Visitors' satisfaction and evaluation to walk on the trails of forest: evidence from the national forest of Akasawa, Japan

T Zhang\textsuperscript{1,3}, S Q Deng\textsuperscript{2}, Y Gao\textsuperscript{1}, Z Zhang\textsuperscript{1}, H Meng\textsuperscript{1} and W K Zhang\textsuperscript{1}

\textsuperscript{1}Landscape Planning Laboratory, Shenyang Agricultural University No.120 Dongling Road Shenyang, Liaoning 110161 P. R. China

\textsuperscript{2}Forest Measurement and Planning Laboratory, Agriculture Faculty, Shinshu University, 8304, Minamiminowa-Vill., Kamiina-Dtrct., Nagano Pref. 399-4598, Japan.

\textsuperscript{3}E-Mail: tongzhang@syau.edu.cn

Abstract. In the recent decade, people's interest for forests has increased tremendously throughout the globe. So, providing good forest landscape space to visitors has become an important issue for the landscape designers. Because, good forest resource planning and development can not only drive the sustainable development of the forest industry, but also its ripple effect can induce improvement in agricultural industry and economy in the region. The present study identified the evaluative behaviors among visitors walking on the trails of Akasawa national recreational forest, the birthplace of forest bathing in Japan. The study determined the factors that influenced the satisfaction rates of the visitors. The significance of this study is not only to improve the planning and design of the forest space itself, but also to provide theoretical guidance for the planning of the regional landscape of the rural areas attached to it. The study results revealed, visitors' subjects for evaluation changed with the surrounding environment. While visitors appreciated large-scale landscape elements, such as “large-size trees” and “buttress roots” within coniferous forests. They valued small-scale landscape elements such as “flowering plants” within broad-leaved or mixed forests. Another important issue came out as a result of the present study is that the light and dark changes in the forest walking trail can continuously awaken the evaluation behavior of tourists. In this study visitors displayed evaluative behaviors most frequently on the Mukaiyama Course. It is rich in different types of forest stands and has variance illumination levels. Factors that influence the satisfaction rates of visitors were “landscape”, “vegetation”, “trail condition” and “ease of walking”. Factors that influence the frequency of evaluative behaviors included “landscapes” surrounding the trails and “ease of walking”. Through this study we can see that when we need to plan the forest spatial walking trails, it is very necessary to consider small-scale landscape elements, rich in different types of forest stands with varying illumination levels.

1. Introduction
In the modern society, it is well known that agriculture and forestry are two inseparable industries. The development of agricultural economy in areas with rich forest resources is significant. Because, to a certain extent, the development of forestry economy is based on the development of agricultural economy. At the same time, the development of superior forestry industry can also assist agricultural economy. High quality forest landscape planning and development can promote the sustainable
development of forest resource-based economy. In the meantime, with the increase in the number of tourists, agricultural product economy can also be promoted in the region concerned. For example, direct sales of agricultural products, development of Green tourism, processing of agricultural products, etc. can be exercised. Relevant research shows that people are no longer simply concerned about the economic benefits brought by the development of agriculture and forestry, but are more inclined to their recreational functions such as health care, leisure and entertainment and landscape appreciation [1-3].

Historical basis of the concept as mentioned above developed roughly 150 years ago in Bayern, Germany. Whence, Kaplan Sebastian Kneipp treated and cured himself through an unusual therapy involving forest recreation and water bathing. Since twentieth century, people’s desires for spending time in natural environments have been increasing [4-9]. In 2007, the Cabinet Office of the Government of Japan conducted a public opinion poll on forest and human life [10]. According to the results of the polls as conducted, the top three intentions for participating in forest activities were: A total of 62.1% chose the answer “mental diversion by forest bathing”, 42.4% chose “to experience contact with nature” and 43.2% chose “to enjoy an attractive scene”. Outdoor activities such as forest bathing or forest walking thus represent a social need. Therefore, the provision of adequate environments enabling visitors to enjoy such activities is an important issue [11-12].

Various studies related to this context have been conducted worldwide [13-16]. Studies concerning the relationship between nature and human behavior can be exemplified by Ulrich’s investigation on the restorative effect of natural views on surgical patients in a suburban Pennsylvania hospital [17]. Over a long period, Ulrich had monitored surgical patients who had undergone cholecystectomy. It was observed that the patients who had views of trees from their windows recovered faster. Not only this, the patients also needed significantly less pain medication and had fewer postsurgical complications than those who did not. Moreover, through the researches on the relationship between human visual evaluation and contact with nature [18-19], Ulrich showed that the color green and views of nature that include water can elicit positive influences on the human psychological condition.

Further, studies concerning the relationship between visitor experiences and views of nature within natural environments have been carried out [20-21]. Chenoweth, through his review of earlier researches, discussed the possibilities of future research, pointing out several issues that should be solved regarding its methodology [22]. Hull et al. applied the method of visitor employed photography and instructed selected hikers visiting the wilderness to record their experiences at specific time intervals [23-24]. The landscape views and elements encountered by the participants were recorded and studied in relation to the participants’ subjective reports of their experiences. Taylor et al. defined the significance of the shorelines and wetlands of Rocky Mountain National Park in relation to visitor experiences [25]. Furthermore, in their research on suburban hiking trails in Korea, Park and Oh examined the difference between hikers’ experiences on valley- and ridge-style trails [26].

In Japan, there are two main practices in the related research. The first practice involves the observation of visitors’ impressions and psychological conditions examined during the walking experiences or observed through photographs taken by visitors. The second practice involves the search for specific factors by examining visitors’ behaviors. Methods such as photography, direct observation and video recording are employed to identify visitors’ behavioral change and patterns of pleasant landscapes.

