.5$, implying that they are unlikely to return to the building in such situations.

2. The factor analysis provided two underlying factors: *environmental* and *disaster severity*.

3. The gender differences in participants' post-evacuation behavior were only observed in situation Q6 (need for restroom facilities). More specifically, the females were more likely to return to the chemistry building than males in order to use such facilities. This finding suggests that portable toilets should be installed immediately following an earthquake in order to prevent women from returning to the building.

The results of reentering/return decisions immediately after a major earthquake would be applied to establish effective emergency management plans for buildings that handle and store hazardous materials, probably helping to reduce casualties during and after to such a disaster.

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Conflict of interest

The authors declare that there are no conflicts of interest.

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Table captions

Table 1

Question items and endpoints.

1	Table 2
2	Demographic data of the participants ($n = 109$).
3	
4	Table 3
5	Mean and standard deviation scores.
6	
7	Table 4
8	Zero-order correlation matrix ($n = 109$).
9	
10	Table 5
11	Final two-factor solution with 12 items after promax rotation ($n = 109$).
12	
13	Table 6
14	Gender differences among the participant's post-evacuation behaviors.
15	
16	
17	Figure caption
18	Figure 1
19	Scree plot of the eigenvalues ($n = 109$).

Table 1

Item	Key terms
Under what conditions would you want to return to your chemistry building?	
Q1 In cold weather	1: Not at all likely; 6: Very likely
Q2 In rainy weather	1: Not at all likely; 6: Very likely
Q3 When you left the building without your personal belongings	1: Not at all likely; 6: Very likely
Q4 When you left the building without your laboratory research data	1: Not at all likely; 6: Very likely
Q5 When people with disabilities remained in the building	1: Not at all likely; 6: Very likely
Q6 When you want to use the restroom facilities	1: Not at all likely; 6: Very likely
Q7 When the other evacuees begin returning to the chemistry building	1: Not at all likely; 6: Very likely
Q8 At night	1: Not at all likely; 6: Very likely
Q9 When the chemistry building has NOT been severely damaged	1: Not at all likely; 6: Very likely
Q10 When the chemistry building has been severely damaged	1: Not at all likely; 6: Very likely
Q11 When the chemistry building is on fire	1: Not at all likely; 6: Very likely
Q12 When a gas leak has occurred in the chemistry building	1: Not at all likely; 6: Very likely
Q13 When the ERDS do not allow you to return to the chemistry building	1: Not at all likely; 6: Very likely
Risk perception	
Q14 Fear	1: Not at all, 6: Very
Demographic questions	
Q15 Gender	Male/Female
Q16 University membership category	Undergraduate/Graduate/Faculty

Table 2

Item	<i>n</i>	%
Gender		
Male	76	69.7
Female	33	30.3
Member category		
Fourth-year undergraduate	33	30.3
Master's student	66	60.6
Doctoral student	4	3.7
Faculty	6	5.5

Table 3

Item	M	SD
Q1	2.00	1.13
Q2	2.34	1.33
Q3	3.39	1.43
Q4	2.31	1.41
Q5	3.25	1.14
Q6	2.23	1.34
Q7	3.27	1.37
Q8	2.06	1.11
Q9	3.12	1.48
Q10	1.47	0.79
Q11	1.17	0.55
Q12	1.16	0.53
Q13	1.35	0.70
Q14	4.31	0.97

Table 4

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14
Q1														
Q2	.75***													
Q3	.51***	.52***												
Q4	.36***	.41***	.56***											
Q5	.06	.15	.22*	.25**										
Q6	.39***	.34***	.34***	.20*	.15									
Q7	.31**	.32***	.40***	.27**	.30**	.32***								
Q8	.35***	.51***	.30**	.29**	.26**	.38***	.25**							
Q9	.35***	.33***	.38***	.27**	.22*	.33***	.55***	.33***						
Q10	.23*	.23*	.13	.16	.15	.21*	.13	.38***	.27**					
Q11	.15	.29**	.08	.17	.04	.04	.05	.32***	.02	.52***				
Q12	.09	.19	.02	.12	.04	.13	.06	.27**	.11	.49***	.83***			
Q13	.34***	.36***	.20*	.27**	.16	.27**	.16	.46***	.29**	.41***	.47***	.53***		
Q14	.03	.07	.11	.10	.06	−.04	.04	.04	−.06	.02	.18	.10	.04	
Q16	.00	.07	.06	.12	.07	−.02	−.07	.16	.07	.00	.05	.08	.35***	.01

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. See [Table 1](#) for more details.

