

The Influence of Walking Attitudes and Walking Environment on Private Vehicle-Dependent Travel Behaviour in Asian Developing Countries

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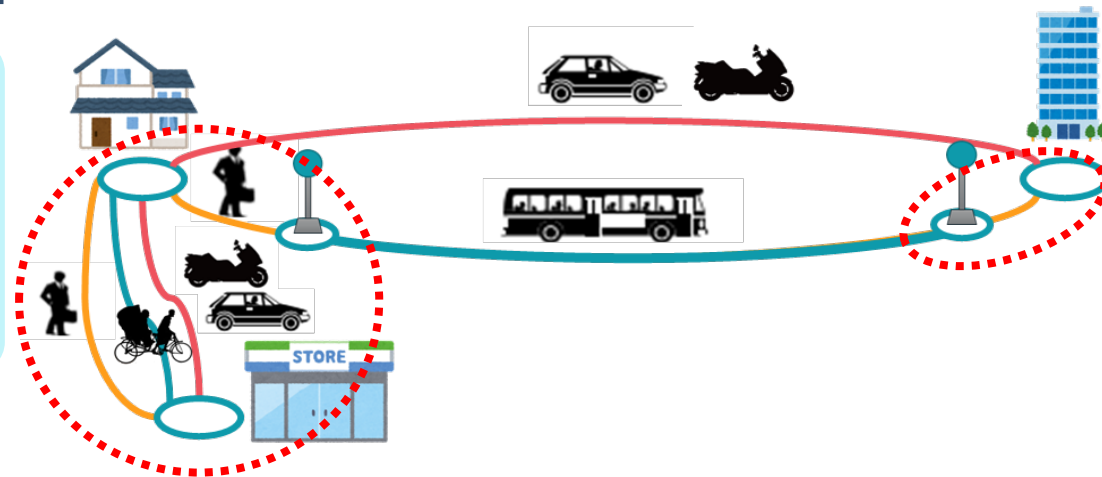
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1. INTRODUCTION

- Rapid motorization and **dependency on private vehicle**: owners tend to rely on vehicles and don't consider other modes as alternatives or disregard them.
- Countermeasures (hard / soft) had targeted mainly **long-distance trips**.
- **Private Vehicle Dependence for Short-distance Trips**:
 - Have less impact on overall transport network performance
 - Causes local congestions
 - Affected to the personal health
 - Undesirable in environment, fuel consumption
 - **May affect the shift in long-distance trips ?**
(Access to the transit stops mainly requires walking)



1. INTRODUCTION

■ Factors on Mode Choice for **Short-distance Trips**:

- Walking Habits,
- Attitudes towards walking
- Walking environment
- Attitudes toward private transportation
- Availability of the modes, such as motorcycles, paratransit

■ Objectives: to clarify the **influence on the mode choice behaviour**, for short- and long-distance trips, utilizing

- Logit Model from Stated Preference (SP)
- Structural Equation Modelling (SEM)

■ Goal: to establish **discussion tool on modal shift measures**.

And conducted in multiple cities, in the same format to verify the **applicability**.

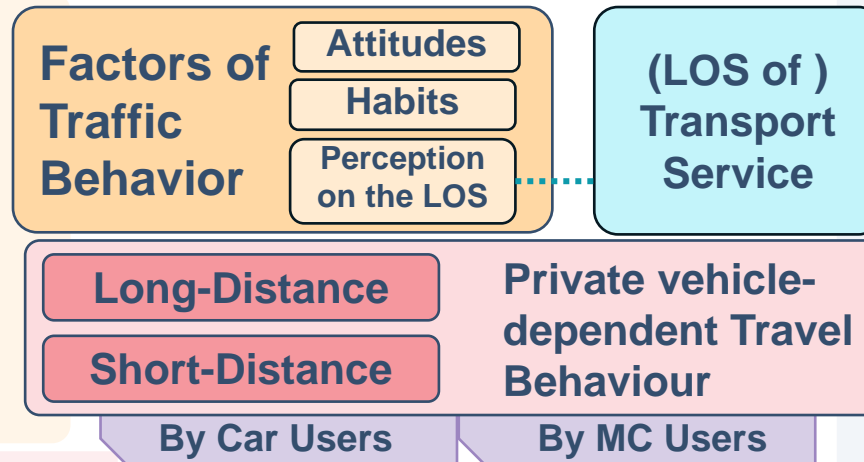
2. LITERATURE REVIEW

Factors of Traffic Behavior

- TPB (Ajzen, 1985) , Attitude Theory (Eangly & Chaiken, 1993)
- Motives for car use: Instrumental and Symbolic-affective (Linda, 2001 & 2005)
- **The influence of past actions (habit) on future behavior:** Indirect impact only (Bamberg et al. 2003) ⇔ Strong impact (Gärling & Axhausen 2003)
- Mode Choice and Perception of Transportation Services (Ben Akiva, 1999, **SHRESTHA, 2007**)

