

Study on Cyclists' Landscape Perceptions and Place Preferences of an Area

-A Case Study on Tama Lake Area-

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As cycling gains popularity as a sustainable and health-oriented activity, understanding how cyclists perceive and evaluate route environments is essential for effective planning. This study investigates cyclists' landscape perceptions and route preferences at the cycling path around Tama Lake, a reservoir near Tokyo. Based on survey data and structural equation modeling (SEM), four key factors were identified: affective experience, environmental quality, built environment integration, and waterbody & open landscape experience. Affective experience had the strongest overall influence on perceived route desirability. Subgroup analysis revealed that older and casual cyclists pay more attention on emotional and scenic elements, while younger and regular cyclists show weaker or more functional responses. These findings suggest the importance of designing cycling paths that reflect different user needs, highlighting the value of emotional engagement and differentiated landscape planning for creating inclusive and attractive cycling environments.

Key Words: Cyclists, Landscape Perception, Place Preference, Greenway, Tama Lake, Structural Equation Model.

1. BACKGROUND AND OBJECTIVE

1.1 Background

In recent years, cycling has emerged as a popular form of recreation and sustainable mobility, especially in urban and peri-urban greenway settings. With the global shift toward environmental awareness and active lifestyles, greenways have become essential components of city planning, offering not only transport routes but also spaces for leisure and nature appreciation. According to the Ministry of Land, Infrastructure, Transport and Tourism (MLIT), Japan has promoted the development of scenic cycling routes through the "National Cycle Route" program, aiming to enhance tourism and regional revitalization.¹⁾ As the global cycle-tourism market was valued at 130.6 billion US dollar in 2023 and is projected to grow at more than 8 percent annually²⁾ and Japan's own bicycle industry reached nearly USD 4 billion in 2024,³⁾ the importance of offering more safe and attractive cycling path is also increasing rapidly.

Nowadays many cycling paths are built to fulfill people's commute and exercise demands.⁴⁾ Cyclists get their first idea of the area along the greenway from the views they see while cycling, especially if they are new to the area. Their opinion of the route and the area is shaped by the scenery they pass.⁵⁾ Also, attractive landscapes and sceneries such as waterscape sceneries, bridges, or views of forests could attract the cyclists and make cyclists slow down or even stop to enjoy the view. In addition, local buildings, especially residence buildings and decorations on them could make cyclists wonder about the local culture and be curious about local life.⁶⁾ As a result, observing the landscape while cycling not only affects how cyclists think about the greenway's quality but also builds their interest in the

wider city and increases their wish to come back or tell others about it.

1.2 Objective

As scenic quality and greenway design shape cyclists' impressions on the area and their route choices of cycling, this study tends to spread questionnaires and applies structural equation modeling (SEM) to the data collected from questionnaires in order to find the cyclists' landscape perceptions, place preferences, and their overall satisfaction of a specific greenway. Specifically, this study tends to:

- (1) Quantify how cyclists' landscape perceptions and place preferences affect their overall satisfaction and attitude to the cycling path.
- (2) Identify the attributes that most strongly drive satisfaction for both recreational and utilitarian cyclists.
- (3) Translate these findings into recommendations for design and management of cyclist-friendly greenways.

2. LITERATURE REVIEW AND TARGET SITE

2.1 Cycling Paths

Cycling paths, or greenways, have become a hot topic that many researchers have focused on. Cyclists have various types of demands on the cycling paths, including physical demands and mental demands. According to Hui He et al,⁵⁾ cyclists' landscape imagery of the greenway is affected by visual perception elements. As a result, when designing greenways, special consideration should be given in order to fulfill cyclists' cognitive and affective demands. Also, the existence of greenways could affect people's mental health and the closer the distance from people's home to the greenway is, the greater improvement in their mental

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health.⁷⁾ In addition, safety conditions could affect cyclists' place preferences. According to Sener, Eluru, and Brat⁸⁾, the design of the cycling path and the amount of other types of vehicles such as cars and trucks could be the direct reason for cyclists to choose the path to cycle, including sports cyclists and commuter cyclists.

Through these studies, it is important to have deeper understandings about how different designs of greenways fulfill people's physical and mental demands and the effect of greenways on people's physical and mental health. However, each cycling path has its own uniqueness so currently more data from different cycling paths is required to have a deeper understanding about what cycling paths could bring to people and what types of traits of cycling paths could attract more cyclists and fulfill their demands better.