Case studies showed that the first practice were a conclusion drawn through observation [27–37]. Wherein, the participants’ physiological and psychological changes within specific forest research spaces were analyzed using the Production and Operations Management Society (POMS) and Semantic Differential (SD) methods via measuring cortisol levels in saliva. Results showed that the area evaluated by physical [31-32] and mental health [33-34] offered a positive relaxing effect. This was resulted because of the “People’s impression of the forest differed depending on the structure of the forest stand”. Some findings [29,30,38] showed that “there are higher possibilities for landscape elements to be identified. If the landscape elements are situated among trails that have a wide view on one side with higher luminosity [38] and if surrounded by a relatively lively atmosphere”. Kasetani showed how the dark and wild forests of Japanese Stone Oaks (Lithocarpus edulis (Makino) Nakai) did not cause
improvements in visitors’ moods and also did not yield any therapeutic effects for visitors [29,30]. Using the POMS method, Uehara studied visitors’ relaxation levels after their walking experiences. The results indicated the relationship between trail types and visitors’ satisfaction rates, stress reduction rate and the rate in the rise of spirit [36].

In actual forest walking, however, visitors keep moving without staying in one area. In such situations, visitors’ consciousness and attention keep changing along with the changes in the surrounding environment. Thus, the second practice of behavioral research becomes important. Some researchers assessed visitors’ behavior of photographing landmarks in their favorite locations [33, 39, 40, 41]. The result showed that the “frequency of taking pictures decreased along the way” of the walk. Additionally, Ōishi identified the wide view of the forest as an important component of the study [31]. Oku employed video in his observation of visitors [31], who frequently show behaviors such as “breaking off the tip of a branch” and “touching the moss” in the “open spaces” among the trails.

All the previous researches as mentioned above mainly focused the physiological and the psychological studies relating to the comfort of visitors in certain areas of forest space. In the behavioral studies, researchers examined visitors’ behaviors in relation to the walking experience and favorable forest spaces. However, little has been discussed about the change in visitors’ subjects for evaluation in relation to the changes in the environment, as well as about the factors that contribute to visitors’ evaluative behaviors.

Conversations and picture taking are evaluative behaviors that reflect the consciousness of visitors while walking the trail and experiencing the surrounding environment. Present study focused on assessing these evaluative behaviors of visitors and the subjects of such acts. Through this study, we hoped to gain the knowledge that can adequately assist in the planning of forest trails that are more comfortable and enjoyable.

Therefore, the goals of the present study were firstly, to determine the factors within the walking trails that influence the evaluative behavior of visitors. Specifically, the first task was involved to examine the relationship between the change in environment and that in visitors’ subjects for evaluation. Secondly, to determine the characteristics of the trails that are thought to provoke visitors’ evaluative behaviors. Thirdly, to identify the factors that influence visitors’ consciousness and their satisfaction rates, as well as those that influence visitors’ evaluative behaviors. As a whole, the aim of the present research was to provide a theoretical basis for the overall trail planning of the forest park.

We believe that the results of the above-mentioned scientific research problems, not only can improve the planning and design of the forest landscape space itself, but also can provide theoretical guidance for the regional landscape planning of the surrounding rural areas. Moreover, through the improvement of the landscape quality of forest parks, the number of tourists and the popularity of forest parks in the region can be increased. All these will contribute significantly in order to assist the rural revitalization in rural areas.

2. Materials and methods

2.1. Study area

The study was conducted in Akasawa national recreational forest, located at Agematsu, Kiso District, in Nagano Prefecture, Japan. It is situated in the western part of the town of Agematsu between altitudes 1,080 and 1,557 m. The Akasawa national recreational forest is considered to be one of Japan’s three most beautiful forests, having a natural stand of 300–350-year-old Kiso Cypresses (Chamaecyparis obtusa (Siebold & Zucc.) Endl.) encompassing 728 ha. The park is known as the “birthplace of forest bathing”. It has been selected by the Forest Culture Association as one of the “100 Best Heritage Sites in Japan to Pass on to the 21st Century” and by the Ministry of Environment as one of the “100 Best Aromatic Landscapes”. The park had also been certified as the “No.1 Base for Forest Therapy” by the Forest Therapy Society in 2006. It has a forest railway running along the canyon and has 8 hiking trails (courses). These are Fureainomichi-, Komadori-, Mukaiyama-, Tsuetazawa-, Nakadachi-, Kamiakasawa-, Keiryu- and Himemiya Course. Figure 1 shows the seven main paths to approach (A-
The park also provides trails for wheelchairs. People visit the park between spring and autumn to enjoy forest bathing amidst fresh greens, streams and autumn foliage. Previous studies identified differences in visitors’ subjects for evaluation in the Mukaiyama and Nakadachi Courses, even though the geographical features of the two were similar. On the basis of these previous study results, these two courses were selected as our research sites [42].

Figure 1. Distribution of eight trails in study area and investigation site.

2.2. Accompanying study
With the participants’ consent, we accompanied visitors on their trails in the Mukaiyama and Nakadachi Courses to observe their evaluative behaviors. More specifically, two researchers accompanied each group to observe visitors’ behaviors. In order to maintain a generality for visitors’ evaluation subjects, the subjects to which more than half the members of the visitor group displayed evaluative behaviors were registered using GPS and their locations were marked on the trail map. When the group size was large, one researcher stayed in the middle of the group and observed the front half of the group, while other researcher observed the back half of the group. Researchers used radios to share and confirm the collected data with each other.

