Factors Influencing Walkability and Bicycle Use in a Medium-sized city: The Case of Iloilo City

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Abstract: This study identified the factors that influence walking and bicycle use in a medium-sized city of the Philippines. The study analyzed data collected from a survey of 400 samples using a 23-item questionnaire aimed to subjectively measure the psychological, physical environmental, security, and external factors that influence walking and bicycle use, along with socio-economic factors. Test for association and correlation showed that gender, educational level, age, and ownership of private vehicles and bicycles are associated with the propensity to walk and use bicycles. Models that best predict the outcome for the four conditions of likelihood to walk and bicycle use were generated using multiple linear regression. Results show that the strongest predictor for walking is the physical environmental factor of functionality; i.e., walking as the most convenient mode for shorter trips. Bicycle use is similarly strongly influenced by the same perception on the physical environmental factor; i.e., cycling as the most convenient mode of transport to getting around the city, and strong personal preference for bicycle use over public transport. Deterrents to both modes were also discussed, along with practical recommendations to increase modal share of walking and bicycle use.

Keywords: Walkability, Bicycle use, Medium-sized city, Multiple Linear Regression

1. INTRODUCTION

Many cities in developed countries have embraced the paradigms of sustainable urban mobility through the expansion of public transport coverage and promotion of human-powered modes such as walking and bicycle use. Mobility as a universal human right (United Nations Human Settlements Programme, 2013) is further promoted by the UN Sustainable Development Goals (SDG), particularly SDG 11, which targets safe, inclusive and sustainable cities by 2030.

The crafting of the National Environmentally Sustainable Transport Strategies (NESTS) in 2011 paved for the participation of the country in the promotion of sustainable mobility, and address the negative effects of motorization brought about by rapid urbanization. However, despite this, high modal share for active transport modes remain elusive. Studies have found that in Metro Manila, nearly 35% of destinations are within a 15-minute walk or bicycle trip, and yet majority of short trips are made by jeepneys, tricycles and even cars (Leather et al., 2011). Given the seemingly undesirable direct and indirect effects of owning and using a car, people still remain attracted to it. Other cities in the Philippines, like Iloilo City are also experiencing continued increase in private car use. Although public transport use is high at 80-85% (Almec Corporation, 2015)the absence of local programs and policies to improve public transport service, and curb car ownership and use could have negative impacts on the future traffic and transport conditions of the city. In addition, inasmuch as cities in developing countries desire to increase walking and bicycle use, the shortage of available data on pedestrian and cycling remains a problem. The lack of data for more evidence-based planning is especially true in countries with low rates of bicycle use (Barberan, et al., 2017).

Modal shift from motorized to non-motorized modes could begin if the factors that enable for the shift to take place are provided, and people are made capable to perform that shift. Sen's Capability Approach Theory (Robeyns, 2003) detailed on the relationship between an individual's functioning and his capacity to perform certain functions. The person's proper functioning as a mobile individual is only achieved if he/she is afforded with the capacity (e.g., through provision of pedestrian infrastructure) to perform it. Troped et al. (2003) found that neighborhood physical environmental factors(e.g., presence of sidewalks) are correlated with transformational activity, and therefore modal shift at the neighborhood level can happen if individuals are provided with facilities that enhance their capacity as pedestrians and bicycle users. Moreover, modal shift mainly involves personal decisions. It is therefore imperative that in planning for shift towards use of sustainable transport modes, individual decisions are also taken into account. According to the Theory of Planned Behavior (Ajzenet al., 1991), an individual's behavior is largely based on the intention to perform it. Individual beliefs and attitude, the prevailing social norms and the control factors are just a few of those that influence an individual's decision to act on the said intention. These factors, along with the desire to perform the intention, manifest as behavior. The more positive the beliefs, the higher the intention becomes, and the more likely to result in performance. A positive attitude is influential towards one's likelihood to act on a certain behavior. In this case, perhaps a person educated at environmental issues may think of walking and biking to have positive effect on the environment and the community but externalities related to walking or biking such as the issue of road safety could deter him from actually performing the behavior.

Gatersleben and Appleton (2007) affirmed previous studies on gender-associated differences between men and women in terms of cycle use (i.e., men tend to cycle more). Lawsonet al.'s (2013) study also supported these gender-associated differences, in addition to other socio-economic factors (e.g., education and employment), journey distance, and vehicle ownership as determinants to an individual's cycle use. Ryley (2008) found out that socio-economic, spatial and attitudinal variables also influence a person's likelihood to walk. Environmental factors were found to be influencing of a population's likelihood of walking regularly, particularly in areas with shorter blocks, high density and mix of land use, streetscapes, and safe pedestrian passages(Fenton, 2013). However, an area perceived to be less supportive of pedestrian mobility, despite presence of pedestrian facilities, could negatively influence an individual's decision to walk (Giles-Corti, 2002). Pucher and Dijkstra (2003)on the other hand, acknowledged that safety from crime is one of the influencing factors to people's decision to travel by foot.

The primary aim of this research is to gain a better understanding of the psychological and physical environmental factors which influence the choice of an individual to walk or use bicycles. Studies such as this one, which seeks to define behavior and choices at individual levels, help to enrich ways to develop options for travelers, especially those seeking to better manage their short-distance trips. The methods used in this study are quite similar to the ones found in the tools for generating public opinion, and when used in combination with other known participatory tools and methods, can generate information for the development of human-scale urban transport. Likewise, the resulting models are significant inputs to the planning and decision-making processes of public agencies, allowing them to be more responsive to the mobility requirements of its population, and ultimately help to achieve social equity. This is particularly useful in cities of developing countries where attainment of social inclusivity and improved mobility options remain to be a challenge.

The study site is Iloilo City, located in the Visayas group of islands in central Philippines. It is a mid-sized city, with a population of 424,619. Its geographical make-up is suitable for intermodal travel, and the city can easily be reached through sea, air and land (roll-on roll-off mode). It is comprised of six (6) districts, with Jaro District as the biggest in terms of population and land area (Iloilo City Planning and Development Office, 2014). The city is typically flat with low level mass making it ideal for walking and cycling.