Behaviour for Walking Distance Trips

- Distance threshold to choose to walk or drive and the associated factors are indicated (Loukopoulos & Gärling, 2005)
- The influence of people's perceptions on the mode choices of residents within 1 km of a P&R facility (Walton & Sunseri, 2010)
- Factors related to the acceptable walking distance & time among residents within 1 km of MRT stations (Pongprasert et al., 2019)
- Latent variables associated with travel behaviour in short-distance trips by car users (Mingwei et al., 2020)



Paratransit (mainly for short-distance)

- How it is used and its position in urban transport (Akkarapol et al., 2009; FUJITA, 2014; WICAKSONO, 2015; PHUN & YAI, 2016; PHUN et al., 2017)

Trip Characteristics on Motorcycle Users

- Difference of trip characteristics between car users & motorcycle users (ex. Futose & Okamura, 2022)
- The effect of habit was higher than the intention in the case of motorcycle use (Chen & Lai, 2011)
- Attitudes toward motorcycle have less contribution to public transport use intention (Hoang & Okamura, 2015)

Research Gaps filled by this Study

- Factors related short-distance trips and their impacts on private vehicle dependence, for short & long-distance trips
- The structure of attitudes towards transport behaviour, focusing on difference between private car & MC users.
- Relationship between paratransit use habits and private vehicle dependency.

3. SURVEY DESIGN

Target Cities

City	Duration	Characteristics	Supported by	Samples
Manila, Philippines	June 7 th ~ July 13 th , 2022	Private cars are widely used, and various transport services, including paratransit for short-distance trips, are available.	University of Philippines, National Center for Transportation Studies (UP-NCTS)	513
Ho Chi Minh, Vietnam	June 21 th ~ July 9 th , 2022	Motorcycles are widely used and are the dominant travel mode.	Center of Environment and Transport. Development	605
Dhaka, Bangladesh	July 20 th ~ 31 st , 2022	<ul style="list-style-type: none"> Private car owners are limited, but they show the strong dependency. Paratransit (rickshaw) plays a significant role 	Bangladesh University of Engineering and Technology (BUET)	834

Online- Based Survey (Google Form), Questionnaire Design

Question about Personal Information (Exogenous Factors)

- Age group
- Gender
- Household Members
- Residence Area
- Employment State
- Income

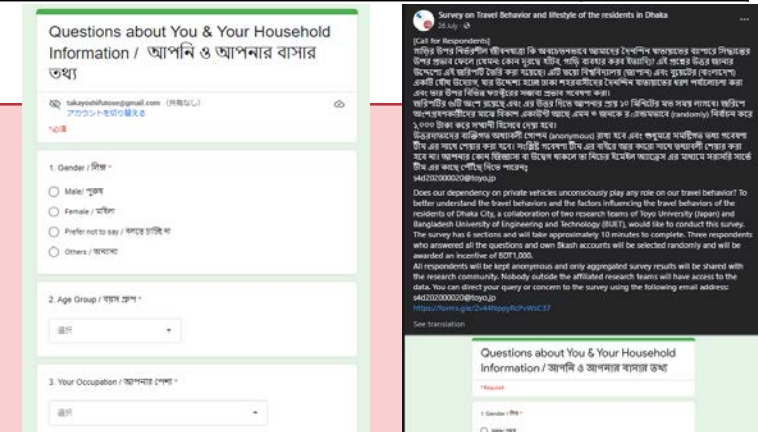
Question about Mobility

- Vehicle Ownership
- Driving Experiences
- Usage of Transport Services
- Walking Intensity

Questions about Image of the Transport Modes

Questions on Lifestyle (Walking, Car, COVID-19, Behavioral Intention for Short Distance Trip)

Stated Preferences on Walkable Distance Trip (500 m / 1km) & Long Distance Trip (4km / 7km/ 10km)

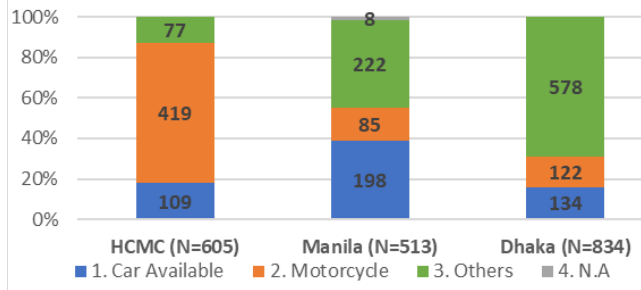


Web based Interview has risk of biased sample.

⇒ Focusing on gap between private vehicle owners & Non owners.

4. SURVEY RESULTS

■ **Personal Attribute:** the number by the vehicle availability is sufficient for the analysis.