2.3. Questionnaire survey
After the walk, visitors were asked to complete a survey questionnaire consisting of 19 items. The survey referenced the surveys used in previous studies [28,31] and contained questions on visitors’ impression on the current walk, their satisfaction rates, the order of the courses they took, the quality of the environment around the trail and on the condition of the trails. Survey participants selected answers on the basis of a 7-point Likert-type scale.

2.4. Investigation of the environment
We walked the Mukaiyama and Nakadachi Courses to investigate the environment around the trails. The first investigation was conducted in June, when it is easier to distinguish the tree types from fresh leaves. In the June investigation, the main forest stands surrounding the trails, the ground conditions of the trails and the state of the streams were identified and recorded on the map. The second investigation was conducted in October during the autumn foliage season, when visitor numbers were assumed to reach a peak. Using two PHP-5101 light sensors, the illumination levels on both trails were measured every 10 s and their relative illumination levels were calculated.

2.5. Analyzing method
A factor analysis was performed to determine the factors involved in visitors’ evaluations. A Promax Rotation was applied using IBM SPSS for Windows 11.5J. Moreover, the relationship between the evaluation factors and visitors’ satisfaction rates, the frequency of evaluative behaviors, the order of
trails walked and the subjects of appreciation were determined. Spearman’s rank correlation coefficient was calculated for the satisfaction rate and visitors’ subjects for evaluation, the order of trails walked and the frequency of evaluative behaviors. The evaluative behaviors observed on each course were also analyzed. And the relationships between appreciative behaviors and streams, forest stands, trail conditions and relative illumination were examined. We also used SEM (IBM SPSS Amos) to analyse the relationship between visitors’ satisfaction rates the frequency of evaluative behaviors and the order of trails walked.

3. Results and discussion

3.1. Results of the accompanying study and observed evaluative behaviors

Researchers accompanied 16 groups from June to November, 2015. There were a total of 64 people including 21 male visitors (32.8%) and 43 female visitors (67.2%).

Table 1 shows the basic attributes of visitors, dates of each walk, weather and the frequency of the evaluative behaviors. There is a large difference in the frequency of evaluative behaviors between the two trails, with 190 times (23.9 times/group) on the Mukaiyama Course and 33 times (4.1 times/group) on the Nakadachi Course.

Table 1. Number of groups observed. This table made by Tong Zhang from Excel.

| Course          | Group | Number of Visitors | Weather       | Frequency of Evaluative Behavior | Order of Trails |
|-----------------|-------|--------------------|---------------|----------------------------------|-----------------|
|                 |       | Male | Female | clear | cloudy/clear | 15 | 3 |
| Mukaiyama Course| 1     | 0    | 3      | clear  | 16  | 3 |
|                 | 2     | 2    | 1      | clear  | 23  | 4 |
|                 | 3     | 0    | 4      | cloudy/clear | 36 | 2 |
|                 | 4     | 0    | 12     | cloudy/clear | 25 | 1 |
|                 | 5     | 2    | 2      | clear  | 20  | 4 |
|                 | 6     | 1    | 3      | clear  | 25  | 1 |
|                 | 7     | 2    | 1      | cloudy/clear | 30 | 1 |
| Nakadachi Course| 8     | 0    | 3      | cloudy/clear | 6  | 3 |
|                 | 1     | 0    | 3      | clear  | 8   | 2 |
|                 | 2     | 3    | 3      | cloudy/clear | 6  | 3 |
|                 | 3     | 3    | 2      | clear  | 3   | 1 |
|                 | 4     | 1    | 1      | clear  | 2   | 2 |
|                 | 5     | 1    | 1      | clear  | 4   | 3 |
|                 | 6     | 3    | 0      | clear  | 2   | 3 |
|                 | 7     | 0    | 4      | clear  | 2   | 1 |

Figures 2 and 3 display the aggregate data collected at every 20 m distance on the trails, locations where more than half of the visitors displayed evaluative behaviors, subjects for evaluation, stream conditions, trail conditions, illumination levels and viewpoints as introduced in the brochure distributed previously among the tourists. Following are the analyses of visitors’ evaluative behaviors based on four different environmental conditions, which include stream conditions, forest stands, trail conditions and relative illumination.
Figure 2. Relationships among Visitors’ Subjects for Evaluation, Forest Stand Condition, Trail Condition, Relative Illumination Rate and the Distribution of Viewing Spots, based on the Data Collected Every 20 m of the Mukaiyama Course.

Stream conditions: Both the Mukaiyama and Nakadachi Courses have three locations from which visitors can view the streams. In the Mukaiyama Course, one of these three locations include a view from the “Hirasawa Bridge” that crosses over the stream.

In the Mukaiyama Course, evaluative behaviors were observed 15 times (1.9 times/group) by the side of water and the most frequent number of evaluative behaviors were observed at the “Hirasawa...
Bridge,” totaling eight times (average 1 time/group). It has been observed that visitors gave most positive evaluations of the water view while on the bridge.

Forest stand conditions: In addition to coniferous forests, the Mukaiyama Course had a large distribution of broad-leaved and mixed forests. Their repeating arrangements on the trail were in the following order: coniferous-, broad-leaved-, coniferous- and followed by mixed forest. In contrast, most of the Nakadachi Course trail consisted of coniferous forests, with only two locations of mixed forests.