2. FACTORS ON WALKING AND BICYCLE USE

The factors were based on the framework developed by Pikora et al. (2003). Functional features, under the physical environmental factor, includes specific attributes of the path, the type and width of the street, the volume, speed and type of traffic, and the directness of routes to the destination. Also included in the physical environmental factors are the features on safety and convenience. Aesthetics is also categorized under physical environmental factors, which covers a more extensive definition that includes not only sceneries for visual satisfaction but the sense of well-being from the physical ease that features like shaded sidewalks bring. Other factors included in the study are security, external (climate/weather), psychological and socio-economic factors (Table 1).

Table 1. Predictors of walking and bicycle use

Factors and Features			**Elements and Items: Cycling (23 predictors)**	**Elements and Items: Walking (26 predictors)**
Physical Environmental Factors	1	Functional	*Traffic* • Shared lanes with motor vehicles • Traffic volume • Traffic speed • Cycling is the quicker way to get around	• Traffic volume • Traffic speed • Walking is the quicker way around
			Walking/cycling surface • Presence of segregated bike lanes	• Presence of sidewalks • Well-connected sidewalks • Well-paved sidewalks
			Permeability • Alternative routes for bikes	*Permeability* • Alternative routes • Access points
	2	Safety		*Traffic* • Pedestrian road crossing facilities *Personal* • Well-lighted streets
	3	Destination (Convenience)	*Distance* • Destinations are within biking distance	• Facilities are within walking distance
			Facilities • Bicycle parking facilities	• Vehicle parking
	4	Aesthetics	*Streetscape* • Tree-line streets	• Shaded sidewalks
Security	5	Peace and order	• Neighborhood crime rate	

Factors and Features			Elements and Items: Cycling (23 predictors)	Elements and Items: Walking (26 predictors)
External factors	6	Comfort	• Climate • Weather	
Psychological Factors	7	Personal capacity or self-efficacy	• Preference for bicycling as mode • Bicycling for physical fitness • Skill/capacity to use bicycle • Cycling is safe	• Preference for walking as mode • Walking for physical fitness • Capacity to walk
Socio-economic	8	Individual attributes	• Gender • Age • Income • Employment status • Education level • Owns bike • Owns car	

Source: Modified from Pikora et al. (2003)

3. DATA COLLECTION AND ANALYSIS

A 23-item questionnaire was used in a guided interview of 400 respondents, proportionately distributed among the six (6) districts of Iloilo City. The survey was conducted on April 6-14, 2016 and covered at least one weekend to consider respondents who are not at home on weekdays because of work. The instrument was based on existing questionnaires used in various pedestrian and bicycling surveys, such as the Neighborhood Environment Walkability Scale (NEWS) (Cerin et al., 2009; Cerin et al., 2006), and the Pedestrian and Bicycle Survey (PABS) (Krizek et. al., 2010).

PABS is a 28-item questionnaire with five categories including profile of the respondent's recent and general travel, walking and bicycling activities in the last seven days, and general household information. PABS is essentially conducted through a mail out-mail back system, although for this study, an interview-based method was instead used. This is to ensure that the desired sample size is achieved at a definite time possible and issues on non-response or low mail back rates are avoided. One of the reasons as to why PABS was referenced is that having been tested prior, there is the assurance of producing highly reliable data. The questionnaire, however, required translation to local language (Hiligaynon) for the benefit of those who would rather self-administer the questionnaire. Questions on individual travel profile for this study were mainly referenced from PABS.

NEWS, on the other hand, is an instrument which attempts to come up with a resident's perception of neighborhood environmental features related to physical activity, including structures for walking and bicycling, traffic and crime safety. There are eight themes in the questionnaire focusing on neighborhood settlements type, presence and access to neighborhood facilities and services, street characteristics, and safety from traffic and crime. Majority of the questions in the research pertaining to physical environmental factors were sourced from NEWS.

The version of the questionnaire for this study have two parts and contained questions covering the socio-economic, psychological/attitudinal factors, and the physical environmental factors with questions sourced from both the PABS and NEWS. The questions were grouped together based on the five (5) parameters used for assessing determinants of walkability and bicycling (see Table 1). Part 1 focused on the socio-economic data and included items on gender, age, income, employment, educational level, and ownership of private vehicle and bicycles. Part 2containeditems on trip patterns and behavior. This part is further divided into two - one for walking and another for bicycle use. The survey is limited only to the self-reported, subjective measures of the factors on walking and bicycle use.

The outcome variables on the likelihood to walk and bicycle use utilize a 5-point Likert-type scale (1=highly unlikely to 5=highly likely). The explanatory variables on the psychological and physical environmental factors similarly used a 5-point scaling system (1=strongly disagree to 5=strongly agree). Socio-demographic variables are mostly categorical, except for age and income. Coding for gender is 0 = male, 1 = female; education level for high school graduate and above = 1; high school level and below = 0; and so on. Under the physical environmental conditions, the elements of functionality, aesthetic, destination, and safety were considered as explanatory variables. Additionally, the socio-economic, security and external factors were also included. Multiple linear regression was used to come up with models and the list of predictor variables, each for the likelihood to walk and bicycle use.

4. RESULTS

Respondents are almost equally distributed in terms of gender. The mean age is 41 years, most have finished high school, are employed and earning on the average PhP17,000 per month, which is comparably lower than the national (PhP 22,000) and regional average (PhP 19,000) (Philippines Statistical Authority, 2016). Majority owns bicycles (about 62%) while about 36% indicated owning private vehicles (combined private cars and motorcycles). Table 2 summarizes the respondents' profile.

