

# Exploring the Behavior of Recreational Bicyclists: an Empirical Study in Danshuei and Bali, Northern Taiwan

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**Abstract**—The Taiwan government has invested approximately 21 billion NT dollars in the construction of bicycle paths since bicycling has gained huge popularity as a healthy leisure and recreational activity. This study focuses on the behavior of recreational bicyclists in Danshuei and Bali, northern Taiwan. Data were collected from a field investigation carried out along the Danshuei bicycle path and Bali left-bank bicycle path. A total of 578 questionnaires were gathered for data analysis. Descriptive statistics and Chi-Square tests were used to assess bicyclists' behaviors. The frequency shows that, in these areas, Danshuei and Bali, most bicyclists rented bicycles, rode the bicycle path in the afternoon for about 2 hours. They used the bicycle path one time per week. For most, it was the first time to ride these bicycle paths. There were significant differences in distribution of bicycle ownership, time of day, duration of ride, ride frequency, and whether riding occurred on weekdays or weekends. Results indicated that most bicyclists in Danshuei and Bali were infrequent users.

**Keywords**—recreational bicyclist, bicyclist behaviors, Northern Taiwan

## I. INTRODUCTION

IN recent years, cycling has become a popular activity in many countries, with Holland, Japan, Germany and England having established elaborate bicycle lane systems. In the face of soaring oil prices and the need for the promotion of energy saving and CO<sub>2</sub> emission reduction, the bicycle is once again gaining popularity worldwide [1]. Taiwan has been recognized as a world leader in bicycle manufacturing whereby many Europeans are proud of having a bicycle that is *Made In Taiwan* because of its high quality, durability and innovative in design. However, encouraging bicycle usage as a means of transportation in Taiwan has always been an issue confronting

local transportation authorities and the bicycle manufacturing industry. The low popularity of bicycle usage is evident in the rate of bicycle ownership in the affluent capital city, Taipei, only 0.25 per household. There is a serious lack of variety in transit choices for work, leisure and living [2]. However, Taiwan society experienced a transition from an agricultural to an industrial society at the beginning of the twentieth century. Quality of life has been enhanced due to this country's economic development [3-4]. Success has led to increased leisure followed by increasing demand for recreational and tourism activities by more and more members of society. Bicycle touring has become an increasingly important mode of vacation or holiday transport [5-7]. Tourism related bicycle lane construction projects are currently being planned and implemented throughout Taiwan. In the late 90s, the plan for development of land between the Danshuei River and Hsintien Creek led to construction of the first bicycle lanes for recreational purposes in Taiwan [2].

Popularity has led to increasing investment in bicycle tourism. Both central and local governments have been trying to stimulate the development of tourism and recreational cycling. The central government launched its policy for the Planning and Establishment of Bikeway Systems in Taiwan in 2002. Approximately 21 billion New Taiwan Dollars (NTD) will be invested in the program over five years. The National Development Plan also stresses the importance of building a national bikeway system [8-9] in view of the fact that more and more people are becoming involved in this activity [1]. Danshuei and Bali, located on opposing sides of the Danshuei River mouth, have the advantages of beautiful landscape and being very close to Taipei. Thus, the Danshuei bicycle path and Bali left-bank bicycle path have become the popular destinations in northern Taiwan (Fig. 1).

This study looks at usage of these two bicycle paths. A questionnaire survey is used to probe bicyclists' behaviors, including the ownership of the bicycle, the times people like to ride the bicycle path, duration of the ride, when they ride and how many times per week. Finally, we offer conclusions and propose suggestions for criteria that would help the government to plan new bicycle paths and renovate old ones.

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\*A-B Danshuei bicycle path A-C Bali left-bank bicycle path

Fig.1. Location of study site.