Reviewing the viewers’ evaluative behaviors on each trail, the frequency of evaluative behaviors observed in the coniferous forest of the Mukaiyama Course was 27 times (3.4 times/group) for “large-sized trees”, 16 times (2 times/group) for “buttress roots” and 15 times (1.9 times/group) for “flowering plants”. In the mixed forests of the Mukaiyama Course, visitors displayed evaluative behaviors 11 times (1.4 times/group) for “large-sized trees”, 2 times (0.5 times/group) for “buttress roots” and 28 times (3.5 times/group) for “flowering plants”. In the broad-leaved forest of the Mukaiyama Course, visitors didn’t display evaluative behaviors for “large-sized trees” and for “buttress roots”, but 38 times (4.8 times/group) for “flowering plants”. These have showed that visitors’ subjects for appreciation differ depending on the walking space.

In the coniferous forest of the Nakadachi Course, visitors displayed evaluative behaviors 4 times (0.5 times/group) for “large-sized trees”, 10 times (1.3 times/group) for “flowering plants” and 2 times (0.25 times/group) for “stream view”. In the mixed forest of the Nakadachi Course, visitors displayed evaluative behaviors 1 time (0.1 times/group) for “flowering plants”.

Ground conditions of trails: In the Mukaiyama Course, wood chips were placed over the buttress roots crossing the trails. Also, wood paths were set in many parts of the trail (areas 25-36, 43-67, Figure 2). On the other hand, in the Nakadachi Course, the trail surface consisted of soil and tree roots that are not covered by wood chips.

Visitors positively evaluated the “feel of the trail ground” in the Mukaiyama Course, with evaluative behavior count of 18 times (2.3 times/group). The most positively evaluated location was around the “Norikura viewing area” (areas 24-31, Figure 2) close to the peak of the hill which was evaluated a total of eight times. There were no evaluative behaviors observed relating to the “feel of the trail ground” south of the “Hirasawa Bridge”.

While there were no evaluations on the Nakadachi Course regarding the “feel of the trail ground”, evaluations were observed seven times (0.9 times/group) regarding complaints that the trail was “difficult to walk”. This was observed most frequently in the areas near “Nakadachidai”. This was done 2 times in each of the areas 26 and 27 (Figure 3). Visitors displayed evaluative behaviors regarding the ground conditions in areas near the peak of the hill where there are more slopes.

Relative illumination: Relative illumination levels of the Mukaiyama Course had a wide range of 3-25%. Locations such as “area of cypress forest with buttress roots and wood chip trails”, “Norikura viewing area”, “Hirasawa Bridge” and the “area of Ōyamarenge colonies” had higher relative illumination levels. These locations provided walkers with a good visual environment. Relative illumination levels of the Nakadachi Course had a small range i.e., 3-11%. There were only small changes in the illumination levels, especially in the areas starting from the northern entrance of the trail to the hill-peak area of “Nakadachidai”, where relative illumination stayed in the range of 5-11%.

On the Mukaiyama Course, visitors showed frequent evaluative behaviors around the “area of cypress forest with buttress roots and wood chip trails” and “Norikura viewing area” (24-30, Figure 2). All these totaled to 33 times (4.1 times/group) and around “Hirasawa Bridge” (47-48, Figure 2) totaling 14 times (1.8 times/group). There were 22 locations where more than half of the groups showed evaluative behaviors.

On the Nakadachi Course, evaluative behaviors were observed 11 times (1.4 times/group) in the areas between the northern entrance and “Nakadachidai”, where there were low levels of illumination. Evaluative behaviors were observed 18 times (2.3 times/group) between “Nakadachidai” and the southern entrance. There was only one location in the trail where more than half of the group visitors displayed evaluative behaviors. The area was situated at the northern entrance (area 3, Figure 3). This is much less compared to the number of 22 locations observed in the Mukaiyama Course.
In relation to the illumination condition and forest stands, difference was also observed between the two trails regarding visitors’ behaviors. In the Mukaiyama Course, the illumination levels changed between 3 and 23% between areas 4 and 29 (Figure 2), where there were many conifers. Viewers displayed evaluative behaviors 74 times (9.3 times/group) in these areas. In the Nakadachi Course, there are also many conifers between areas 1 and 22 (Figure 3). However, the illumination levels stayed at 5% or below. Visitors displayed evaluative behaviors of 11 times (0.6 times/group), which was much less than the numbers observed on the Mukaiyama Course.

These results indicated that visitors showed fewer evaluative behaviors in locations with lower relative illumination levels, unchanging environment and smaller range in the change of illumination levels. The so-called “tunnel effect” which makes visitors concentrate on the act of walking instead of paying attention to the surrounding environment was observed. In contrast, visitors showed frequent evaluative behaviors in locations with a wider range in the change of illumination levels.

Analysing this result, it was found to be more appropriate to assess visitors’ evaluative behaviors toward “water” at open locations with a “bridge” that crosses a stream, rather than at locations on the trails alongside the stream. Visitors’ subjects for evaluation in the coniferous forests were large-scale landscape elements such as “large-sized trees” and “buttress roots”. On the other hand, in the broad-leaved and mixed forests, visitors’ subjects for evaluation were rather of small-scale landscape elements such as “flowering plants”. Visitors’ subjects for evaluation changed with the surrounding environment. Therefore, the arrangement of different types of landscape elements around the trails may gain higher frequency of evaluative behaviors, as well as a better walking experience.

In addition, the present study showed that visitors became increasingly aware of the ground conditions in areas with slopes and around the hill peaks of the trails. Therefore, providing better trail conditions intended for the ease of walking may result in an increase in positive evaluations by visitors. Finally, the result obtained from the Mukaiyama Course suggested that visitors will pay more active attention and thereby display more evaluative behaviors if frequent changes in illumination levels are arranged in the forest environments.