Table 2. Profile of respondents

Gender		*Income*	*Mean: PhP 17,272.4*
Males	195 (49%)	<PhP 5,000	52 (14.1%)
Females	205 (51%)	PhP5,000-9,999	101 (27.4%)
		PhP10,000 - 19,999	137 (37.1%)
Age in years	*Mean: 40.77*	PhP 20,000 - 39,999	52 (14.1%)
15-19	15 (4.1%)	PhP 40,000 - 59,999	19 (5.1%)
20-24	43 (11.7%)	PhP 60,000 - 99,999	4 (1.1%)
25-29	43 (11.7%)	PhP 100,000 - 249,000	2 (0.5%)
30-34	35 (9.5%)	>PhP 250,000	2 (0.5%)
35-39	48 (13.1%)		
40-44	38 (10.4%)	*Education*	
45-49	43 (11.7%)	< high school level	79 (20.3%)
50-54	30 (8.2%)	>high school graduate	310 (79.7%)
55-59	26 (7.1%)		
60-64	21 (5.7%)	*Owns private vehicle?*	
> 65	25 (6.8%)	Yes	145 (35.8%)
		No	255 (64.2%)
Employment			
Employed	248 (63.6%)	*Owns bike?*	
Not employed	142 (36.4%)	Yes	247 (61.9%)
		No	152 (38.1%)

3.1 Travel Profile of Respondents

Public transport in the form of jeepneys is the dominant mode in Iloilo City. Figure 1 shows the relatively higher percentage of jeepney users in three out of four identified trip purposes:

work (31.1%), shop (35.2%) and leisure (42.9%). For travels related to exercise or sports, a large percentage of respondents walk (71%), followed by bicycle use (19.3%).

Majority of the respondents walk for utilitarian purposes (to work, school, market, etc.). Common destinations for these are the jeepney stops, workplaces, schools and recreational areas around the neighborhood, including visits made to friends. Walks to jeepney stops are short-distance trips, typically done under five (5) minutes while walks to workplaces and schools and recreational areas could last as long as half an hour. Evidence from previous studies shows that recreational walking trips including trips for exercise usually take longer than trips for other purposes (Corpuz et al., 2005).

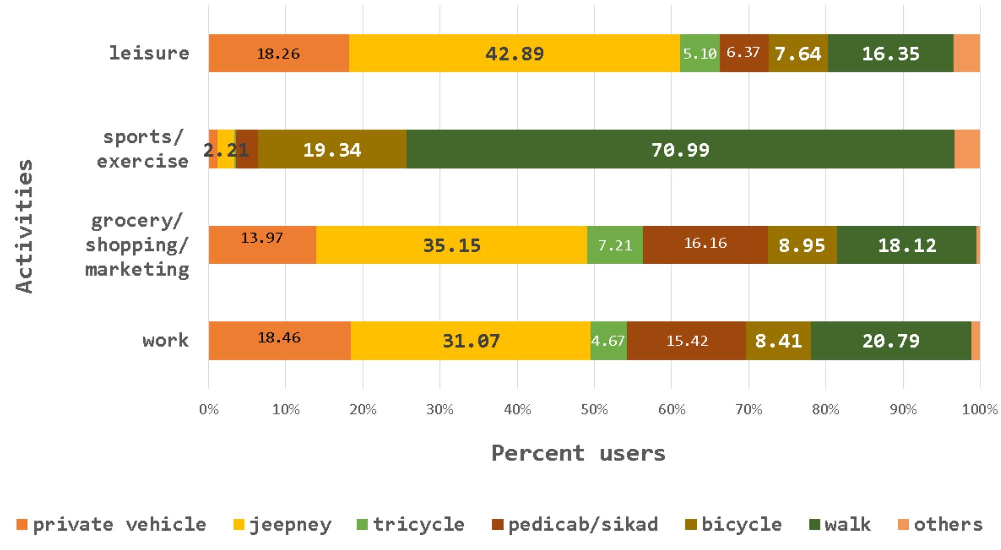

Figure 1. Activities and corresponding transport modes used

3.3. Correlates of Walking

Table 3 shows the socio-economic correlates of the four conditions of likelihood to walk. Education showed associations with all four conditions while gender is only associated with the likelihood to walk at night and during peak hours of traffic. This may be attributed to concerns on safety, particularly of the females. Private vehicle ownership showed positive association with likelihood to walk at night implying that vehicle owners exhibited willingness to walk at this time of the day, more likely for recreational purposes. Age also showed positive correlation with walking at night, denoting that older people tend to prefer to walk at nighttime, also suggesting that this could be for recreational or leisure walks. While bicycle ownership showed negative association with likelihood to walk during traffic hours, those without bicycles would show preference to walk given this condition implying the willingness to shift to more active modes of transport when the traffic congestion is at its peak.

Table 3. Socio-economic correlates of likelihood to walk

		Gender	Education	Owns private vehicles	Owns bicycles		Age
Likelihood to walk in good weather	*t*	.744	**2.200**	1.279	1.129	*r*	-.041
	df	392	**382**	392	392	*p-value*	.417
	sig	.457	**.028**	.202	.260	*N*	393
Likelihood to walk	*t*	**3.285**	**2.312**	**3.377**	.033	*r*	**.123***

at night	*df*	**389**	**379**	**389**	389	*p-value*	**.015**
	sig	**.001**	**.021**	**.001**	.974	*N*	**390**
Likelihood to walk during peak traffic hours	*t*	**2.295**	**3.666**	1.852	**-2.167**	*r*	.062
	df	**391**	**381**	391	**391**	*p-value*	.217
	sig	**.022**	**.000**	.065	**.031**	*N*	392
Likelihood to walk if sidewalks are well-paved	*t*	-.246	**2.475**	-.952	.313	*r*	-.006
	df	389	**379**	389	389	*p-value*	.907
	sig	.806	**.014**	.342	.755	*N*	390

* Correlation is significant at the 0.05 level (2-tailed)
[boldface] Significance at p-value < 0.05

The psychological and physical environmental factors were measured for correlation with the likelihood to walk at given conditions (Table 4). An individual's inherent preference for walking is positively correlated with the likelihood to walk in good weather but not with walking at night, walking at peak traffic hours and walking in enabling environments (i.e., at well-paved sidewalks). Perceived efficacy to walk has shown positive correlation with walking at night and walking during peak traffic hours suggesting that people who tend to view themselves as healthy are more likely to use walking as a mode in more challenging situations, such as walking at night. Other psychological elements such as preference for walking over other modes, perception of walking as a viable form of exercise showed positive relationship with all the conditions for walking.