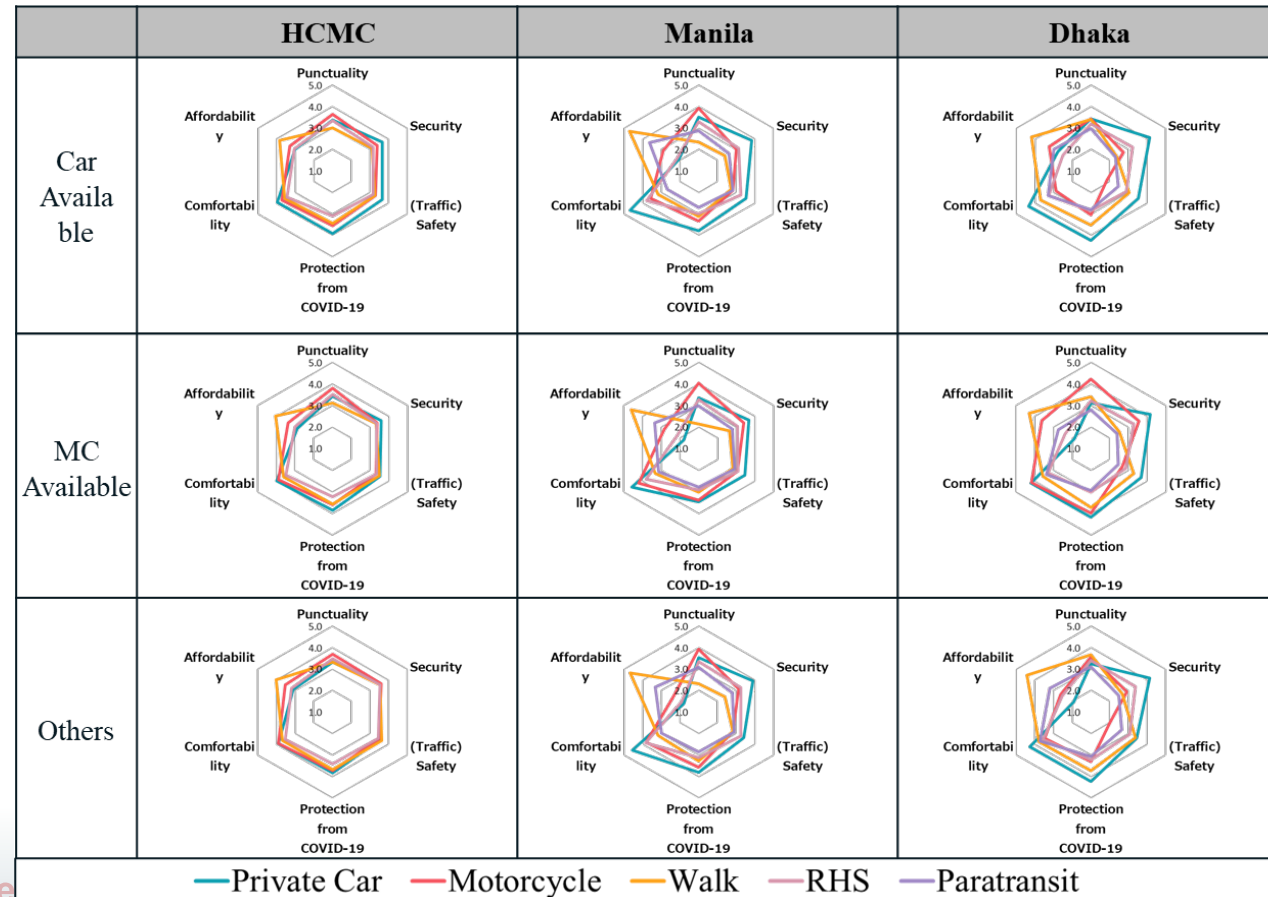
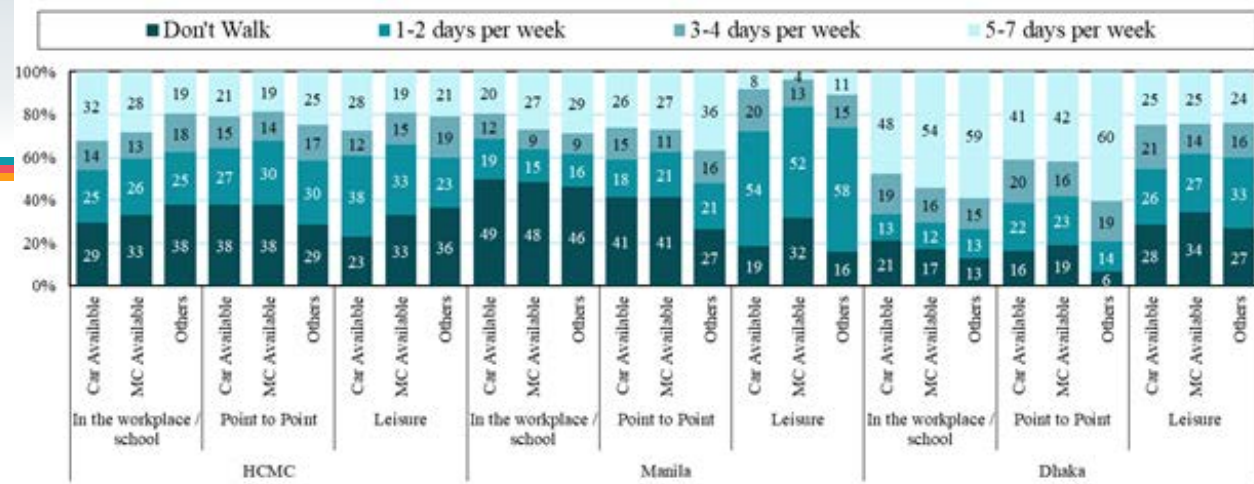