## II. METHOD

In order to probe into the behavior of bicyclists using the Danshuei and Bali left-bank bicycle paths in northern Taiwan we surveyed participants at the Shihnsanhang Museum of Archaeology in Bali, an important scenic point along the Bali left-bank bicycle path, and the Metro Transport (MRT) station in Danshuei, an important resting point along the Danshuei bicycle path, on both weekdays and weekends. The public squares in front of the museum and the MRT station are used by bicyclists to take a break, rest and gather. This makes these suitable sites for researchers interested in talking to bicyclists using these bicycle paths. Systematic sampling was carried out on twenty-one days. Each day was divided into four three-hour sample periods between 8 a.m. and 8 p.m. During each selected period, the researchers asked bicyclists stopped at the Shihnsanhang Museum of Archaeology or MRT station whether they would agree to complete a questionnaire. The questionnaire included two parts. The first part was comprised of questions related to the bicyclist's behavior, include "Which time do you prefer to ride the bicycle path", "On which day do you prefer to ride the bicycle path", "Which period do you prefer to ride the bicycle path", "What is the duration of your ride", "How many times do you ride on this bicycle path per week", and "How did you obtain information about this bicycle path". The second part of the questionnaire included questions about the bicyclist's profile such as "gender", "age", "bicycle ownership" and "domicile". The non-probability sampling technique and accidental sampling methods were used to collect a sample of 631 bicyclists. A total of 578 questionnaires were completed. The rest were not completed for unknown reasons. The response rate was 91.6% which is deemed very acceptable for purposes of social research [10]. A total of 578 questionnaires were used in the data analysis. Frequency distribution and percentage were used to create a descriptive profile including the behavior and domicile of the bicyclist. Chi-Square testing, Wilcoxon rank sum testing and Kruskal-Wallis testing were used to test distribution differences in behavior of the individuals. All of the results described below are significantly different, significant at a level of  $p < .05$ . The analysis software used is the SPSS12.0 package.

## III. RESULTS

### A. Bicyclists' profile

Two statistical techniques were used to analyze the response to the questions. Descriptive analysis was conducted to answer study questions relevant to the frequency distribution for the bicyclists' profile and behavior. The results are presented in Table 1 and Table 2. As can be seen in Table 1, considering the overall sample of respondents, males were slightly in the majority (50.35%). In terms of age groups, under 30 years age group was the largest (43.08%), followed by 31-50 years (37.89%). Most of the respondents were from Taipei City or Taipei County (78.72%). Of the 578 respondents, 313 (54.15%) used rented bicycles and 265 (45.85%) used his or her own.

TABLE I  
FREQUENCY DISTRIBUTION OF BICYCLIST' PROFILE FOR DANSHUEI AND BALI

	Variable	Frequency	%
Gender	Male	291	50.35
	Female	287	49.65
Age	Under 30	249	43.08
	31 to 50	219	37.89
	Above 51	110	19.03
Domicile	Taipei city or Taipei county	455	78.72
	Out of Taipei	123	21.28
Bicycle ownership	Own	265	45.85
	Rent	313	54.15

### B. Bicyclists' behaviors

As to frequency distribution and chi-square test of the bicyclists' behaviors, according to Table 2, most of bicyclists (49.83%, chi-square value was 115.976,  $p < .05$ ) were rode the bicycle path in Danshuei and Bali, no matter weekend or weekday.

TABLE II  
FREQUENCY DISTRIBUTION OF BICYCLIST' BEHAVIORS IN DANSHUEI AND BALI

		n	%	$\chi^2$
Which day	Weekend	211	36.51	115.976*
	Weekday	79	13.67	
	Both	288	49.83	
Which period	Morning	138	23.88	301.848*
	Midday	66	11.42	
	Afternoon	317	54.84	
	Evening	57	9.86	
Duration	1 hour less	175	30.28	166.972*
	1 to 2 hours	252	43.60	
	2 to 3 hours	108	18.69	
	3 hours more	43	7.44	
How many times per week	1 time	413	71.45	675.343*
	2 times	83	14.36	
	3 times	53	9.17	
	4 times more	29	5.02	
How information was obtained	Internet	179	30.97	162.740*
	Magazine	94	16.26	
	TV or Radio	44	7.61	
	Bicycle Shop	51	8.82	
	Waymark	75	12.98	
	Official Information	45	7.79	
	Other Information	90	15.57	

More than 50% of bicyclists (54.84%, chi-square value was 301.848,  $p < .05$ ) rode in the afternoon. The ride duration for 73.88% (chi-square value was 166.972,  $p < .05$ ) on the bicycle

path was less than 2 hours. Of the 578 respondents, 179 (30.97%, chi-square value was 675.343,  $p < .05$ ) had found information about the Danshuei and Bali bicycle paths on the internet (30.97%, chi-square value was 162.740,  $p < .05$ ), followed by Magazine (16.26%). As the results indicate bicyclists preferred to ride the paths 1 time per week, in the afternoon, for about 2 hours. Most had obtained information for the internet or magazines, and showed no preference for weekdays or weekends.