The strongest relationship, albeit medium in strength, is with the destination feature of the physical environmental factor (r=.338) where walking is perceived as the quickest way to travel for short trips. Similarly, the destination feature that the facilities in the neighborhood are within walking distance is also correlated with the four conditions of likelihood to walk, along with the perception that walking is a mode that provides one with more route choices. The quantity of alternative routes for walking were found to be also positively correlated with all four conditions for walking. Safety features on the presence of pedestrian crossings, unexpectedly, is inversely correlated with the likelihood to walk at night, and during traffic hours. One plausible explanation for this could be the negative perception on the function of pedestrian lanes as a facility which regulates crossing and walking behavior of people. In the case of Iloilo City, its presence could be viewed as restrictive of an individual's freedom to easily get from one place to another, considering the existing anti-jaywalking laws of the city. People expect that at night and when traffic flow is severely congested, anti-jaywalking laws are rarely enforced, and crossing restrictions should be more lenient. However, having pedestrian lanes at times when leniency to anti-jaywalking laws are expected could possibly have negative effects to propensity of an individual to walk that these times of the day. This implies that individuals perceive pedestrian crossings less as a safety intervention than as a facility that restrict their freedom to use the streets as they see fit.

On the other hand, functional features of the environment such as lower traffic speed is positively correlated with walking at night and during peak traffic hours. Higher traffic volume is unusually positively correlated with walking at night, peak traffic hours and if sidewalks are paved suggesting that people would prefer to walk if other modes make it more inconvenient for them to travel at these conditions (e.g., traffic congestion), and most especially if facilities for walking are available (e.g., good quality sidewalks). Additionally, weather appears to be a non-factor in the likelihood to walk as the perception that weather makes it more difficult for individuals to walk showed no correlation with all four conditions for walking.

Table 4. Psychological and environmental correlates of likelihood to walk

		Likelihood to walk in good weather	Likelihood to walk at night	Likelihood to walk during peak traffic hours	Likelihood to walk if sidewalks are well-paved
Psychological factors					
I like to walk	*r*	**.186****	-.013	-.023	.030
	p-value	**.000**	.797	.652	.556
	N	**393**	390	392	390
I prefer to walk than take the jeepney	*r*	**.210****	**.124***	**.123***	**.116***
	p-value	**.000**	**.014**	**.015**	**.021**
	N	**394**	**391**	**393**	**391**
I should walk more for physical fitness	*r*	**.244****	**.187****	**.189****	**.278****
	p-value	**.000**	**.000**	**.000**	**.000**
	N	**393**	**390**	**392**	**390**
I am fit to walk	*r*	.034	**.298****	**.214****	**.153****
	p-value	.501	**.000**	**.000**	**.002**
	N	393	**390**	**392**	**390**
Physical environmental factors					
The destinations are within walking distance.	*r*	**.105***	**.221****	**.226****	**.126***
	p-value	**.038**	**.000**	**.000**	**.013**
	N	**394**	**391**	**393**	**391**
Walking is the quickest way to travel for short trips.	*r*	**.149****	**.338****	**.319****	**.296****
	p-value	**.003**	**.000**	**.000**	**.000**
	N	**394**	**391**	**393**	**391**
Walking gives me flexibility to choose routes.	*r*	**.180****	**.178****	**.146****	**.226****
	p-value	**.000**	**.000**	**.004**	**.000**
	N	**394**	**391**	**393**	**391**
There are alternative routes for walking.	*r*	**.180****	**.178****	**.146****	**.226****
	p-value	**.000**	**.000**	**.004**	**.000**
	N	**394**	**391**	**393**	**391**
There is enough number of sidewalks.	*r*	.028	**.182****	**.112***	**.174****
	p-value	.583	**.000**	**.026**	**.001**
	N	394	**391**	**393**	**391**
The sidewalks are well connected through a network of sidewalks.	*r*	.009	**.133****	**.102***	**.181****
	p-value	.866	**.009**	**.044**	**.000**
	N	393	**390**	**392**	**390**
Traffic volume in neighborhood is high.	*r*	-.029	**.130***	**.142****	**.166****
	p-value	.567	**.010**	**.005**	**.001**
	N	394	**391**	**393**	**391**
Traffic speed in neighborhood is slow.	*r*	.038	**.147****	**.137****	.098
	p-value	.452	**.004**	**.007**	.053
	N	394	**391**	**393**	391
The sidewalks are well-paved.	*r*	.077	**.205****	**.118***	**.280****
	p-value	.126	**.000**	**.019**	**.000**
	N	394	**391**	**393**	**391**
The streets are well-lit at night.	*r*	**.167****	**.252****	**.139****	**.209****
	p-value	**.001**	**.000**	**.006**	**.000**
	N	**394**	**391**	**393**	**391**
There are pedestrian crossings.	*r*	-.017	**-.145****	**-.114***	-.008
	p-value	.739	**.004**	**.025**	.880
	N	393	**390**	**392**	390
The sidewalks are shaded.	*r*	**.102***	**.156****	.065	**.147****
	p-value	**.043**	**.002**	.196	**.004**
	N	**394**	**391**	393	**391**
Security factor					
Neighborhood is crime free.	*r*	**.118***	**.142****	-.010	.040
	p-value	**.019**	**.005**	.849	.432
	N	**394**	**391**	393	391
External factors					
I walk regardless of weather.	*r*	**.242****	**.298****	**.303****	**.229****
	p-value	**.000**	**.000**	**.000**	**.000**
	N	**393**	**390**	**392**	**390**
The weather makes it difficult for me to	*r*	-.015	-.001	-.077	.023
	p-value	.764	.988	.130	.651
	N	392	389	391	389

		Likelihood to walk in good weather	Likelihood to walk at night	Likelihood to walk during peak traffic hours	Likelihood to walk if sidewalks are well-paved
walk					

* Correlation is significant at the 0.05 level (2-tailed)
**Correlation is significant at the 0.01 level (2-tailed)

3.4. Correlates of Bicycle use

Table 5 shows the correlates between socio-economic factors and likelihood to use bicycles. For the four (4) conditions of bicycle use, only three (3) socio-economic factors showed associations; i.e., gender, bicycle ownership and age. Bicycle use tends to favor males while those who do not own bicycles expressed interest or willingness to use bicycles as indicated by the negative association. Age tend to be inversely correlated with bicycle use favoring the younger population more.