■ **Walking Behaviour:**

- Private vehicle users walk less.
- **HCMC:** non-users walk less for work/school and leisure.
- **Manila and Dhaka:** MC users walk less during leisure, may reduce walking opportunities.

■ **Image of the Transport Services**

- **HCMC:** differences on mode are small.
- **Walking** shows lower evaluations, especially among private vehicle users.
- **Motorcycle users** highly rate motorcycles, unlike car users and non-users.
- **RHS and paratransit** are rated significantly lower than private cars.



4. SURVEY RESULTS:

Opinion about the Lifestyle and Principal Component Analysis

Principle Component Analysis	HCMC			Manila			Dhaka		
	1	2	3	1	2	3	1	2	3
WA1. Walking could be good for my health.	0.84	0.22	0.09	0.80	0.11	0.22	0.80	0.15	0.12
WA2. Walking could be a chance to socialize	0.76	0.14	0.20	0.77	0.07	-0.24	0.75	0.05	0.05
WA3. Walking could be good for my vitality and Quality of Life	0.85	0.12	0.17	0.86	0.08	0.05	0.87	0.11	0.15
WA4. Walking could be benefit for the environment	0.84	0.09	0.20	0.81	0.01	0.28	0.82	0.06	0.11
CA1. I am (was) dreaming of owning my own car	0.32	0.65	0.06	0.05	0.76	0.12	0.17	0.78	-0.01
CA2. Owning a car is a symbol of my social status	-0.12	0.79	0.11	-0.04	0.79	-0.13	-0.02	0.71	0.02
CA3. It's fun to ride a car	0.37	0.74	0.04	0.20	0.69	0.11	0.06	0.65	0.04
CA4. I feel everything under control when I drive.	0.12	0.75	0.20	0.11	0.63	0.29	0.13	0.64	0.14
CV1. Compared with others, I am more careful about infection control	0.46	0.19	0.64	0.58	0.21	0.47	0.21	0.05	0.81
CV2. Since COVID-19 pandemic, I became anxious about using public transport	0.16	0.15	0.89	0.10	0.14	0.89	0.08	0.10	0.86
Proportion Explained	0.32	0.23	0.14	0.30	0.22	0.13	0.27	0.20	0.15
Cumulative Proportion	0.32	0.55	0.69	0.30	0.52	0.65	0.27	0.47	0.62

5. TRAVEL MODE CHOICE MODEL INTEGRATING THE PEOPLE'S ATTITUDE AS A VARIABLE

■ SP 1: Walkable Distance (500 m / 1km)



<p>1. Walking</p>	Time: 7.5 min
<p>2. Xe Om</p>	Time: 4 min Cost : 10,000 VND
<p>3. Private Vehicles (Car / MC)</p>	Time: MC: 4 min Car: 3 min

■ SP 2: Long Distance (4 / 7 / 10 km)

<p>1. Xe Om</p>		Cost (VND): 40,000 Time (min): 25 (5 minutes waiting time)
<p>2. Bus</p>		Cost (VND): 5,000 Time (min): 40 (10 minutes waiting time)
<p>3. Taxi</p>		Cost (VND): 80,000 Time (min): 35 (5 minutes waiting time)
<p>4. Private Vehicles (Car / MC)</p>		
<p>Cost (VND): 5000 / 2000 Time (min): 30 / 20</p>		
Cost (VND)	<p>40,000 5,000 80,000 5,000 2,000</p>	
Time (min)	<p>Xe Om Bus Taxi Car Motorcycles</p> <p><input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/></p> <p>(25) (40) (35) (30) (20)</p>	

SP1

Pattern	Q	Parameter			
		Distance	Time Zone	Pedestrian	Road Traffic
1	1	500 m	Day-time	Busy	Free flow
	2	1,000 m	Night	Busy	Congested
	3	1,000 m	Night	Not Busy	Free flow
2	1	500 m	Day-time	Busy	Free flow
	2	500 m	Night	Not Busy	Free flow
	3	1,000 m	Day-time	Busy	Congested
3	1	500 m	Day-time	Busy	Free flow
	2	1,000 m	Night	Busy	Free flow
	3	500 m	Night	Busy	Congested

