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# **MOTORIZATION PATHWAY IN CHINA: CASE STUDY OF SHANGHAI**

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## MOTORIZATION PATHWAY IN CHINA: CASE STUDY OF SHANGHAI

**Key words:** Motorization Pathway, Travel Mode, Survey, Shanghai, China

### INTRODUCTION

In articles about China in both technical journals and the popular press one often finds an implicit assumption that Chinese consumers are on a direct path that will lead to car ownership sometime in the near-to-mid-term future. The purpose of this paper was to determine if there is a “common” pathway toward car ownership and if so identifying the stages of this pathway. The study also tested the validity of an assumed hypothetical motorization direction – from non-motorized to motorized, from low cost to high cost, and from shared to private-owned. The answers to these questions could be used to predict future levels of auto usage based on the number of people currently in different auto precursor stages.

Our analysis was based on a survey of 1,037 adult respondents done in Shanghai between July 28<sup>th</sup> and October 27<sup>th</sup>, 2006, of which 992 responses were usable for analysis. Because car ownership is still relatively rare in Shanghai but is important for long-range analysis, the survey team over-sampled car owners by distributing surveys at Ford dealerships, a car exhibition, and a driving school as well as surveys from on-street intercepts. As shown in Figure 1, the 24 survey locations (13 on-street locations, 3 automobile dealerships, and 8 communities) were spread among the seven districts in Shanghai.

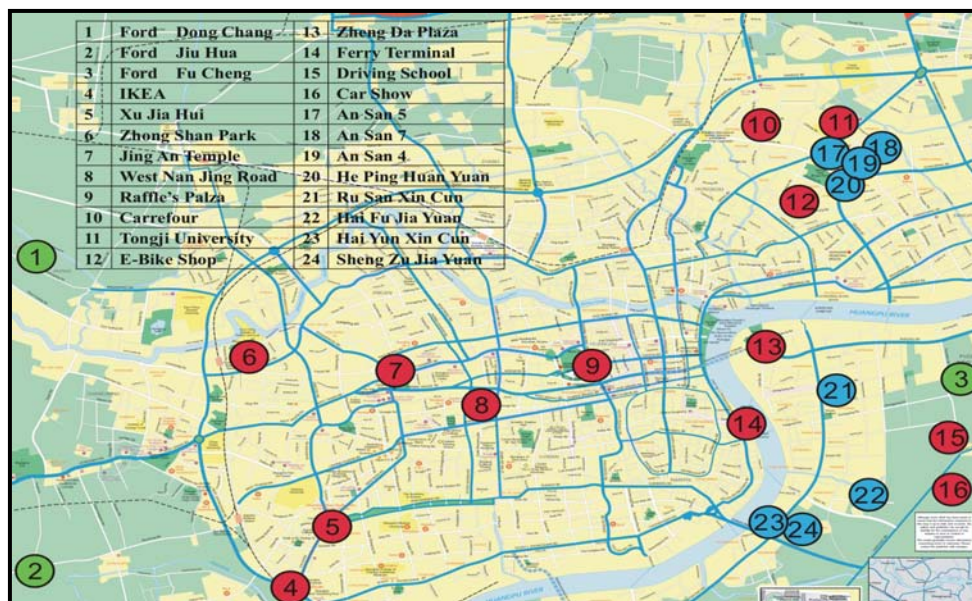


Figure 1: Survey Locations (car dealerships shown in green, retail locations in red, communities in blue)

The results found that no single common pattern existed; the most frequent pattern only covered 6.5% of entire sample. Instead, we found that the motorization pathway in Shanghai is complicated and usually contains a combination of non-motorized and motorized travel modes. Regarding the hypothetical motorization direction, slightly over half (53%) of respondents self-reported that their motorization direction followed this general direction. Nearly as many people (43%) followed a different motorization direction or never transitioned away from their starting mode (4%).

## QUESTION DESIGN

In this research the motorization pathway was defined as the series of travel modes people make at different stages of their life<sup>1</sup>. This type of information could potentially be found through longitudinal studies conducted by following a set of respondents over a period of years. However, for the purposes of this study we assumed that the same information could be captured by having people self-identify their motorization stages, from the past to the present – for example, “*I used to take bus, but I am basically a bicycle person now*” or “*I started by walking everywhere, and now I use bus and bicycle interchangeably.*”

The survey was framed this way:

*Please sort the sequence of the travel modes you have used from the earliest past (in your memory) till now. Please fill in the numbers inside the boxes. (Put zero in the box if you never use that travel mode)*

- Bicycle*
- Walk*
- Personal Car*
- Public Transportation*
- Auxiliary Power Vehicle<sup>2</sup>, Motorcycle*
- Taxi, Rented car*
- Shared Company Car*
- No, there is no such “pathway”. (Why? \_\_\_\_\_)*

*For example: [1] Bicycle, [2] Motorcycle, [3] Car = Bicycle → Motorcycle → Car*

<sup>1</sup> People may use several modes of travel at any given stage of their life. This study focuses on the primary or the most common mode of travel at each stage

<sup>2</sup> In the original survey questionnaire, the wording for scooter is “auxiliary power vehicle”.