Table 5. Socio-economic correlates of likelihood to use bicycle

		Gender	Owns bicycle		Age
Likelihood to use bicycle in good weather	*t*	**5.229**	**-4.074**	*r*	**-.165******
	df	**391**	**391**	*p-value*	**.001**
	sig	**.000**	**.000**	*N*	**392**
Likelihood to use bicycle at night	*t*	**8.022**	**-3.835**	*r*	-.001
	df	**391**	**391**	*p-value*	.991
	sig	**.000**	**.000**	*N*	392
Likelihood to use bicycle during peak traffic hours	*t*	**9.083**	**-4.209**	*r*	**-.105***
	df	**391**	**391**	*p-value*	**.037**
	sig	**.000**	**.000**	*N*	**392**
Likelihood to use bicycle if sidewalks are well-paved	*t*	**5.061**	**-4.083**	*r*	**-.161******
	df	**390**	**390**	*p-value*	**.001**
	sig	**.000**	**.000**	*N*	**391**

* Correlation is significant at the 0.05 level (2-tailed)
** Correlation is significant at the 0.01 level (2-tailed)
[boldface] Significance at p-value < 0.05

Psychological factors showed positive relationship with the likelihood to use bicycles (Table 6). The strongest relationship was on the item about one's innate preference for riding bicycles and the likelihood to cycle in good weather (r = .423). Comparing it with the physical environmental factor, the item on the functional feature showed the strongest relationship; i.e., the perception that given the right infrastructure, cycling can be the most convenient mode to use for getting around the city (r = .597). High traffic volume is also correlated with bicycle use, albeit negatively, meaning that congestion has the potential to negatively impact the people's propensity to use bicycles. Other positive relationships are exhibited by items under the physical environmental factor such as bikeable distances to destinations and presence of alternative routes. Security factors are also associated with bike use, along with external factors such as the weather.

Table 6. Psychological and environmental correlates of likelihood to use bicycles

		Likelihood to cycle in good weather	Likelihood to cycle at night	Likelihood to cycle during peak hours of traffic	Likelihood to cycle for leisure
Psychological factors					
I like to ride bicycles	*r*	**.423****	**.282****	**.342****	**.349****
	p-value	**.000**	**.000**	**.000**	**.000**

		Likelihood to cycle in good weather	Likelihood to cycle at night	Likelihood to cycle during peak hours of traffic	Likelihood to cycle for leisure
	N	389	389	389	388
I prefer to travel by bike over public transport	*r*	.470**	.412**	.462**	.504**
	p-value	.000	.000	.000	.000
	N	388	388	388	387
Cycling is a healthy way to travel	*r*	.374**	.236**	.254**	.347**
	p-value	.000	.000	.000	.000
	N	388	388	388	387
I am fit enough to cycle	*r*	.276**	.204**	.331**	.229**
	p-value	.000	.000	.000	.000
	N	383	383	383	382
Cycling is safe	*r*	.100*	.280**	.295**	.209**
	p-value	.050	.000	.000	.000
	N	387	387	387	386
Physical environment factors					
Cycling is the quickest way to get around	*r*	.597**	.443**	.383**	.516**
	p-value	.000	.000	.000	.000
	N	387	387	387	386
There are alternative routes to get from one place to another	*r*	.093	.086	.046	.138**
	p-value	.065	.088	.364	.006
	N	393	393	393	392
Bike shares the same road as motor vehicles	*r*	.073	.088	.073	.088
	p-value	.146	.082	.147	.081
	N	393	393	393	392
Traffic volume in neighborhood is high	*r*	-.163**	-.058	-.074	-.161**
	p-value	.001	.249	.142	.001
	N	393	393	393	392
Traffic speed in neighborhood is slow	*r*	-.069	-.031	-.001	-.007
	p-value	.175	.543	.981	.893
	N	392	392	392	391
Presence of tree-line streets	*r*	-.078	.089	.069	-.039
	p-value	.123	.077	.175	.437
	N	392	392	392	391
Bike parking facilities is available	*r*	-.074	.021	.009	-.099
	p-value	.144	.673	.866	.051
	N	392	392	392	391
Distance to destination is bikeable	*r*	.222**	.376**	.301**	.296**
	p-value	.000	.000	.000	.000
	N	385	385	385	384
Security factor					
Neighborhood is crime free	*r*	-.056	.063	-.068	-.156**
	p-value	.270	.214	.181	.002
	N	392	392	392	391
External factors					
I bike when it rains	*r*	-.031	.214**	.237**	.131**
	p-value	.542	.000	.000	.010
	N	388	388	388	387
I bike when it is too hot	*r*	-.036	.213**	.237**	.072
	p-value	.474	.000	.000	.155
	N	388	388	388	387

*Correlation is significant at the 0.05 level (2-tailed)
**Correlation is significant at the 0.01 level (2-tailed)

3.6. Models for Likelihood to Walk or Use Bicycle

Multiple regression analysis was used to determine the models for predicting variables that directly affect the individual's likelihood to walk or use bicycles. Resulting models with the highest value of Adjusted R-squared were selected.

3.6.1 Predictor and Outcome Variables for Likelihood to Walk

There were twenty six (26) predictors included in the multiple regression analysis for likelihood to walk. Table 7 shows the four (4) outcome variables presenting the different situations one shall encounter when walking. Table 8 shows the resulting models with the corresponding predictor variables for each.

Table 7. Four outcome variables for likelihood to walk

Outcome Variables for Likelihood to Walk	Codes
1. Likelihood to walk in good weather	OV1 – Walk
2. Likelihood to walk at night	OV2 – Walk
3. Likelihood to walk during peak hours of traffic	OV3 – Walk
4. Likelihood to walk if sidewalks are well-paved	OV4 – Walk

Model for OV1-Walk resulted in an adjusted R squared value (0.160) with five predictors included. The adjusted R squared value tells us that this model can account for about 16% of the variability in OV1-Walk (about 14% of the changes in OV1 can be explained by this model). The preference for walking as a mode regardless of the weather conditions appears to have the strongest influence, based on this model. This item belongs to the external factors influencing the likelihood to walk. Two items from the psychological factor, and one from the physical environmental factor were also included in the model. Additionally, a security factor pertaining to low neighborhood crime rate also influences a person's decision to walk. All five variables are statistically significant with p-values < 0.05.