3.2. Questionnaire survey results
Sixty-two valid surveys were collected from the questionnaire survey conducted on 64 participants.

3.2.1. Visitors’ subjects for evaluation. A factor analysis was performed using visitors’ evaluations regarding 19 items about the trails in order to ascertain what factors were considered by the visitors in the evaluation of the trails (Table 2). Five factor categories were obtained, as shown in Table 2. The first factor was “landscape”, the second one “nature”, the third one “course condition”, the fourth one “vegetation” and the fifth one was “the ease of walking”.

Table 2. Factor Loads Derived Through Factor Analysis. This table made by Tong Zhang from SPSS.

| Evaluation items                              | First Factor | Second Factor | Third Factor | Forth Factor | Fifth Factor |
|-----------------------------------------------|--------------|---------------|--------------|--------------|--------------|
| View of streams along the trail               | 0.938        | 0.024         | -0.002       | -0.174       | 0.052        |
| Wide view from trail                         | 0.812        | -0.010        | -0.173       | 0.105        | 0.081        |
| Landscape in forest                          | 0.700        | -0.100        | 0.143        | 0.242        | -0.032       |
| Big roots and giant trees along trail         | 0.478        | 0.189         | -0.017       | -0.079       | -0.009       |
| Sound of stream                              | 0.434        | 0.298         | 0.171        | -0.010       | -0.034       |
| Wild animals and plants                       | 0.416        | -0.134        | -0.132       | 0.386        | 0.095        |
| Aroma of trees and soil                       | 0.062        | 0.888         | 0.073        | -0.001       | -0.135       |
| Fresh air                                     | -0.090       | 0.856         | 0.040        | 0.050        | 0.165        |
| Natural atmosphere                            | 0.072        | 0.626         | -0.072       | -0.005       | -0.050       |
3.2.2. Difference in the evaluations of the Mukaiyama Course and the Nakadachi Course. The average values of the satisfaction rates, collected from the seven-item scale evaluation of the trails, were calculated to examine the difference in the evaluations between the Mukaiyama and Nakadachi Courses. Table 3 shows the factor categories, average values and variance in satisfaction rates. The average satisfaction rate of Mukaiyama Course was 6.09, while that of Nakadachi Course was only 3.96, which is approximately half that of the Mukaiyama Course. Also, huge variances in the satisfaction rates were observed between the two trails under the categories “landscape”, “ease of walking”, “vegetation” and “course conditions”.

Table 3. Average values of the 7-point scale satisfaction evaluation of the Mukaiyama Course and Nakadachi Course. This table made by Tong Zhang from SPSS.

| First Factor | Second Factor | Third Factor | Forth Factor | Fifth Factor | Satisfaction rates |
|--------------|--------------|--------------|-------------|-------------|--------------------|
| Mukaiyama Course | 0.25 | 0.04 | 0.11 | 0.13 | 0.14 | 6.09 |
| Nakadachi Course | -0.33 | -0.06 | -0.15 | -0.17 | -0.18 | 3.96 |
| Mean range | 0.58 | 0.10 | 0.26 | 0.30 | 0.31 | 2.13 |

3.2.3. Relationship between evaluation factors and visitors’ satisfaction rates, evaluative behaviors and the order of trails. In our previous survey, we found that during the forest walk, tourists’ evaluation of surrounding landscape elements and their psychological preferences for landscape nodes on the walking trails will change with the walking order [42-44]. In the present study, we tried to analyze the relationship between the evaluation factors, the walking order and the evaluation behavior of tourists on the walking trails. The different walking conditions of the forest walking trails considered, were different design conditions form the perspective of the overall design of the trail. This was necessary in order to provide a theoretical basis for the overall trail planning of the forest park.

To determine the relationship between the evaluation factors, orders of trails and frequency of evaluative behaviors, Spearman’s rank correlation coefficient was calculated. The calculation was done for the factor points and visitors’ satisfaction rates, order of trails and frequency of evaluative behaviors (Table 4, Figure 4).
Table 4. Correlation between Evaluation Factors and Visitors’ Satisfaction Rates, Trail Order and Evaluative Behaviors. This table made by Tong Zhang from SPSS.

| Order of trails | First Factor | Second Factor | Third Factor | Forth Factor | Fifth Factor |
|----------------|-------------|---------------|-------------|-------------|-------------|
| Satisfaction rate | 0.205 | 0.687** | 0.251 | 0.404** | 0.533** | 0.529** |
| Frequency of evaluative behaviors | -0.355** | 0.353** | 0.030 | 0.168 | 0.257 | 0.442** |

** Significant in 1% correlation coefficient; * Significant in 5% correlation coefficient.

Figure 4. Model diagram of behavioral psychology and environment. The model is recursive. Sample size = 73.

The results showed correlation between visitors’ satisfaction rates and the frequency of evaluative behaviors. A negative correlation was found between the order of trails and the frequency of evaluative behaviors. However, a positive correlation was obtained between the satisfaction rate and each of the evaluation factors such as “landscape”, “course condition”, “vegetation” and “ease of walking”. Correlations between the frequency of evaluative behaviors and the evaluation factors “landscape” and “ease of walking” were also positive.

The study showed that visitors’ satisfaction rates are effected by the four categorized factors i.e., “landscape” (e.g., “views of stream along trails”, “unobstructed views from trails”, and “views in the forest”), “course conditions” (e.g., “width of trails”, “slope of trails”, and “steps in trails”), “vegetation” (e.g., “plants around trails” and “explanation of plants”) and “ease of walking” (e.g., “feel of ground surface” and “easiness to walk the trail”). The present study also showed that visitors’ evaluative behaviors are influenced by two categorized factors like “landscape” and “ease of walking.” Among them, the biggest factor effecting visitors’ satisfaction rates is the “landscape” (0.52) and visitors’ evaluative behaviors in the order of trails (-0.04).