2.2 Studies on Landscape Perceptions

Landscape perceptions could be easily linked to psychology as it reflects what people would think about an area. Many elements such as view and sound could affect people's landscape perceptions on an area directly. Lee and Son⁹⁾ focused on landscape perception theory and used visitor-employed photography and interviews to explore how different user groups perceive landscape elements in Bukhansan National Park in Seoul, Korea. The results showed that certain visual features could directly influence visitors' landscape perceptions and recreational satisfaction. Also, Li and Liu¹⁰⁾ studied how visual and auditory factors influence people's perception and restoration experiences. Their results also showed that many visual and auditory factors benefits the visitors directly and some specific visual and auditory factors could benefits specific types of restorativeness. Thus, in order to have a better understanding on cyclists' landscape perceptions, it is necessary to dig deep into their thoughts on the cycling path and find out what make them have such opinions and how such opinions are generated.

2.3 Studies on Place Preferences

Place preferences expresses how people evaluate and emotionally invest in a specific setting or environment. Kaplan and Kaplan¹¹⁾ framed preference as an informational process driven by visual qualities such as coherence, complexity, and mystery. This study became the foundation for many studies focused on place preferences after its publication. Satisfaction of places is also crucial as a part of place preferences and another study by Stedman¹²⁾ researched on people's satisfactions on areas around several North American lakes through on-site surveys and modeling of data. In addition, structural equation modeling (SEM) is also used in an ecotourism context and the results showed that place preference first boosts place attachment and such attachment could be used to predict the subjects' intentions of pro-environmental behavior¹³⁾. Overall, current studies studies imply that place preference arises from an interplay of visual cues, functional qualities, and personal meaning. Therefore, in order to understand cyclists' place preferences along a greenway, it is necessary to study the landscape's visible

elements and the mental and emotional processes that convert those elements into feelings of attachment, satisfaction, and the intention to visit or use the place.

2.4 Positioning of the Study

Other studies usually focus on greenways themselves or cyclists themselves. Many of current studies would prefer to observe the designs of greenways and safety settings of them. However, there is a lack of comprehensive study on cyclists' preferences of views and perceptions of the area along their cycling path. Besides, many studies focusing on people's landscape perceptions focus on park visitors instead of cyclists. In addition, even though there are studies focusing cyclists' choices of routes, such studies mainly focus on cyclists on common roads but not specifically designed greenway for cyclists or pedestrians. Thus, this study could fulfill the gap of lack of studies focuses on cyclists' comprehensive aesthetic demands and their preferences on greenways.

2.5 Target Site

In order to choose an ideal cycling spot and path, the target site must possess the following characteristics.

First, this cycling path must not be too far away from giant cities such as Tokyo or Osaka. If the path could be easily accessed from such giant cities, it is more likely to attract more casual or recreational cyclists. The locations of such paths could significantly increases the potential sample size and diversity of participants, allowing for the collection of more comprehensive data on riders with varying skill levels. Moreover, an accessible location facilitates on-site engagement and distribution of questionnaires, which could significantly improve the efficiency and effectiveness of data collection. Through this strategic placement, valuable insights can be obtained from a broader spectrum of cycling enthusiasts.

Second, the view from the path must have a high variety of landscape. This includes features such as lakes, mountains, forests, bridges, and other natural or artificial elements that contribute to the scenic beauty of the area. A high variety of landscapes not only enhances the aesthetic appeal but also offers a dynamic environment that could lead to different preferences and provide a sense of exploration and connection to the local environment for cyclists traversing the path.

Third, there must be at least one spot on the path that the cyclists would gather at. This spot could be a rest area, a viewpoint, a restroom, or any other location that could make cyclists to make a brief stop and interact. These gathering points are crucial for this study, as they provides chances to approach cyclists directly, distribute questionnaires, and collect feedback on their experiences and preferences. By choosing a route with such spots, the data-gathering process becomes more smooth and effective, ensuring a higher likelihood of successful engagement with participating cyclists.

Among all of the requirements , the cycling path

around Tama-lake is an ideal site for this study. It is located in Higashiyamato City and Tokorozawa City, which are both close to central Tokyo. Also, different types of sceneries such as forest, reservoir, residence houses, and bridges could be seen when cycling along this path. the total length of this cycling path is 11.82km, which is not too long so rookie cyclists could also come to this place. In addition, there are several gathering points such as rest spots and toilets so that cyclists would gather at these spots. Last but not least, different types of sceneries such as forest, reservoir, residence houses, and bridges could be seen when cycling along this path. Thus, the study would focus on this area.



Fig.1. Map of the Cycling Path Around Tama Lake ¹⁴⁾

3. RESEARCH FLOW AND METHOD

3.1 Research Flow

This study would be done following the flowchart shown in Fig.2.