The model for OV2-Walk can account for 37.1% variability with the physical environmental factor "*Walking is the quickest way to travel for short trips"* (β coefficient of 0.240) as the strongest predictor. Simply saying, individuals who believe that walking allows them to quickly reach their destinations would easily choose to walk than use other modes. This implies that physical environmental factors that allow individuals to conveniently walk to their destinations, such as connectivity, can positively influence an individual's decision to walk. The same predictor shows the strongest influence in the model for OV3-Walk (adjusted R squared = 0.257), and OV4-Walk (adjusted R squared = 0.221). It suggests again that individuals would choose to walk instead of taking other modes if given options to take shorter routes. Physical environment in the form of street design and other pedestrian infrastructure improvements which are supportive of this perception must therefore be pursued.

Table 8. Determinants of likelihood to walk

Five-predictor model for OV1-Walk: Likelihood to walk in good weather					
Predictors	**B**	**SE B**	**β**	**t**	**p**
(Constant)	1.757	.348		5.056	.000
I walk regardless of weather (external factor)	.151	.032	.224	4.709	.000
I should walk more for physical fitness (psychological factor)	.245	.061	.196	4.022	.000
I like to walk (psychological factor)	.121	.031	.182	3.866	.000

Neighborhood is crime free(security factor)	.089	.036	.118	2.502	.013
There are alternative routes for walking from one place to another (physical environmental factor)	.099	.045	.107	2.189	.029
adjusted *R* squared					.160
Ten-predictor model for OV2-Walk: Likelihood to walk at night					
Predictors	**B**	**SE B**	**β**	**t**	**p**
(Constant)	-2.171	.494		-4.400	.000
Walking is the quickest way to travel for short trips (physical environmental factor)	.403	.076	.240	5.302	.000
I am fit to walk (psychological factor)	.219	.047	.212	4.704	.000
I walk regardless of weather (external factor)	.211	.054	.174	3.897	.000
The streets are well-lit at night	.143	.063	.108	2.273	.024
Gender (socio-economic factors)	-.596	.133	-.194	-4.486	.000
The distance to destination is walkable (physical environmental factor)	.156	.049	.141	3.180	.002
The sidewalks are well-paved (physical environmental factor)	.117	.053	.099	2.188	.029
Neighborhood is crime free (security factor)	.149	.061	.112	2.468	.014
Walking provides me with flexibility and freedom to choose routes (physical environmental factor)	.163	.075	.097	2.166	.031
Owns private vehicles (socio-economic factor)	-.280	.141	-.087	-1.991	.047
adjusted *R* squared					.371
Seven-predictor model for OV3-Walk: Likelihood to walk during peak hours of traffic					
Predictors	**B**	**SE B**	**β**	**t**	**p**
(Constant)	.636	.452		1.409	.160
Walking is the quickest way to travel for short trips (physical environmental factor)	.392	.068	.277	5.804	.000
I am fit to walk (psychological factor)	.171	.042	.196	4.053	.000
Traffic speed in neighborhood is slow (physical environmental factor)	.265	.069	.179	3.828	.000
I walk regardless of weather (external factor)	.183	.049	.180	3.729	.000
Education level (socio-economic factor)	-.379	.151	-.118	-2.516	.012
Owns a bicycle (socio-economic factor)	.297	.123	.112	2.408	.017
The weather makes it uncomfortable for me to walk (external factor)	-.120	.056	-.102	-2.151	.032
adjusted *R* squared					.257
Nine-predictor model for OV4-Walk: Likelihood to walk if sidewalks are paved					
Predictors	**B**	**SE B**	**β**	**t**	**p**
(Constant)	1.958	.335		5.839	.000
Walking is the quickest way to travel for short trips (physical environmental factor)	.139	.051	.152	2.747	.006
The streets are well-lit at night (physical environmental factor)	.108	.037	.149	2.872	.004
I walk regardless of weather (external factor)	.092	.032	.140	2.831	.005
I should walk more for physical fitness (psychological factor)	.193	.064	.161	2.998	.003
I am fit to walk (psychological factor)	.086	.028	.152	3.044	.003
The sidewalks are well-paved (physical environmental factor)	.079	.032	.123	2.506	.013
Owns private vehicles (socio-economic factor)	.236	.087	.135	2.707	.007
Education level (socio-economic factor)	-.287	.103	-.138	-2.775	.006
Age (socio-economic factor)	-.006	.003	-.109	-2.197	.029
adjusted *R* squared					.221

3.6.2. Predictor and Outcome Variables for Likelihood to Use Bicycle

There were twenty-three (23) predictors included in the regression analysis of the four (4) outcome variables for likelihood to use bicycles. Table 9 shows the four (4) outcome variables presenting the different situations one shall encounter when using bicycles while Table 10 shows the resulting models with the corresponding predictor variables for each.

Table 9. Determinants of likelihood to use bicycle

Outcome Variables (OV) for Likelihood to Use Bicycle	Codes
1. Likelihood to cycle on good weather	OV1-Bike
2. Likelihood to cycle at night	OV2-Bike
3. Likelihood to cycle during peak hours of traffic	OV3-Bike
4. Likelihood to cycle for leisure	OV4-Bike

The selected model for OV1–Bike (adjusted R squared = 0.501) indicated the perception of "*Cycling is the quickest way to get around*" as the highest predictor of likelihood to use bicycle in good weather. This is under the physical environmental factor which reflects the fundamental structural aspect of the environment such as directness of route, which supports the perception that given the right environmental feature, individuals could perceive bicycling as a mode that could bring them to their destinations much faster. Age, gender and employment are socio-economic factors included in the list. They showed negative associations which means that younger males who are unemployed have the higher propensity to use bicycles in good weather conditions.OV2–Bike (adjusted R squared =0.426) and OV4–Bike (adjusted R squared=0.424) likewise have the same strongest predictor.