Therefore, the satisfaction rates of visitors who come to walk in the forest sacrificing their daily lives can be expected to improve through their experience of looking at wide views in the forest. The views of the visitors could be characterized as walking on comfortable trails and enjoying a wide variety of vegetation. In addition, the study showed that while visitors enjoy the view of the forest or the streams surrounding the trails, they also remain conscious about the conditions of the ground.

From the results of the questionnaire survey, a correlation between visitors’ satisfaction rate and evaluative behavior has been observed. As well, results obtained from the accompanying study showing the high evaluation on “stream views” and “view of Norikura”. From this, it can be said that
in order to achieve higher satisfaction among visitors trail planning must consider some important elements. These include the width and landscape around the trails and visibility of plants and ease of walking on the trails. On the other hand, to increase visitors’ behavioral actions on the trail, planning must consider wider and open views of the forest or streams around the trails. The layout of the trails that allow comfortable walking experiences should also be considered as well.

In addition, the methods used in this study included the direct collection of data by recording visitors’ conversations and observations. The research was carried out under full consent of the participants. The validity of the research methodology used in the study has been discussed below.

Because the research method required prior consents of the participants, the type and numbers of participating groups were limited. Nevertheless, the research data will provide helpful insight into the reconstruction of the trails because the data reflects the direct evaluative behaviors of the actual visitors of these trails.

However, future research methods should consider several factors that could influence the data of the research results. This may include the presence of the researchers in the accompanying study, the size of the groups and the level of intimacy among the group members. Also, in order to generalize these research results, it will be necessary to increase the number of research and research sites and to take into consideration seasonal changes and their effects on visitor behaviors.

On the other hand, in addition to the method of selecting favorable areas through the mapping of photographed locations, the present study has also used an alternative method. It is the direct involvement and accompanying visitors on their walks as well as identifying and locating the subjects for appreciation through the direct recording of visitors’ conversations and actions. Direct observation proved to be an advantageous method that helped in the collection of detailed data and in the introduction of new components to the research, which was not possible otherwise.

4. Conclusions
Based on the assessment of visitors’ evaluative behaviors of conversation and photography, the comparative study of the trails’ environmental conditions and the analysis of the questionnaire surveys collected from visitors, the present study outlined the following:

(1) Visitors’ behavioral attention shifts with the changes in the surrounding environment (changes in forest stand throughout the trails).

Specifically, visitors while walking in the forest trails had evaluated large-scale landscape elements such as “large-size trees” and “buttress roots” within the coniferous forest. They also evaluated small-scale landscape elements such as “flowering plants” within broad-leaved and mixed forests. Results obtained from all these show the same tendency as described by Ōishi in his psychocognitive research. The research of Ōishi states that, “People’s impression of the forest differed depending on the structure of the forest stand” [31]. However, the results of the present research give some additional insight into how the evaluated subjects may differ among different forest stands. For instance, “flowering plants” do not grow in coniferous forests and therefore are less noticed and less evaluated by visitors. Meanwhile, “large-size trees” and “buttress roots” of Hinoki cypress (C. obtusa) are larger in scale and therefore are more likely to be noticed and evaluated by visitors. Visitors also gave more evaluations for “flowering plants” that grow easily and are more visible within broad-leaved forests.

(2) The light and dark changes in the forest walking trail can continuously awaken the evaluation behavior of tourists

Previous studies had shown that visitors are more likely to display evaluative behaviors on the Mukaiyama Course. Because there was a wider variety of forest stands and a wider range in illumination levels, rather than on the Nakadachi Course with a single forest stand and a low illumination rate [42-44]. This results from the “tunnel effect”, which occurs in spaces with little change in illumination levels and visual environment. The “tunnel effect” makes visitors concentrate on the act of walking instead of paying attention to the surrounding environment. Conversely, within areas having variations in forest stand and illumination levels, the ‘tunnel effect’ allows visitors to experience consistent changes in
environment as well as alertness towards their surroundings. Therefore, visitors’ behaviors are influenced by the variation in forest stands and illumination change across the trails.

In this survey, we have also found that the evaluation behavior of tourists is more positive in the Mukaiyama Course. Because, this course beset with the light and dark changes in an orderly manner. At the same time, it can be seen from the results obtained through the questionnaire survey, concerning the identification of landscape elements that influence visitors’ evaluative behaviors.

(3) Visitors consciously evaluate the trail in the order of “landscape”, “nature”, “course condition”, “vegetation” and “ease of walking”.

Among these evaluation factors, “landscape”, “vegetation”, “course condition” and “ease of walking” influence the satisfaction rates of visitors. Whereas, the factors “landscape” and “ease of walking” influence visitors’ evaluative behaviors. These results show the same tendency described by Uehara [36]. In his study, the effect of forest bathing is related to the diversity of the forest, ease of walking and the landscapes. That is, the satisfaction rates of visitors who leave their daily lives and come for walking in the forest may improve through the experience of looking at wide views in the forest, walking on comfortable trails and enjoying a wide variety of vegetation. In addition, the study showed that while visitors enjoy the view of the forest or the streams surrounding the trails, they remain conscious about the conditions of the ground they are walking on.

Through the above-mentioned analytical results, we recommend:

Firstly, when we carry out planning and designing the forest walking trails, we should not only take into account some large-scale landscape nodes such as big trees, streams, lakes and views on the trails but also some miniature landscape views such as flowers, moss and other matching elements. This will also produce a high satisfaction rating among visitors.