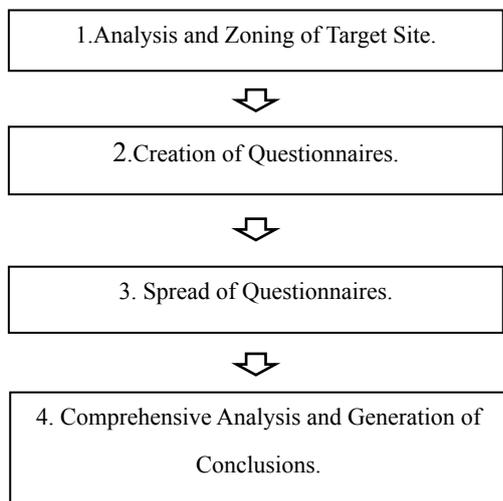


Fig.2. Flowchart of the Research

3.2 Research Process and Methods

As shown in Fig.2, this study will be conducted through 4 steps: Analysis and Zoning of Target Site, Creation of the Questionnaire, Spread of Questionnaires, and Comprehensive Analysis and Generation of Conclusions.

1) Analysis and Zoning of Target Site



Fig.3. Sections of the Cycling Path

Table.1. Photos and Information of Each Section

Park Sections 0.37km Average Slope: -0.002	
Dam Section 0.53km Average Slope: -0.001	
Peripheral Landmark Section 2.52km Average Slope: 0.006	
Bridge Sections 0.22km Average Slope: 0.029 (northern) Average Slope: -0.010 (southern)	
Forest Sections 6.29km Average Slope: 0.012 (northern bridge to highest point) Average Slope: -0.010 (highest point to southern bridge) Average Slope: -0.004 (southern bridge to town section)	
Town Section 1.89km Average Slope: -0.008	

In order to have a better understanding of the target site, especially the change of landscape and sceneries that cyclists would see in different parts of the path, panorama photos are taken along the whole cycling path. The photos are classified and analyzed according to their locations and sceneries that are taken. Besides, the slopes at different parts of the cycling path are also analyzed by ArcGIS.

According to the results of analysis on panorama photos and GIS data of slopes, the cycling path is divided into 6 sections as shown in Fig.3. Each part of the cycling path could offer different landscape and sceneries so the separation of the path has a difference on the length of each part in order to maintain the similarities of landscape and sceneries in each section. The cycling path is separated into 6 parts and the example scenery of each part is shown in Table.1. The photos shown are parts of panorama photos facing the direction of cycling taken along the path. The slopes are calculated in the counterclockwise direction along the path.

2) Creation of Questionnaires

Base on the results of analysis from step 1, questionnaire targeting on road-bike cyclists is created. The questionnaire has 4 pages and the questions are mainly about the cyclists' basic information, landscape perception on the path, place preferences of cycling paths, and sections preferences. Questions in page 1 and 4 are multiple choice questions and each cyclist could only choose one answer for each question. Questions in page 2 and 3 are score-rating questions that allow cyclists to see an opinion first and then choose from totally agree to totally disagree to show their opinions. The questionnaire have 44 questions in total.

Part 2 and 3 of the questionnaire will generate results for SEM analysis. Thus, the questions focusing on landscape perceptions and place preferences are classified into 5 groups in order to make the model for structural equation modeling analysis. The five latent variables and all 28 questions in these 2 parts are shown in Table.1. However, not all of the questions will be used for SEM analysis. The reasons that some questions that are not going to be used for SEM analysis are also shown in Table.1.

Table.1. Classification of Questions

Variables	Questions	Use/Not for SEM	Reasons if not use
Natural Environment	Q11: I love the plants along the cycling path.	Use	
Perception (NEP)	Q12: The plants are in their most beautiful colors these days.	No	Too season-dependent. Weight of questionnaires spread in different seasons is not the same.
	Q13: I cycle at this path mainly because of the view of plants.	Use	
	Q14: The animals in the area are lovely.	Use	
Waterbody & Open Landscape	Q15: I love the view of this reservoir.	Use	
Experience (WLE)	Q16: The view of the reservoir could make me feel comfortable.	Use	
	Q17: I like the atmosphere on the dam.	No	Functionally repeated with Q29.
	Q18: The small house inside the reservoir is pretty.	Use	
Built Environment Integration (BEI)	Q19: I like the sculptures at the end of the dam.	Use	