Respondents sorted their personal history of travel modes to trace their motorization pathway, or absence of one. People responded to this question by assigning numbers (representing the sequence) to seven groups of travel modes as shown above. Based on the experiences of a pilot survey, some travel modes, e.g., scooter and motorcycle, taxi and rented car, were combined to ensure a large enough sample (in the combined groups) for analysis. According to the definition of motorization pathway, people were encouraged to respond to this question based on use rather than ownership of vehicles.

## **DATA CLEANING**

### ***Modify the Out-of-Range Responses***

In the survey, people can only assign one number (or leave it blank) to one travel mode. That is, one travel mode can only show up once in people's motorization pathway. But two different modes can be assigned the same sequence number. We had two reasons for this; the first reason is that, although there may be some people that moved to a more motorized stage and then went back, our interest was in understanding the general motorization pathway. Second reason was that, by doing so, the complexity of possible answers can be greatly reduced – as a tradeoff of limiting this question to identify a loop-back pattern, such as “walk → car → walk”.

According to the question design, the biggest number that should be associated with any travel mode is seven, since there are seven listed travel modes. However, we found three cases with out-of-range responses. Two people assigned “10” to private car, and one person assigned “8” to the group of motorized two-wheelers and motorcycles. We considered those values as the last travel modes they used and changed them to the highest values they should have been.

### ***Discard and Recode the Missing Data***

In addition to the out-of-range values, we noticed missing data which would generate non-response errors. One common error was to number only the modes used and not put zeros next to modes never used. Our assumption was that such item non-response can be legitimately treated as the “should-be missing” (i.e. no use experience) instead of the “truly missing” (i.e. people overlooked or skipped the question for whatever reason). Those missing data were recoded as zero in the analysis. Also, there were 45 respondents who did not provide a sequence number to any of the seven travel modes. These responses were discarded from the analysis. Thus, the final sample for the pathway analysis consists of **992** cases (instead of the original 1,037).

## COMMON MOTORIZATION PATHWAY

### *Frequency Distribution of Actual Patterns*

As mentioned, one goal of the motorization pathway analysis was to identify the “common” pathway patterns out of many possible combinations. A total of 331 motorization pathways were reported by 992 survey respondents. Since the most common pathway contained only 6.5% of the respondent, one obvious conclusion from the study was that no “common” or “typical” pathway existed.

We next tried to identify the most frequently-occurring pathways to see if any patterns emerged. Table 1 presents the 22 patterns (out of a total of 331) that had 1% or more of the responses. In the table the code *W* stands for walk, *B* for bicycle, *P* for public transportation, *M* for motorized two-wheeler or motorcycle, *T* for taxi or rented car, *S* for shared company car, and *C* stands for private car.

In terms of the sequence, patterns all start with non-motorized modes (walk, bicycle, etc.), and most end with some type of motorized modes (taxi, car, etc.). The most common pattern, reported by 6.5 percent of sample, was: “Walk (*W*) → Bicycle (*B*) → Public Transportation (*P*) → Taxi or Rented Car (*T*).” Private car did not appear until the third most frequent pattern (*W* → *B* → *P* → *T* → *C*). Despite deliberate over-sampling of car-oriented locations, among the 22 most common patterns only seven patterns involved cars at any stage, which suggests that cars are not yet a mobility option for most Shanghai residents.

Motorization Pathway	Frequency	Percentage of 992 cases
W→B→P→T	64	6.5%
W→P→T	33	3.3%
W→B→P→T→ <u>C</u>	32	3.2%
W→B→P	30	3.0%
B	25	2.5%
W→B	25	2.5%
B→M	22	2.2%
W→B→M	20	2.0%
W→B→P→T→M	19	1.9%
W→B→P→M	18	1.8%
B→P→T	17	1.7%
W→P	17	1.7%
B→ <u>C</u>	15	1.5%
W→B→P→M→T→S→ <u>C</u>	15	1.5%
W→B→P→ <u>C</u>	12	1.2%
W→B→P→M→T	12	1.2%
W→B→P→T→S	12	1.2%
W→P→B→T	11	1.1%
W→P→T→ <u>C</u>	11	1.1%
B→M→ <u>C</u>	10	1.0%
B→W→P→T	10	1.0%
W→B→P→M→T→ <u>C</u>	10	1.0%
<b>TOTAL</b>	<b>440</b>	<b>44.1%</b>

**Table 1: Most Common Motorization Pathway Patterns**

### ***Number of Motorization Stages***

In addition to the frequency distribution, reviewing the number of motorization stages is another way to define common motorization patterns. Table 2 classifies 992 respondents based on the number of motorization stages. In terms of the number of stages, the most commonly reported patterns have three or four stages which together represent more than half of the sample (52%). In the remaining half, 18% of respondents reported simpler pathways with one or two stages and 30% reported more complicated pathways with five, six or seven stages.