SP2

Pattern	Q	Parameter			
		Distance	Waiting time for Public Mode	Parking Fee for Private Mode	Traffic Condition
1	1	4 km	Long	No	Free flow
	2	7 km	Long	Yes	Congested
	3	10 km	Short	No	Congested
2	1	4 km	Long	Yes	Congested
	2	7 km	Long	No	Free flow
	3	10 km	Long	Yes	Congested
3	1	4 km	Long	No	Congested
	2	7 km	Short	Yes	Congested
	3	10 km	Long	No	Free flow

Estimated MN-Logit Model: SP1(Walkable Distance)

			HCMC		Manila		Dhaka	
			β	t	β	t	β	t
Mode Dummy		Paratransit	-2.338	-7.95**	-3.199	-9.54**	-1.432	-6.39**
		Private Vehicles	0.055	0.22	-0.600	-2.47*	-2.216	-9.21**
Principle Component Scores	PC1: Attitude on Walking	Walk	0.492	6.72**	0.310	4.84**	0.132	2.73**
	PC2: Attitude on Car	Walk	-0.053	-0.88	-0.229	-3.48**	-0.231	-4.05**
	PC3: Attitude on Infection Risk	Walk	0.051	0.83	-0.008	-0.13	0.063	1.08
Attribute Dummy	Paratransit Frequent Users (More than several times per week)	Paratransit	1.943	6.77**	2.479	9.09**	0.576	4.79**
	PV Frequent Users (Daily User)	Private Vehicles	0.787	5.38**	0.076	0.57	0.714	4.83**
	Female	Walk	1.114	8.02**	-	-	-	-
	40++	Paratransit	-	-	0.612	3.78**	0.119	1.02
	Non-Walker (Less than 210 /420 min per last 1 week)	Walk	-0.610	-4.72**	-0.585	-4.89**	-0.391	-3.62**
Walking Condition Dummy	Night Time	Walk	-1.377	-9.67**	-1.103	-8.76**	-1.251	-11.3**
	Busy Street	Walk	0.152	0.96	-0.133	-0.91	0.626	3.60**
	Trip for 1 km	Walk	0.898	5.65**	1.247	7.32**	0.311	1.65
Evaluation Score for Transport Service (1-5)	Punctuality	Common	0.019	0.35	0.058	1.30	0.291	6.98**
	Security		0.003	0.04	-0.008	-0.19	-0.021	-0.50
	Traffic Safety		0.011	0.16	-0.011	-0.23	-0.100	-2.36*
	Infection Risk		-0.003	-0.03	0.015	0.37	0.080	1.62
	Convenience		0.139	1.70	0.226	4.54**	0.235	4.58**
	Affordability		0.221	3.65**	0.240	5.46**	0.106	2.70**
Estimation Results	SP samples		1543		1467		1950	
	Adjusted ρ^2		0.327		0.177		0.299	

Estimated MN-Logit Model: SP2(Long Distance)

			HCMC		Manila		Dhaka	
			β	t	β	t	β	t
Travel Time (min)		Common	0.031	4.47**	-0.016	-4.24**	-0.010	-1.58
Travel Cost (000 VND/ Php / BDT)			0.008	2.53*	-0.001	-0.31	-0.000	-0.01
Mode Dummy		Paratransit	-0.171	-0.66	0.114	0.40	-1.906	-5.89**
		Taxi / RHS	-1.618	-4.30**	-1.292	-2.65**	-3.228	-7.40**
		Private Vehicle	1.261	6.02**	1.394	5.89**	-0.299	-1.29
		Railway			0.954	4.13**		
Principle Component Scores	PC1: Attitude on Walking	Private Modes	-0.171	-2.44*	-0.281	-4.43**	-0.478	-7.89**
	PC2: Attitude on Car		0.042	0.69	0.520	7.63**	0.203	3.13**
	PC3: Attitude on Infection Risk		-0.047	-0.76	-0.015	-0.24	0.028	0.43
Travel Length is 7km or 10km		Taxi	1.303	3.93**				
Frequent Users of the travel modes (more than few times per month)	Paratransit		0.834	2.18*	1.162	4.48**	1.331	6.25**
	Public (Road Base)		1.159	6.83**	1.614	8.35**	1.310	7.98**
	Taxi / RHS		0.199	1.21	0.399	1.03	1.370	3.97**
	Private Vehicle		1.234	8.81**	0.490	4.00**	1.909	13.10**
	Railway				1.033	7.25**		
Evaluation Score for Transport Service (1-5)	Punctuality		0.075	1.02	0.207	4.52**	0.155	3.67**
	Security		0.098	1.05	-0.103	-2.16*	0.196	3.69**
	Traffic Safety		-0.126	-1.49	0.168	3.42**	-0.016	-0.32
	Infection Risk		0.288	3.57**	0.014	0.48	0.171	2.92**
	Convenience		0.200	2.45*	0.084	1.54	0.138	2.46*
	Affordability		0.283	4.39**	0.134	3.09**	0.011	0.25
Estimation Results	SP samples		1,579		1,536		1,847	
	Adjusted ρ^2		0.220		0.255		0.365	