Variables	Questions	Use/Not for SEM	Reasons if not use
Built Environment Integration (BEI)	Q20: Seibu Dome (the giant baseball stadium along the path) fits in well with the surrounding environment.	No	The location is too specific so the results has no representative.
	Q21: The residential houses along the path are pretty.	Use	
	Q22: The bridges along the cycling path are designed very beautiful.	No	Functionally repeated with Q23.
	Q23: The view from the bridges is good.	Use	
Perceived Environmental Quality (PEQ)	Q24: Now is the best season to cycle around Tama Lake.	No	Too time-sensitive.
	Q25: The design of the greenway around Tama Lake is good.	Use	
	Q26: The greenway around Tama Lake is well managed.	No	Partially functionally repeated with Q25.
	Q27: The greenway is not crowded at all.	No	Could easily be affected by different spread time of questionnaires.
Perceived Environmental Quality (PEQ)	Q28: This area is a safe spot for cycling.	Use	
	Q33: The spread of rest spots along the path is reasonable.	Use	
	Q34: There are some dangerous points along the path.	No	Functionally repeated with Q28.
	Q29: I love cycling on the dam.	Use	
Affective Experience & Route Engagement (ARE)	Q30: I love cycling on the greenway below the trees.	Use	
	Q31: The slopes along the greenway make the cycling path interesting.	No	Highly depend on cyclists themselves interest on slopes.
	Q32: The leaves along the path increase the difficulty of this path.	No	Results could be highly affected by seasons.
	Q36: Cycling in this area makes me feel comfortable.	Use	
Perceived Route Desirability (PRD)	Q35: Compare to other cycling paths, this area has its own uniqueness.	No	Emphasis on comparison instead of direct preference
	Q37: This is my favorite path for cycling.	Use	
	Q38: I would recommend my friends to cycle here.	No	Mainly about social behavioral intention, not own preference.

3) Spread of Questionnaires

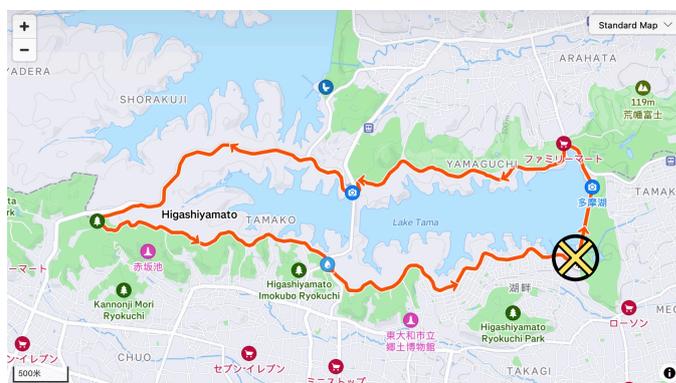


Fig.4. Location of Spread of Questionnaire

The questionnaires would be spread hand to hand at a rest spot along the cycling path around Tama Lake. Questionnaires would be spread at a rest spot next to a

lavatory where the cyclists would gather at. The questionnaires would only be spread to road-bike cyclists. The spot of spread is shown in Fig.4.

4) Comprehensive Analysis and Generation of Conclusions

Structural equation modeling (SEM) will be applied to the data from questionnaires in order to trace the pathways that connect cyclists' landscape perceptions to their place preferences and furthermore to their overall satisfaction and overall intentions. First, a measurement model that latent constructs are defined by their respective survey items about landscape perception will be specified. Then, estimate the structural model to evaluate how they influence the cyclists' place preferences and how the perceptions shape cyclists' overall satisfaction the intention to visit or use this cycling path. When the model fit is acceptable rates, which are $CFI \geq 0.90$ and $RMSEA \leq 0.06$, inspect standardized path coefficients to identify the strongest causal links. Finally, link the results from SEM analysis to GIS analysis and find which features are the most effective ones to lead to good place preferences and high overall satisfaction on the path. Thus, data-supported basis for targeted greenway improvements could be made.

4. RESULTS

4.1 Basic Information of the Participants

Table.2. Date of Spread of Questionnaires

Time	Weather	Amount of Spread	Amount of Usable Questionnaire Collected
2025/1/14	Sunny	10	10
2025/2/9	Sunny	2	2
2025/2/23	Sunny	11	11
2025/2/24	Sunny/ windy	8	8
2025/3/22	Sunny	4	4
2025/4/7	Small rain	1	1
2025/6/21	Sunny/ Windy	14	14
2025/6/22	Sunny/ Windy	15	15
2025/6/23	Sunny/ Windy	4	4
2025/6/28	Sunny	5	5
2025/6/29	Sunny/ Windy	22	22
2025/6/30	Sunny/ windy	7	7

The questionnaires were spread at the biggest gathering spot of cyclists located in the park section from January 14th, 2025 to June 30th, 2025 as shown in Table.2.

4.2 SEM Analysis

4.2.1 Steps and Results of SEM Analysis

In order to quantify the study's hypothesized relationships, structural equation modeling (SEM) is used to guide both questionnaire construction and data analysis. Drawing on the literature and an initial factor check, all items related to landscape perceptions and place preferences are grouped into six latent constructs, which make up the measurement model. On this basis, the structural model specifies the causal paths among the latent variables. Then, it is possible to test how landscape perceptions influence place preferences, satisfaction, and behavioral intentions. SEM is chosen because it simultaneously estimates measurement error and structural coefficients, providing reliable statistical support for the theoretical framework.