Secondly, for the designing in-forest space, the singularity of the landscape elements should be avoided. At the same time, a high-light space should be designed at a certain position after the end of a continuous closed space. So that visitors can avoid poor visual fatigue and also can promote the germination and growth of ground cover landscape plants in the space under the forest. This will increase tourists’ interest in the space around the forest walking trails and enhance tourists’ interest evaluation of the forest walking trails.

Thirdly, when planning the walking trails, we should combine the road conditions and the current status of landscape resources to plan the starting and ending point for tourists walking. That is, from the perspective of the overall planning and designing of the park, to predict the walking sequence of tourists. The corresponding landscape nodes are arranged according to the walking sequence of tourists to avoid the visual fatigue and physical exertion caused by the continuous use of similar landscape elements. This would further enhance tourists’ evaluation of the overall satisfaction of the forest park.

Finally, compared with the previous studies, the present study carried out a peer survey (behavioral annotation) by the visitors to record the behavioral characteristics of the visitors during the forest walk on the basis of their consent. This is in novelty and the most direct and effective method as featured in this research. However, undertaking any behavioral investigation must be based on visitors consent but data acquisition in such cases might create some difficulties. In the future, on the basis of continuing to increase the amount of data, exploring and clarifying the relationship between the space of different forest trails and the behavioral characteristics of visitors is the main subject of this research.

Acknowledgments
Firstly, we gratefully acknowledge all the staffs of Landscape Laboratory, Faculty of Agriculture, Shinshu University for their advices on the study and helps in the field and making plot survey. We also want to thank all the visitors for their advices on the study and supports in the accompanying investigation and questionnaire survey. Finally, we acknowledge helpful comments of anonymous reviewers and editor.
Conflict of Interest
The authors declare no conflict of interest.

Acknowledgement
The research was supported by the Natural Science Foundation of China (31971714).

References
[1] Deng S Q, Yin N, Guan Q W, Katoh M 2013 Short–term effects of thinning intensity on scenic beauty values of different stands J. For. Res. 18 209–19 Doi:10.1007/s10310-012-0342-5
[2] Gong L, Zhang Z D, Xu C Y 2015 Developing a quality assessment index system for scenic forest management: a case study from Xishan mountain, suburban Beijing Forests 6 225–43 Doi:10.3390/f6010225
[3] Tampakis S, Andrea V, Karanikola P, et al 2019 The growth of mountain tourism in a traditional forest area of Greece. Forests 10 1022 Doi:10.3390/f10111022
[4] Armerger A 2006 Recreation use of urban forests: An inter-area comparison Urban For. Urban Green. 4 135–44 Doi:10.1016/j.ufug.2006.01.004
[5] Jim C Y, Chen W Y 2009 Ecosystem services and valuation of urban forests in China Cities 26 187–94 Doi:10.1016/j.cities.2009.03.003
[6] Eriksson L, Nordlund A M, Olsson O, et al 2012 Recreation in different forest settings: a scene preference study Forests 3 923–43 Doi:10.3390/f3040923
[7] Takayama N, Korpela K, Lee J, et al 2014 Emotional, restorative and vitalizing effects of forest and urban environments at four sites in Japan Int. J. Environ. Res. Public Health. 11 7207–30 Doi:10.3390/ijerph110707207
[8] Ochiai H, Ikei H, Song C, et al 2015 Physiological and psychological effects of forest therapy on middle-aged males with high-normal blood pressure Int. J. Environ. Res. Public Health. 12 2532–42 Doi:10.3390/ijerph120302532
[9] Wu J Z, Zhong Y D, Deng J Y 2019 Assessing and mapping forest landscape quality in China J. Forests. 10 648 Doi:10.3390/f10080684
[10] The Cabinet Office, Government of Japan; Forest and life public opinion poll Available online: http://survey.gov-online.go.jp/h19/h19-sinrin/index.html (accessed on 10 March 2015)
[11] Silvennoinen H, Alho J, Kolehmainen O, et al 2001 Prediction models of landscape preferences at the forest stand level Landsc. Urban Plan. 56 11–20 Doi:10.1016/S0169-2046(01)00163-3
[12] Oku H, Fukamachi K 2001 Fluctuation of landscape and satisfaction evaluation with sequential change of forested trail Landsc. Res. Japan. 64 729–34 Doi:10.5632/jila.64.729
[13] Cherem G J, Driver B L 1983 Visitor employed photography: A technique to measure common perceptions of natural environments J. Leis. Res. 15 65–83
[14] Li S H, Zhang W X 2009 Progress in horticultural therapy scientific research Chin Landscape Architect 19(5) 19–23
[15] Zheng Q M, Yang X Y 2013 Study and practice of forest-bathing field in Japan J. Asian Agric. Res. 5(02) 18-20+25 Doi:10.22004/ag.econ.146003
[16] Ohtsuka Y, Yabunaka N, Takayama S 1998 Shinrin-yoku (forest-air bathing and walking) effectively decreases blood glucose levels in diabetic patients Int. J. Biometeorol. 41(3) 125-7 Doi:10.1007/s10716-004-00506-4
[17] Ulrich R S 1984 View through a window may influence recovery from surgery Science 224 420–1 Doi:10.1126/science.6143402
[18] Chenoweth R, Driver B L 1990 The nature and ecology of aesthetic experiences in the landscape Landscape J. 9(1) 1–8
[19] Ulrich R S 1981 Effects of natural view and urban view on human emotion and physiology Environ. Behavior 13 523–56
[20] Kadogullar A I, Sönmez T, Başkent E Z, et al 2017 Updating land-cover change via analysis
based on elevation and distance to settlements: A case study from Turkey *Revista Chapingo Serie Ciencias Forestales y del Ambiente* 2 275–88