### C. Bicyclists' behavior divided by profile

The results of the Wilcoxon rank sum test and Kruskal-Wallis test for distribution differences in behavior of bicyclists are shown in Table 3 to Table 6. According to Table 3, there was a big difference in preferred riding period between male and female bicyclists (Z value was -2.357,  $p < .05$ ). Male bicyclists preferred riding the bicycle path in the morning, but female bicyclist liked the afternoon (see Table 4).

TABLE III  
BICYCLISTS' BEHAVIOR DIVIDED BY DIFFERENT GENDER

	Gender	Rank Sum	Z-value
Which day	Male	83003.00	0.496
	Female	84328.00	
Which period	Male	79962.50	-2.357*
	Female	87368.50	
Duration	Male	81619.00	-1.392
	Female	85712.00	
How many times per week	Male	86341.00	-1.314
	Female	80990.00	
How to get information	Male	83694.00	-0.280
	Female	83637.00	

\*significant at 0.05

In contrast, male and female bicyclists preferred the same day (Z value was .496,  $p > .05$ ), duration of ride (Z value was -1.392,  $p > .05$ ), times per week (Z value was -1.314,  $p > .05$ ) and how information was obtained (Z value was -.280,  $p > .05$ ).

TABLE IV  
DIFFERENT GENDER PREFER PERIOD

		Male	Female
Which period	Morning	85	53
	Midday	36	30
	Afternoon	137	180
	Evening	33	24

Table 5 shows that there were differences in behavior for bicyclist of different ages such as how many times per week they rode (Z value was 7.843,  $p < .05$ ) and how they obtained information about the path (Z value was 7.167,  $p < .05$ ). As can be seen in Table 6, bicyclist's aged over 30 used the bicycle paths more times per week than those under 30. Those under 50 years old preferred getting information about the bicycle path from the internet (see Table 6).

TABLE V  
BICYCLISTS' BEHAVIOR DIVIDED BY DIFFERENT AGE

	Age	Rank Sum	Z-value
Which day	Under 30	290.71	.034
	31 to 50	289.05	
	Above 51	287.65	
Which period	Under 30	300.14	3.368
	31 to 50	287.91	
	Above 51	268.58	
Duration	Under 30	276.24	3.135
	31 to 50	298.95	
	Above 51	300.71	
How many times per week	Under 30	271.74	7.843*
	31 to 50	303.31	
	Above 51	302.22	
How to get information	Under 30	271.53	7.167*
	31 to 50	294.34	
	Above 51	320.55	

\*significant at 0.05

However all bicyclists exhibited the same behaviors in choice of day (Z value was .034,  $p > .05$ ), period they (Z value was 3.368,  $p > .05$ ) and duration of (Z value was 3.135,  $p > .05$ ).

TABLE VI  
DIFFERENT AGE PREFER TIMES PER WEEK AND WAY TO GET INFORMATION

		Under 30	31 to 50	Above 51
How many times per week	1 time	193	144	76
	2 times	28	45	10
	3 times	20	19	14
	4 times more	8	11	10
How to get information	Internet	85	66	28
	Magazine	38	42	14
	TV or Radio	24	12	8
	Bicycle Shop	20	17	14
	Waymark	36	27	12
	Official Information	26	10	9
	Other Information	20	45	25

Bicyclists showed the same behaviors regardless of domicile as shown in Table 7. In other words, bicyclists who live in Taipei City, Taipei County or Out of Taipei chose the same behaviors in terms of day, period, duration, times per week and way information was obtained (Z values were -0.116 to -1.481,  $p > .05$ ).