Table 5

Item	Factor loading	
	Factor 1	Factor 2
	Environmental	Disaster severity
Q3	.75	−.13
Q1	.77	−.00
Q2	.73	.10
Q9	.58	−.17
Q7	.56	−.08
Q4	.53	.03
Q6	.51	.02
Q8	.47	.29
Q12	−.15	.94
Q11	−.12	.92
Q10	.14	.55
Q13	.27	.53
Cronbach's alpha	.83	.80

Note: Factor loadings in bold exceed the threshold of .40.

Extraction method: Principal axis factoring.

Rotation method: Promax rotation.

Correlation between the two latent factors: .34.

Kaiser–Meyer–Olkin measure of sampling adequacy: KMO = .77.

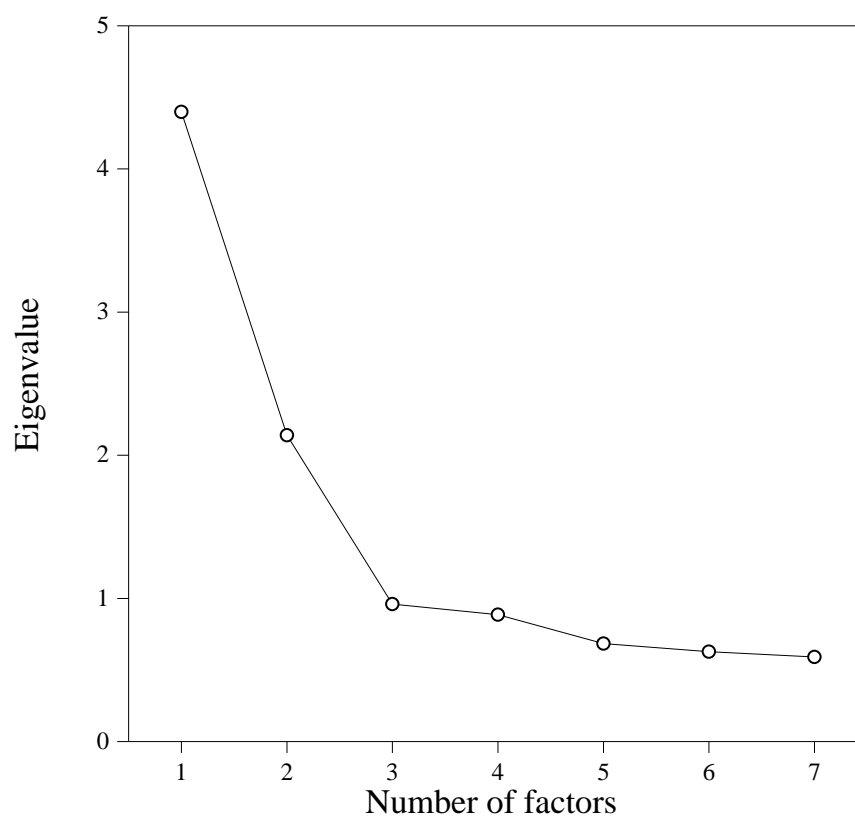
Bartlett's test of sphericity: $p < .001$.

Table 6

Item	<i>M (SD)</i>		<i>p</i> value
	Male	Female	
Q1	1.92 (1.09)	2.18 (1.21)	.33
Q2	2.25 (1.35)	2.55 (1.30)	.22
Q3	3.51 (1.48)	3.12 (1.27)	.17
Q4	2.30 (1.48)	2.33 (1.24)	.69
Q5	3.22 (1.17)	3.33 (1.07)	.89
Q6	2.09 (1.31)	2.55 (1.37)	.07 [†]
Q7	3.28 (1.39)	3.24 (1.32)	.85
Q8	2.01 (1.13)	2.18 (1.07)	.32
Q9	3.00 (1.39)	3.39 (1.68)	.18
Q10	1.43 (0.75)	1.55 (0.87)	.62
Q11	1.17 (0.55)	1.15 (0.57)	.69
Q12	1.11 (0.42)	1.27 (0.72)	.22
Q13	1.36 (0.71)	1.33 (0.69)	.91

[†] Approaching significance ($p < .10$). See [Table 1](#) for more details.

Figure 1 Scree plot of the eigenvalues ($n = 109$).



Highlights

- This study examined post-evacuation behaviors following an earthquake in Japan.
- A questionnaire survey was conducted with university members.
- They returned to the campus building in several non-severe situations.
- The factor analysis extracted two factors: environmental and disaster severity.
- Gender differences influenced the use of restroom facilities on campus.