[21] Bielinis E, Takayama N, Boiko S, et al 2018 The effect of winter forest bathing on psychological relaxation of young Polish adults *Urban Forestry Urban Greening* 276-83 DOI:10.1016/j.ufug.2017.12.006

[22] Chenoweth R 1984 Visitor employed photograph: A potential tool for landscape architecture *Landscape J.* 3(2) 136–43 DOI:10.3368/lj.3.2.136

[23] Hull R B, Stewart W P 1995 The landscape encountered and experienced while hiking *Encountered Behavior* 27 404–26 DOI:10.1177/0013916595273007

[24] Heyman E 2012 Analysing recreational values and management effects in an urban forest with the visit or-employed photography method *Department of Plant and Environmental Sciences University of Gothenburg* 267-77 DOI:10.1016/j.ufug.2012.02.003

[25] Taylor J G, Czarnowski K J, Sexton N R, et al 1995 The importance of water to Rocky Mountain National Park visitors and adaptation of visitor-employed photography to natural resources management *J Applied Recre. Res.* 20(1) pp 61–85

[26] Park C, Oh J 1998 Study on the characteristics of landscape of urban forest (II) *FRI J. For. Res.* 58 104–13

[27] Takayama N, Kagawa T, Kasetani T, et al 2005 The comfortableness of the light/thermal environment for bathing in the forest atmosphere *Landscape Res. J.* 68(5) 819–24 DOI:10.5632/jila.68.819

[28] Takayama N, Fujizawa M, Aramaki M 2011 Creating an environmental image for the maintenance of comfortable “forest bathing” applied by a Grounded Theory Approach *Landscape Res. J.* 74(5) pp 613–18

[29] Kasetani T, Okugawa K, Yoshida S, et al 2007 Differences in the physiological and psychological effects of walking in various santayana landscapes *Landscape Res. J.* 70(5) 569–74 DOI:10.5632/jila.70.569

[30] Kasetani T, Takayama N, Park B J, et al 2008 Relation between Light / thermal environment in the forest walking road and subjective estimations for taking in the atmosphere of the forest *Landscape Res. J.* 71(5) pp 713–6

[31] Ōishi Y, Kanae H, Hiyane T, et al 2003 Comparison of forest image and mood: psychological examination in a forest environment using profile of mood states and semantic differential method *J. Japan. For. Soc.* 85 70–7. DOI:10.11519/jjfs1953.85.1.70

[32] Wei H X, Wang D, He X Y, et al 2018 Can forest bathing in spring enhance the positive psychological response of university students: A pilot study in Northeast China *Forestry Environment Sci. J.* 34(04) pp 123-30

[33] Oku H, Kagawa T, Tanaka N 2007 Attractive landscaping guide of forest *Japan Forest Improvement and Promotion Society, Tokyo, Japan.* 413–6

[34] Lee J, Park B J, Tsunetsugu Y, et al 2010 Effect of forest bathing on physiological and psychological responses in young Japanese male subjects *J. Public Health* 93-100 DOI:10.1016/j.puhec.2010.09.005

[35] Hayashi S, Iwasaki H, Mishima K, et al 2008 Study on physical and psychological effects of the light condition in the forest path *Jpn. Soc. Reveget. Tech.* 34(1) 307–10

[36] Uehara M 2008 The relation between evaluation of forest therapy footpaths landscape and relaxation effect of forest bath in a mental side *Landscape Res. J.* 73(5) 413–6

[37] Ohtsuka Y, Yabunaka N, Takayama S 1998 Shinrin-yoku (forest-air bathing and walking) effectively decreases blood glucose levels in diabetic patients *Internat. J. Biometeorol.* 41(3) 125-7 DOI:10.1007/s004840050064

[38] Hull R B, Stewart W P, Yi Y K 1992 Experience patterns: capturing the dynamic nature of a recreation experience *J. Leis. Res.* 24 240–52 DOI:10.1080/00222216.1992.11969891

[39] Ballantyne M, Pickering C M 2015 The impacts of trail infrastructure on vegetation and soils:
Current literature and future directions J. Environ. Sci. Manag. 164 53–64
Doi:10.1016/j.jenvman.2015.08.032

[40] Oku H, Fukamachi K 2000 The relationships between experienced landscape types and people’s visiting forms on a trail in a forest Landscape Res. J. 63(5) 587–92
Doi:10.11519/jjfs1953.63.587

[41] Oku H, Fukamachi K 2003 Occurrence pattern of landscape experience during forest recreation J. Japan. For. Soc. 85(1) 63–9 Doi:10.11519/jjfs1953.85.1.63

[42] Zhang T 2010 The evaluation of forest path by visitors: A case study in Akasawa Chubu Branch of Japanese Institute of Landscape Architecture 7 pp 33–4

[43] Zhang T, Deng S Q, Ma Q Q, et al 2015 Evaluations of landscape locations along trails based on walking experiences and distances traveled in the Akasawa Forest Therapy Base, Central Japan Forests 6 2853–78 Doi:10.3390/f6082853

[44] Zhang T, Zhang W K, Meng H, Zhang Z 2019 Analyzing visitors’ preferences and evaluation of satisfaction based on different attributes, with forest trails in the Akasawa National Recreational Forest, Central Japan Forests 10(5) 431 Doi:10.3390/f10050431