One possible explanation for the results of OV2–Bike has something to do with the supply of public transport at night. Despite the jeepney being the dominant mode in the city, getting public transport is almost always problematic because of longer waiting hours due to either shortage of supply or excess of it. Shortage happens during peak hours, which expectedly would result in longer queuing of passengers. Excess in supply is a different situation all in all. At low peak period, it is the jeepney that takes longer in the queue, waiting for the optimum number of passengers before going their way. In this situation, using a bicycle is indeed quicker than taking the public transport. Gatersleben and Appleton(2007) has noted that for people who have experienced cycling, flexibility of the mode often came up as one of the aspects that made cycling fun. The pleasant experience with cycling as a kind positive reinforcement to the behavior could possibly support the intention to perform the same behavior (using bicycles to commute) in the future.

Table 10. Determinants of likelihood to use bicycle

Nine-predictor model for OV1-Bike: Likelihood to cycle in good weather					
Predictors	**B**	**SE B**	**β**	**t**	**p**
(Constant)	1.469	.435		3.374	.001
Cycling is the quickest way to get around (physical environmental factor)	.457	.043	.464	10.605	.000
I like to ride bicycles (psychological factor)	.142	.037	.168	3.835	.000
Cycling is a healthy way to travel (psychological factor)	.354	.072	.205	4.957	.000

Age (socio-economic factor)	-.008	.003	-.095	-2.420	.016
Employment Status (socio-economic factor)	-.333	.105	-.125	-3.175	.002
Traffic speed in neighborhood is slow (physical environmental factor)	-.101	.059	-.069	-1.714	.088
I am fit enough to cycle (psychological factor)	.078	.035	.094	2.264	.024
Bike parking facilities is available(physical environmental factor)	-.087	.042	-.084	-2.086	.038
Gender(socio-economic factor)	-.212	.104	-.085	-2.046	.042
				adjusted *R* squared	.501
Eight-predictor model for OV2-Bike: Likelihood to cycle at night					
Predictors	**B**	**SE B**	**β**	**t**	**p**
(Constant)	-1.341	.501		-2.678	.008
Cycling is the quickest way to get around (physical environmental factor)	.378	.056	.311	6.791	.000
Gender (socio-economic factor)	-.779	.135	-.253	-5.753	.000
Distance to destination is bikeable (physical environmental factor)	.358	.056	.288	6.426	.000
I bike when it is too hot (external factor)	.179	.067	.133	2.688	.008
Cycling is safe (psychological factor)	.199	.068	.144	2.907	.004
Household income (socio-economic factor)	.000	.000	-.097	-2.315	.021
Neighborhood is crime free (security factor)	.159	.061	.115	2.622	.009
Traffic volume in neighborhood is high(physical environmental factor)	.141	.070	.089	2.027	.043
				adjusted *R* squared	.426
Eight-predictor model for OV3-Bike: Likelihood to cycle during peak hours of traffic					
Predictors	**B**	**SE B**	**β**	**t**	**p**
(Constant)	-.109	.304		-.358	.721
I prefer to travel by bike over public transport (psychological factor)	.177	.055	.178	3.224	.001
Gender (socio-economic factor)	-.669	.122	-.248	-5.498	.000
I am fit enough to cycle (psychological factor)	.167	.039	.186	4.301	.000
Distance to destination is bikeable (physical environmental factor)	.211	.049	.193	4.270	.000
Cycling is safe (psychological factor)	.157	.059	.130	2.654	.008
Owns a bicycle (socio-economic factor)	.247	.123	.089	2.005	.046
I bike when it rains (external factor)	.123	.057	.105	2.167	.031
Cycling is the quickest way to get around (physical environmental factor)	.125	.058	.117	2.162	.031
				adjusted *R* squared	.418
Eight-predictor model for OV4-Bike: Likelihood to cycle for leisure					
Predictors	**B**	**SE B**	**β**	**t**	**p**
(Constant)	1.375	.572		2.402	.017
Cycling is the quickest way to get around (physical environmental factor)	.377	.061	.330	6.144	.000
I prefer to travel by bike over public transport (psychological factor)	.206	.056	.193	3.681	.000
Neighborhood is crime free (security factor)	-.227	.057	-.176	-4.018	.000
Traffic volume in neighborhood is high(physical environmental factor)	-.200	.065	-.135	-3.078	.002
Cycling is a healthy way to travel (psychological factor)	.247	.092	.124	2.690	.008
I bike when it rains (external factor)	.177	.053	.139	3.310	.001
Age (socio-economic factor)	-.012	.004	-.117	-2.778	.006
Distance to destination is bikeable (physical environmental factor)	.115	.054	.099	2.158	.032
				adjusted *R* squared	.424

On the other hand, the strongest predictor for the model for OV3-Bike (adjusted R squared =0.418) is the individual's gender, suggesting that males are more inclined to use bicycles at peak hours of traffic. Positive relationship is also exhibited by the predictor *"Cycling is safe"* implying that the advocacy towards use of bicycles should also focus on promoting further the image of cycling as a low-risk activity but one that is as normal as walking. Lorenc et al. (2008) found out that most interventions in promoting bicycles as modes of transport targeted only the public's fear and dislike of local environments, which did very little to improve the image of cycling. It is therefore imperative that advocacy and publicity campaigns should emphasize that walking and cycling as not intrinsically risky while at the same time addressing the need to improve the physical environment to address safety issues.

3.7. Factors that Deter Walking and Bicycling

The main deterrent to walking is extreme weather (i.e., too hot or too rainy), followed by security factor (problems on peace and order), and pollution coming from motor vehicles (Figure 2). Survey results showed that compared to these three, basic pedestrian facilities such as adequate and properly maintained sidewalks appeared to be not a hindrance to walking. The reason for this is that people believe that if the trip necessitates them to walk, lack of space should not be a hindrance. They can always use the narrow roadsides or snake their way around parked vehicles. On the other hand, weather is seen to be a hindrance due to health implications of walking under extreme weather conditions.