Scenario Analysis on Consciousness (PC Score)

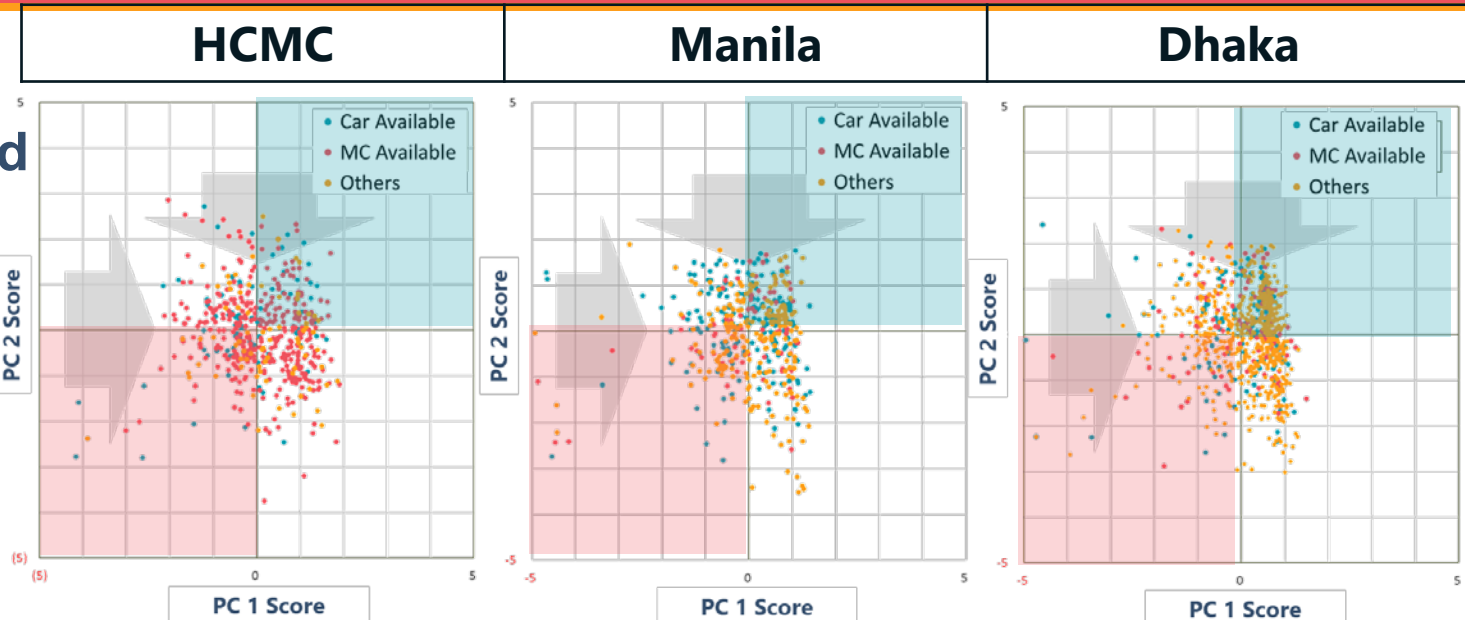
■ Model for Long Distance was updated

■ The attitudes (PC Scores) are mitigated

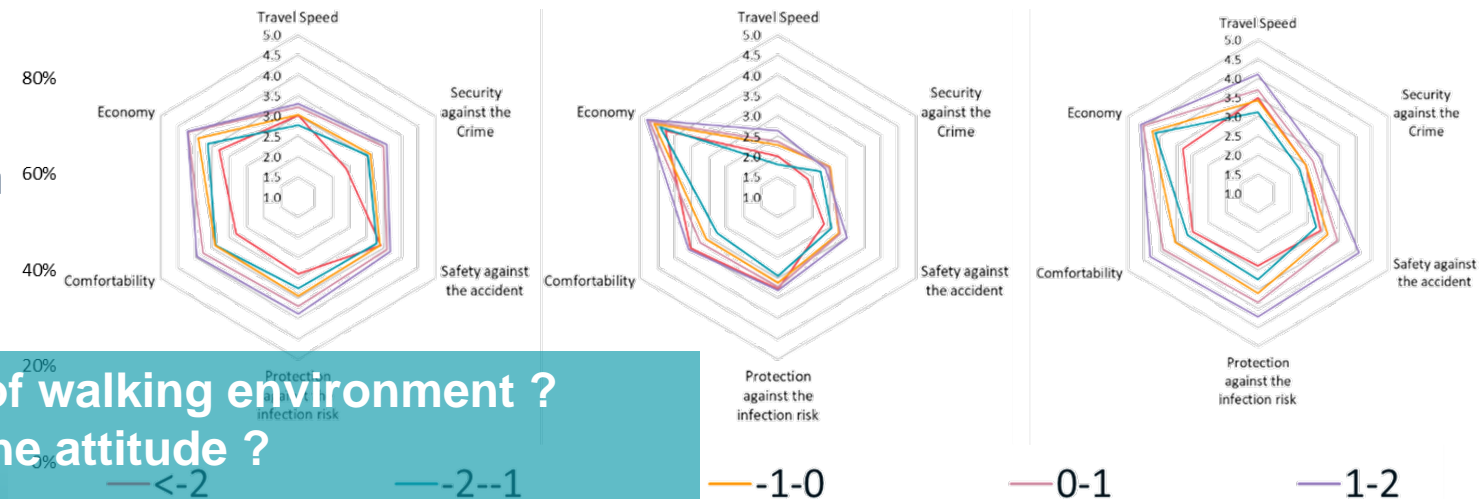
- People with Negative PC 1 (Attitude toward walking) $\Rightarrow 0$
- People with Positive PC 2 (Attitude toward Car) $\Rightarrow 0$

■ Results

- Promotion to encourage walking, would make a shift from private vehicles to public transport.