This study hypothesizes all latent variables have an effect on one dependent variable, which is cyclists' Perceived Route Desirability, or PRD. The hypothesized model is shown below in Fig.5. In order to maintain the accuracy and stability of the model, for each latent variables, only results of 3 representative questions will be used in the SEM analysis.

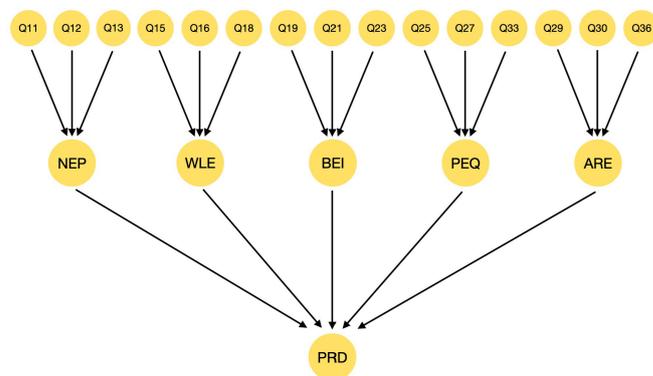


Fig.5. Hypothesis Model of this Study

Table.3. Results of SEM Analysis

Group	Estimate	Standard Error	Z-value	P	Std. Iv	Std. all	Result
NEP to PRD	0.780	0.401	1.943	0.052	0.282	0.282	
WLE to PRD	0.853	0.178	4.781	<0.001	0.466	0.466	Pass
BEI to PRD	1.019	0.267	3.812	<0.001	0.471	0.471	Pass
PEQ to PRD	0.948	0.245	3.868	<0.001	0.621	0.621	Pass
ARE to PRD	1.316	0.347	3.789	<0.001	0.745	0.745	Pass

The results of SEM analysis of each latent variables on PRD, the only dependent variable is shown in Table.3. The results indicates that other than natural environment perception, all other 4 latent variables exert positive influences to cyclists' perceived route desirabilities. The model is shown in Fig.6.

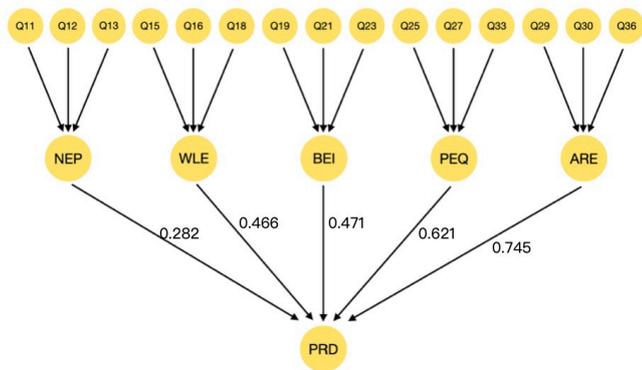


Fig.6. Diagram of SEM Analysis Results

4.2.2 Discussions on Overall SEM Analysis

According to the results from SEM analysis, Waterbody & Open Landscape Experience has a positive influence to cyclists' perceived route desirabilities. To be more specific, the standardized coefficient (Std.all = 0.466, $p < 0.001$) indicates a moderately strong effect, suggesting that the presence of water features and expansive natural views contributes meaningfully to how strong cyclists are attracted by a cycling route. This finding indicates that incorporating waterbody elements, such as lakes, rivers, and open landscapes, into cycling infrastructure design may enhance perceived value and promote greater route engagement among cyclists.

Besides, the results of SEM analysis showed that built Environment Integration exerts a statistically significant positive influence on cyclists' perceived route desirability. The standardized coefficient (Std.all = 0.471, $p < 0.001$) indicates a moderately strong effect, suggesting that the visual and experiential integration of man-made structures—such as bridges, sculptures, and residential houses—into the cycling landscape significantly enhances cyclists' overall perception of route quality. This finding highlights the importance of aesthetic and cultural value provided by built features, especially when they are thoughtfully designed to harmonize with the surrounding environment. Rather than serving solely functional purposes, these structures contribute to the scenic and symbolic richness of the route, creating a more engaging and memorable cycling experience.

In addition, Perceived Environmental Quality was found to have a statistically significant and relatively strong positive influence on cyclists' perceived route desirability (Std.all = 0.674, $p < 0.001$). This indicates that cyclists place considerable importance on practical and experiential aspects of route design, especially the quality of the cycling infrastructure itself, the level of crowding

along the path, and the availability and distribution of rest spots. As the influence is relatively strong, it suggests that a well-designed, comfortably spaced, and user-oriented cycling environment substantially enhances overall perceptions of route attractiveness. Such findings stated the importance of user-centered design in cycling paths and suggest that optimizing path layout and rest point integration can significantly improve satisfaction and promote greater usage of the cycling path.