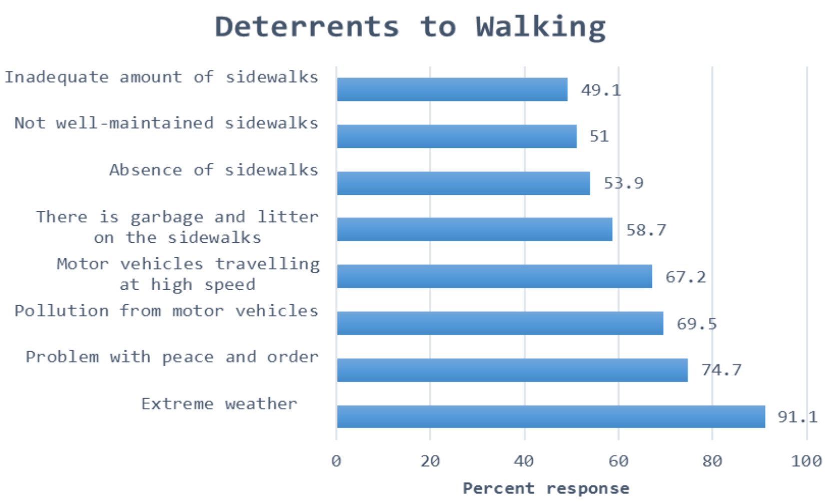

Figure 2. Deterrents to Walking

Weather is also a deterrent to cycling (Figure 3), followed by incidence of bike theft and pollution. Again, since weather is a naturally-occurring factor, the practical way to deal with this is to improve the urban tree canopy of the city. This will not only address the urban heat issue but also improve the aesthetics of the city as well. Studies have shown that recreational cyclists tend to be influenced with aesthetic features more than other physical environmental features. If we are to increase urban bicycling rates, it is also important to consider these type of cyclists in the City's projects and programs. Positive experience would also lead to sustained behavior, which may lead to that behavior becoming a habit. A recreational cyclist enjoying his or her cycling experience might be convinced enough to try cycling as a daily activity and eventually shift into utilitarian cyclists.

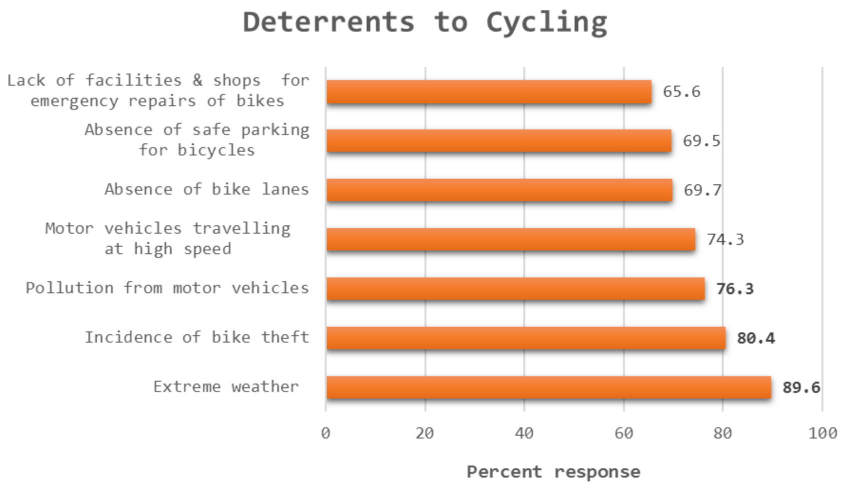

Figure 3. Deterrents to Cycling

Few people mentioned the issue about "stray dogs", as deterrent to both walking and bicycling. This response was extracted from the "others" category of the questionnaire pertaining to deterrents to walking and bicycle use, where they included other items which were excluded in the prepared list of choices. The responses on stray dogs as deterrents were negligible, percentage-wise, to be significant. For this reason, they were not included in the model development. However, the practical relevance of bringing forth the issue on stray dogs as a safety concern for both pedestrian and bicycle users is one that is worth looking into. For one, this is often neglected in the social marketing for promotion of walking and use of bicycles transport. In the Philippines, the problem on stray dogs is more often associated with public health concerns than with mobility or transportation. Stray animals are ordinary sights in many neighborhoods in Iloilo City, and this normalness has resulted in the lack of initiatives to address this particular safety concern for walkers and cyclists.

4. CONCLUSION

This study affirmed findings from previous studies on the socio-economic correlates of walking and bicycle use. It exhibited the varying differences in travel characteristics between gender, age groups, income groups, employed and unemployed individuals, between differing educational levels, and between owners and non-owners of private vehicles. The assumption that walking and bicycle use would be much higher in individuals coming from the lower socio-economic strata also holds true for Iloilo City. However, this is predominantly affected by the individual's access to these forms of transport. Respondents articulated their intention to use bicycles but are unable to, not because of the obvious deterrents, but mostly due to inability to own one. Iloilo City is one of those cities in developing countries with captive pedestrians, for reasons stated above.

The predictors in both walking and bicycle use provide a positive outlook of individuals in the viability of these modes of transport. Positive perceptions "cycling is safe" included in the models is a plus factor for groups aiming to promote positive image of cycling. However, other than promotion, enhancing the capabilities to increase the functioning of people as mobile individuals is still important if walking and cycling rates are to increase significantly. This means that programs and policies must be aimed at sustaining the positive image of cycling, at investing on infrastructure and development supportive of cycling and walking, and must be responsive to the needs of pedestrians and bicycle users across the economic strata.

Iloilo City must be able to find ways to lessen the impact of deterring factors, and invest more on improving existing facilities and building in places that are lacking, to facilitate convenient travel by bicycle. It is important that common destinations and key facilities such as basic school and local shops serving essential needs are within walkable or bikeable distances of most properties. Expanding the current bicycle lane network could be one strategy that is worth looking into, but in order to do that, the City must also invest on improving its traffic database to especially include bicycles and pedestrians. Further studies incorporating and comparing costs of using different modes, including fuel costs, should be conducted to determine if cost is also a factor in one's likelihood to walk or use a bicycle. Since this study only measure the subjective component of factors influencing use of bicycles and walking, an objective study must also be done in order to come up with a more comprehensive analysis of the influencing factors. In addition, it is also important to determine the threshold distances that people walk or use bicycles transport for its practical significance in locating basic facilities.

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