- Attitude toward walking & evaluation on the walking environment is correlated.



Evaluation on Walking Condition, by Score Group of PC1 (Attitude to Walking)



- Attitude enhance the evaluation of walking environment ?
- Walking environment will affect the attitude ?

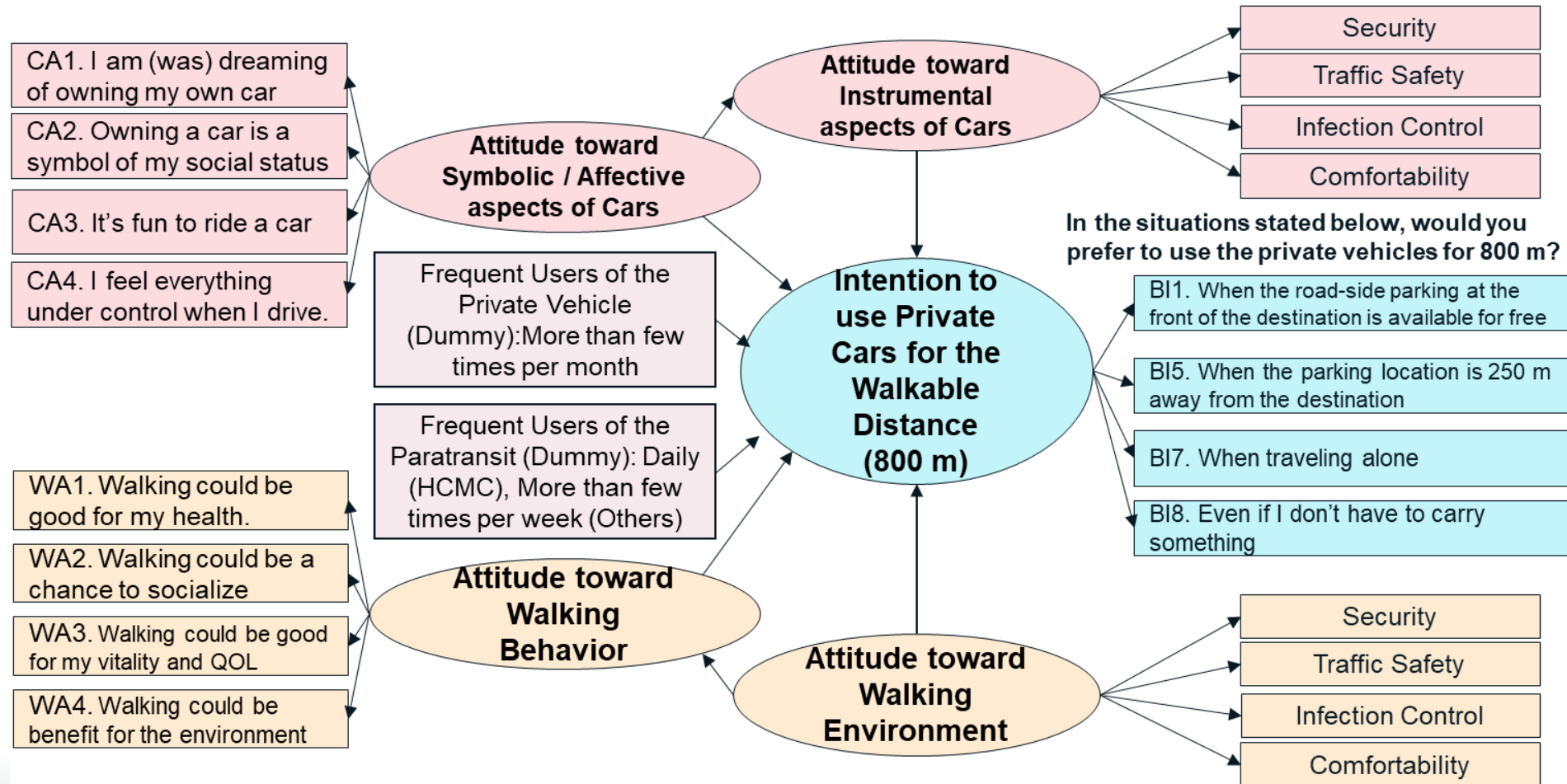
6. BEHAVIOURAL INTENTION TO USE PRIVATE VEHICLES FOR WALKABLE DISTANCE (800 m)