Last but not least, Affective Experience & Route Engagement was found to exert a statistically significant and strong positive influence on cyclists' perceived route desirability (Std.all = 0.745, $p < 0.001$). These questions captures cyclists' emotional responses and psychological comfort during the ride, as reflected in their enjoyment of specific spatial features such as riding on the dam or riding along the path under the trees and their overall sense of ease while cycling in the area. As a result, it is necessary to design the paths not only meet the functional needs but also provide emotionally rich and aesthetically pleasing experiences so that cyclists' both physical and mental demands could be fulfilled and the track would be more attractive.

4.2.3 Discussions on SEM Analysis According to Cyclists' Ages

Table.4. Results of SEM Analysis According to Cyclists' Ages

Group	Estimate	Standard Error	Z-value	P	Std. lv	Std. all	Result
NEP to PRD (50-)	1.213	0.712	1.703	0.089	0.309	0.309	
NEP to PRD (50+)	1.409	0.645	2.185	0.029	0.524	0.524	
WLE to PRD (50-)	0.978	0.381	2.568	0.010	0.334	0.334	
WLE to PRD (50+)	0.915	0.210	4.347	<0.001	0.632	0.632	Pass
BEI to PRD (50-)	2.086	1.262	1.652	0.098	0.461	0.461	
BEI to PRD (50+)	0.812	0.189	4.304	<0.001	0.599	0.599	Pass
PEQ to PRD (50-)	0.995	0.497	2.002	0.045	0.560	0.560	
PEQ to PRD (50+)	1.467	0.469	3.131	0.002	0.872	0.872	
ARE to PRD (50-)	1.689	1.107	1.526	0.127	0.704	0.704	
ARE to PRD (50+)	1.150	0.278	4.137	<0.001	0.823	0.823	Pass

For cyclists' ages, the cyclists are classified as "below 50 years old" and "above 50 years old" considering the median age of Japan, which is 48 years old¹⁵⁾ and the size of samples. The results of SEM calculation is shown in Table.4 and the model is shown in Fig 7. The results showed for cyclists below 50 years old, no latent variables showed significant positive influence on cyclists' perceived route desirability. However, for cyclists above 50 years old, Waterbody & Open Landscape Experience, Built Environment Integration, and Affective Experience & Route Engagement showed positive influence on their perceived route desirability. These results suggest that older cyclists may be more sensitive to environmental and

emotional aspects of the route, such as scenic views, integration of built features, and overall feelings of comfort and enjoyment during the ride. Their route preferences are more closely tied to experiential and aesthetic qualities rather than functional aspects of the cycling environment.

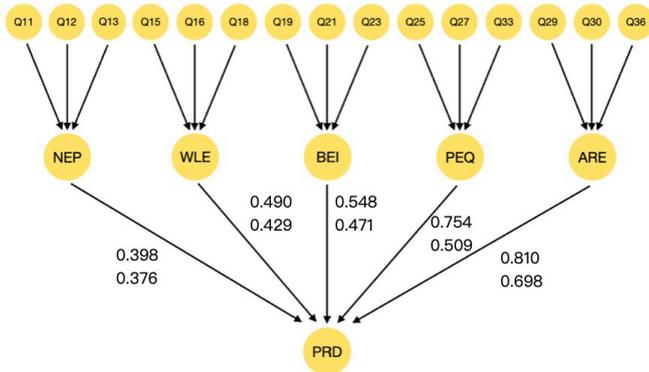


Fig.7. Diagram of SEM Analysis Results According to Cyclists' Ages

4.2.3 Discussions on SEM Analysis According to Cyclists' Weekly Average Cycling Distance

Table.5. Results of SEM Analysis According to Cyclists' Average Cycling Distance per Week

Group	Estimate	Standard Error	Z-value	P	Std. lv	Std. all	Result
NEP to PRD (Casual)	1.067	0.745	1.432	0.152	0.398	0.398	
NEP to PRD (Regular)	1.124	0.520	2.162	0.031	0.376	0.376	
WLE to PRD (Casual)	0.697	0.184	3.793	<0.001	0.490	0.490	Pass
WLE to PRD (Regular)	0.931	0.249	3.733	<0.001	0.429	0.429	Pass
BEI to PRD (Casual)	0.914	0.216	4.241	<0.001	0.548	0.548	Pass
BEI to PRD (Regular)	1.245	0.712	1.748	0.081	0.471	0.471	
PEQ to PRD (Casual)	1.710	0.995	1.718	0.086	0.754	0.754	
PEQ to PRD (Regular)	0.607	0.361	1.683	0.092	0.509	0.509	
ARE to PRD (Casual)	1.312	0.549	2.390	0.017	0.810	0.810	
ARE to PRD (Regular)	1.284	0.494	2.597	0.009	0.698	0.698	