TABLE VII  
BICYCLISTS' BEHAVIOR DIVIDED BY DIFFERENT DOMICILE

	Domicile	Rank Sum	Z-value
Which day	Taipei city or Taipei county	131896.00	-0.116
	Out of Taipei	35435.00	
Which period	Taipei city and Taipei county	130827.00	-0.602
	Out of Taipei	36504.00	
Duration	Taipei city and Taipei county	134009.00	-1.481
	Out of Taipei	33322.00	
How many times per week	Taipei city and Taipei county	132810.00	-0.833
	Out of Taipei	34521.00	
How to get information	Taipei city and Taipei county	131948.50	-0.140
	Out of Taipei	35382.50	

\*significant at 0.05

As can be seen in Table 8, there were differences in behavior between bicyclists who rented bicycles, in terms of choice of day, period, times per week and way information was obtained (Z values were -1.973 to -5.007,  $p < .05$ ) and other bicyclists. However all bicyclists had the same behavior in terms of duration (Z value was -1.576,  $p > .05$ ).

TABLE VIII  
BICYCLISTS' BEHAVIOR DIVIDED BY DIFFERENT BICYCLE OWNERSHIP

	bicycle ownership	Rank Sum	Z-value
Which day	Own	67619.00	-5.007*
	Rent	99712.00	
Which period	Own	69457.00	-4.010*
	Rent	97874.00	
Duration	Own	79679.50	-1.576
	Rent	87651.50	
How many times per week	Own	83592.00	-4.325*
	Rent	83739.00	
How to get information	Own	80582.50	-1.973*
	Rent	86748.50	

\*significant at 0.05

According to Table 9, bicyclists who rent bicycles prefer to ride on the bicycle path anytime during the whole week, in the afternoon, 1 time per week and get information from the internet.

TABLE IX  
DIFFERENT OWNERSHIP PREFER DAY, PERIOD, TIMES PER WEEK AND WAY TO GET INFORMATION

		Own	Rent
Which day	Weekend	124	87
	Weekday	37	42
	Both	104	184
Which period	Morning	99	39
	Midday	25	41
	Afternoon	103	214
	Evening	38	19
How many times per week	1 time	164	249
	2 times	57	26
	3 times	27	26
	4 times more	17	12
How to get information	Internet	72	107
	Magazine	45	49
	TV or Radio	21	23
	Bicycle Shop	25	26
	Waymark	33	42
	Official Information	16	29
	Other Information	53	37

#### IV. DISCUSSION

The purpose of this study is to examine the behaviors of bicyclists using the bicycle paths in Danshuei and Bali in northern Taiwan. Bicyclists in northern Taiwan were approximately 50% male and 50% female. Most bicyclists, who ride these paths are under 50 years old (>80%), live in Taipei City or Taipei County (78%) and rent the bicycles they rode (55%). The results presented above lead to the following conclusions. All disparate age populations participated and most bicyclists choose bicycle paths near their residence.

Bicyclists in Northern Taiwan prefer to ride when they have free time, regardless of whether on the weekday or weekend. They also prefer to ride in the afternoons, perhaps because most families get up later during holidays and the temperature is cooler. Most bicyclists ride for 1 to 2 hours 1 time per week. Residents in Taiwan are constrained by the time paid to work or learning. Construction of bicycle networks is proceeding very well in Taiwan, and northern Taiwan bicyclists prefer to search

for information on tourism on the internet. Finally, we build a profile of bicyclists preferred behavior. Male bicyclists prefer to ride at different times than female bicyclists: males prefer mornings and afternoons but females just prefer afternoons. Female bicyclists prefer afternoons, because they care more about skin protection. Young bicyclists under 30 years old, who have to work and are familiar with computers, prefer to ride fewer times per week and get information from the internet.

#### V. CONCLUSION

This paper provides new information about the behavior of bicyclists in northern Taiwan. As previously noted, most northern Taiwan bicyclists are light users, live in Taipei, prefer to ride when they have free time, prefer the afternoon, ride 1 time per week, less than 2 hours each time and get information from the internet. We also note the influence on behavior of the bicyclists' profile including gender, age and bicycle ownership, as well as domicile. The results have clear implications for bicycle path administrators who should pay attention to how to attract bicyclists who live in nearby Taipei. Another issue is that most bicyclists like to ride in the afternoon, so administrators should arrange more services to take care of bicyclists at that time. The final issue is how to provide more information. As we know most bicyclists obtain information about tourism activities and history to attract more tourists from the internet.

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