Travel behavioural intentions within walking distance (800 m), under the situations stated below are asked.

SEM to estimate the factors determine the intention to use private vehicles

Parameters are estimated by the attributes

- Car Available
- MC Available
- Others



6. BEHAVIOURAL INTENTION TO USE PRIVATE VEHICLES FOR WALKABLE DISTANCE (800 m): Estimation Results

		HCMC						Manila						Dhaka						
		1. Car Available		2. MC Available		3. Others		1. Car Available		2. MC Available		3. Others		1. Car Available		2. MC Available		3. Others		
		β	t	β	t	β	t	β	t	β	t	β	t	β	t	β	t	β	t	
1	Intention to use Private Cars for the Walkable Distance (800 m)	← Attitude toward Walking	0.23	2.12 *	0.10	2.10 *	0.42	2.67 **	-0.33	-2.64 **	0.00	0.05	-0.26	-2.57 *	-0.19	-1.65	-0.12	-0.91	-0.30	-3.91 **
2		← Attitude toward Car	0.50	4.18 **	0.15	4.83 **	0.32	3.29 **	0.31	4.23 **	0.13	1.90	0.43	5.82 **	0.36	2.77 **	0.09	1.28	0.33	7.08 **
3		← Frequency of Paratransit use	0.03	0.18	0.10	1.49	0.17	1.07	-0.46	-3.78 **	-0.04	-0.36	-0.10	-0.85	-0.22	-1.28	-0.26	-1.86	-0.05	-0.51
		← Frequency of Private Vehicle use	0.26	1.58	0.14	2.54 *	0.07	0.47	-0.13	-0.86	0.24	1.52	0.06	0.57	0.14	0.97	0.22	1.41	0.00	0.01
4	Attitude toward Walking	← Evaluation of the Walking Environment	0.41	3.30 **	0.31	5.64 **	0.69	3.48 **	0.31	2.07 *	-0.23	-0.77	0.08	0.99	0.53	3.32 **	0.62	2.72 **	0.18	3.98 **
	Intention to use Private Cars for the Walkable Distance	← Evaluation on Car's LOS	-0.10	-0.88	0.05	1.30	-0.32	-1.76	-0.28	-1.38	-0.06	-0.37	0.04	0.34	-0.29	-1.80	-0.26	-1.39	-0.12	-2.08 *
	Evaluation on Car's LOS	← Attitude toward Car	0.71	7.03 **	0.35	8.15 **	0.50	4.12 **	0.20	2.07 *	0.09	0.71	0.22	2.73 **	0.64	6.31 **	0.05	0.91	0.19	4.14 **
5	Intention to use Private Cars for the Walkable Distance	← Evaluation on Car's LOS	-0.07	-0.71	0.13	3.11 **	-0.06	-0.64	0.11	1.80	-0.00	-0.04	-0.09	-1.24	-0.04	-0.43	0.35	1.67	-0.06	-1.24
GFI			0.795						0.826						0.874					
AGFI			0.745						0.785						0.844					

- Intention to use private vehicles ← Attitude toward walking : Negative
Attitude toward Private Vehicle : Positive
- Attitude toward Car → Car's LOS, Walking Environment → Attitude toward walking
- In some cities / group, paratransit use habit contribute to mitigate private vehicle dependence
- Motorcycle users show a different structure of attitudes towards traffic behaviour compared to others

7. CONCLUSION

■ Attitude towards walking :

- contributes to shift from private vehicles for both short- and **long-distance trips**: To promote public transport, fostering a positive attitude towards walking may be important.
- correlated with the **evaluation of the walking environment**: necessary to improve the walking environment, to encourage people to have a positive attitude towards walking.
- For **motorcycle users**, influence of the walking environment and the attitude are limited. For non-private vehicle users, it is necessary **to enhance a positive attitude towards walking**, especially for short-distance trips.
- **Paratransit** may serve as a feeder mode to **encourage shifting from private to public transport**. However, the image of the service is not as good as the private vehicles and a modernization programme is worth considering.

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