For the cyclists' average cycling distance per week, considering the recommendation from WHO that "people should do at least 150 minutes of moderate-intensity physical activity per week"¹⁶⁾, cyclists are divided as "casual cyclists" who cycle less than 50km per week and "regular cyclists" who cycle more than 50km per week. The results of SEM analysis according to cyclists' average weekly cycling distance is shown in Table.5 and Fig.8. According to the results, Waterbody & Open Landscape

Experience showed positive influence on both casual cyclists' and regular cyclists' perceived route desirability. This could show that water features and open landscapes are widely appreciated, regardless of how professional the cyclist is. Besides, Built Environment Integration showed positive influence on casual cyclists but not regular cyclists. This may indicate that those who cycle less frequently are more responsive to the visual and cultural presence of built features along the route but regular cyclists might place greater emphasis on other aspects of the riding experience.

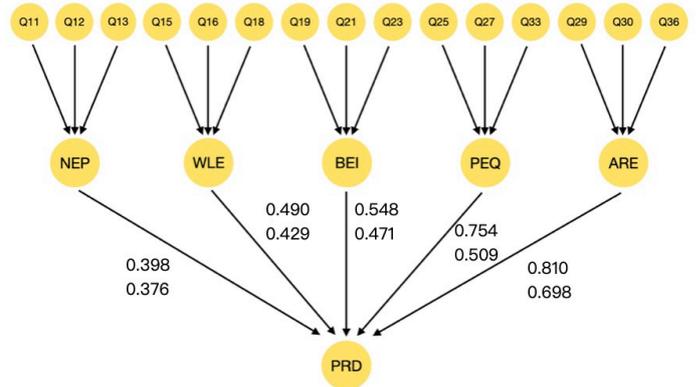


Fig.8. Diagram of SEM Analysis Results According to Cyclists' Average Cycling Distance per Week

4.3 Sections Analysis

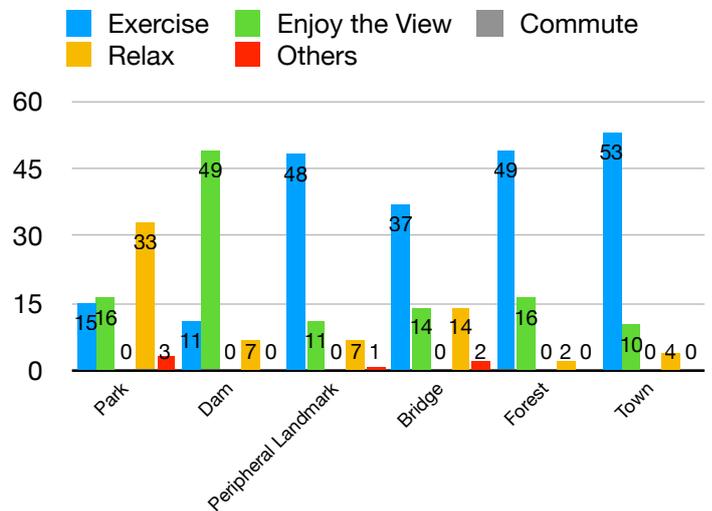


Fig.9. Cyclists' Preferred Behaviors in Each Section

Part 4 of the questionnaire focus on what the cyclists mainly do while cycling in each section. As the cycling path around Tama Lake offers a variety of landscapes and environmental features, cyclists may engage in different activities or focus on different aspects depending on the specific segment they are in. For example, some sections may encourage higher cycling speed or higher climb, while others may make cyclists to slow down and enjoy the scenery. This part of the questionnaire aims to capture

these behavioral patterns and understand how environmental context influences cyclists' behaviors. The results are shown in Fig.9.

For the park section, the results indicate that nearly half of the cyclists primarily use this section to relax, making it the most common activity reported. The aesthetic appeal of the park environment is also highlighted as it accounts for 24% of all responses. Exercise-related cycling makes up 22%, suggesting that some cyclists also consider this area as suitable for light physical activity. These findings suggest that the park section serves primarily as a place for relaxing instead of traveling in high speed.

Besides, for the dam section, the data reveal that a significant majority of cyclists (73%) primarily engage in enjoying the view while passing through this area, underscoring the strong scenic value of the dam landscape. This could also be due to the wide angle of sight on the dam that make cyclists want to slow down and enjoy. Exercise accounts for 16% of responses, suggesting that some of the cyclists still focus on exercising and may want to make use of the long straight line on the dam. Only 10% of cyclists reported using the dam section for relaxation, and no respondents indicated commuting or other activities. Such results shows that the dam area is a highly visually engaging part of the route and cyclists are more likely to slow down or even pause to enjoy the view rather than use it for speed or transportation purposes. The distinct behavioral pattern in this section reflects the powerful influence of the physical environment on cyclists' experiential engagement.

In addition, for the peripheral landmark section, most cyclists (72%) uses this section for exercising, indicating that its extended length and relatively uninterrupted design of road may be well-suited for long-time physical activity. In contrast, only 16% of cyclists reported enjoying the view as their main activity, suggesting that this section may be perceived as more functional than scenic. Considering this section does not have wide angle of sights as the dam section do, it is reasonable that this section is mainly used for exercising. Such results indicates that less visually stimulating sections may encourage a more fitness-oriented style of engagement instead of sightseeing engagements.

For bridge sections, although more than half of the cyclists choose to exercise on the bridges, more cyclists would tend to enjoy the view or relax on the bridge. The view on the bridges would be wider than that of in the previous and next sections of the path. However, as the bridges are not so long, more cyclists still choose to pass the bridge directly instead of slow down. Such results indicate that although the bridges have very good scenic potential, its short distance still makes it not so attractive in landscape and sceneries.

Also, for forest section, the longest section along the path, most cyclists uses this section for exercising, indicating its long length and relatively uninterrupted locations of path may be well-suited for long-time physical activity. Besides, the angle of sight is not wide in this

section and the high amount of slopes and curves makes cyclists hard and dangerous to rest in this section. In addition, the highest point along the whole path is also in this section so the cyclists must climb first and then fully focusing on going down along the path while passing many curves carefully. Thus, although the view of the forests is unique, most cyclists still choose to focus on exercising, indicating indicating safety designs and terrain strongly shape the cyclists' behaviors.

Last but not least, the results of cyclists' preferred behaviors in town section is shown in Fig.15. As the last section of the path, about 4/5 cyclists choose to exercise in this section. This may be due to its close distance to the park section where restrooms and vending machines are available. Also, the angle of sight in this section is similar to that of in peripheral landmark section, which also leads to less relax and view enjoyment. However, as it is close to park section, the amounts of cyclists who choose to relax increases compare to in forest sections. this section serves as a transitional space where physical exertion remains dominant but relaxation becomes more feasible.

5. Conclusions and Future Research Plan

5.1 Conclusions

5.1.1 Key Findings from SEM Analysis

The SEM results reveal several key factors influencing cyclists' perceived route desirability. Affective Experience & Route Engagement had the strongest positive effect (Std.all = 0.745, $p < 0.001$), highlighting the importance of emotional connection, spatial enjoyment, and psychological ease in shaping route preference. Perceived Environmental Quality also showed a strong effect (Std.all = 0.621, $p < 0.001$), reflecting the value of practical aspects like path design, safety, and rest spots. Additionally, Built Environment Integration (Std.all = 0.471, $p < 0.001$) and Waterbody & Open Landscape Experience (Std.all = 0.466, $p < 0.001$) contributed positively, emphasizing the role of well-incorporated built structures and scenic openness in enhancing the cycling experience. Subgroup analysis revealed clear differences: older cyclists (50+) showed significant positive associations with all four variables (except Natural Environment Perception), while younger cyclists (<50) showed no statistically significant effects. Moreover, casual cyclists were more influenced by built features than regular ones. These findings suggest diverse user preferences and the importance of tailored design approaches.

5.1.2 Behavioral Patterns Along the Route

Spatial behavior analysis reveals that cyclists engage with route segments differently based on environmental characteristics. Scenic areas like dams and waterfronts encourage visual enjoyment and affective engagement, often serving as moments of rest or reflection due to their openness and rich views. In contrast, linear segments such as forested paths and peripheral areas support exercise-oriented behavior, offering continuity and flow favored by regular cyclists seeking uninterrupted movement.

Transitional spaces such as bridges and residential zones exhibit multifunctional use. While some cyclists pass through quickly, others slow down or relax without fully stopping. These behaviors are shaped by spatial cues like slope, curvature, and environmental clarity. Overall, the analysis shows that cyclists' engagement varies significantly along the route, with specific spatial features inviting distinct interactions. This highlights the importance of designing and managing each segment not as a neutral connector but as an experiential component tailored to varied user needs and behavior.

5.2 Future Plan

This study's SEM analysis revealed significant relationships between landscape perception, place preference, and cyclists' perceived route desirability. However, several limitations suggest directions for future researches. The use of broad, non-stratified sampling may have skewed group representation so future studies could adopt stratified sampling to better capture age, cycling habits, and cultural differences. Subgroup analysis showed that older cyclists respond more to affective and aesthetic cues, while casual and regular cyclists focus on different built features. Expanding the model to include behavioral variables and use GPS or sensor data could enhance its real-world relevance. Seasonal and weather effects also warrant investigation. Finally, applying the model across different cities or countries could validate its broader applicability and uncover context-specific insights, particularly valuable for planning age-inclusive, sustainable cycling infrastructure.

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