Number of Motorization Stages	Counts	Percentage of 992 cases
1 (with 7 patterns)	46	5%
2 (with 26 patterns)	130	13%
<b>3 (with 77 patterns)</b>	<b>255</b>	<b>26%</b>
<b>4 (with 81 patterns)</b>	<b>254</b>	<b>26%</b>
5 (with 58 patterns)	162	16%
6 (with 36 patterns)	68	7%
7 (with 46 patterns)	77	8%
<b>TOTAL</b>	<b>992</b>	<b>100%</b>

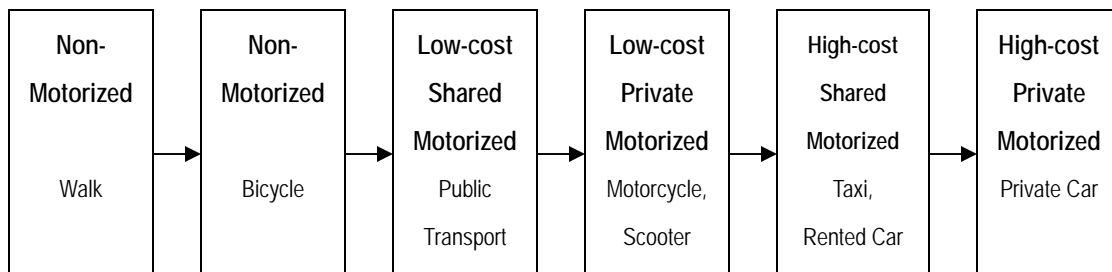
**Table 2: Number of Motorization Stages (100% cases)**

These results imply that motorization pathways are highly individualized and should be treated as complicated patterns involving multiple non-motorized and motorized travel modes. This result is not surprising for Shanghai – a city with rising income and many transportation options available. The results also imply that Shanghai residents are responsive to opportunities to shift modes and that most residents do so several times.

**DIRECTION OF MOTORIZATION**

*Hypothetical Direction*

Prior to the study we hypothesized that the people in Shanghai generally follow a motorization trajectory from non-motorized to motorized, from low cost to high cost, and from shared to private-owned transportation, as shown in Figure 2.



**Figure 2: Hypothetical Motorization Direction**



Each travel mode listed in the survey question was placed into a specific box in Figure 2<sup>3</sup>. We then checked the motorization pathway patterns of the entire sample (992 cases) to see if they matched the hypothetical direction<sup>4</sup> by following this pattern (stages in this pattern might be skipped; it is the sequence that counts):

$$W \rightarrow B \rightarrow P \rightarrow M \rightarrow T \rightarrow S \rightarrow C$$

Table 3 shows that a little more than half (53% if including single-stage pathway, 55% if not) of the sample followed the hypothetical motorization direction. However, nearly as many (43% if including single-stage pathway, 45% if not) did not follow the expected motorization pathway.

<i>Did respondent's path follow the "hypothetical motorization direction"?</i>	Counts	Percentage of 992 case	
		<i>(with single-stage Pathway)</i>	<i>(without single-stage Pathway)</i>
Yes (with 78 patterns)	523	53%	55%
No (with 248 patterns)	425	43%	45%
Single-stage Pathway (with 5 patterns)	44	4%	–

**Table 3: Check of Hypothetical Motorization Direction**

## OTHER FINDINGS

### *Ending Stage of Motorization*

In addition to the overall motorization patterns, we are especially interested in understanding the ending stage of motorization, which indicated people's current level of motorization. As in Table 4, 86% of respondents stated that they are currently at a motorized stage; the other 14% were at a non-motorized stage. Although most people are using motorized vehicles, only 26% of total respondents reported private car as their ending stage of motorization. This would be an over-estimate for the general Shanghai population since survey locations were deliberately

<sup>3</sup> The sole exception was the "shared company car". Depending on the person's circumstances the company car might be similar to a taxi or rented car, or serve as an intermediate stage between "taxi or rented car" and "car". Since this mode was rare in the sample (only two of the 22 most common patterns contained a shared company car at any stage) this mode could be treated as equivalent to "taxi or rented car" little loss of information.

<sup>4</sup> No need to have the same number of stages; only need to match with the sequence.

skewed towards car-oriented sites.

ENDING STAGE	Walk	Bicycle	Public Transportation	Motorcycle/ Scooter	Taxi/ Rented Car	Company Car	Car
Number of Cases	60	82	97	130	245	119	259
% of Sample	6%	8%	10%	13%	25%	12%	26%
	14%		86%				

**Table 4: Ending Stage of Motorization**

***Stage prior to Private Car***

Among all the possible ending stages of motorization, the private car is the most influential because China's transition into a "car era" is expected to have major impact on transportation, energy, and environment regionally and internationally. By consolidating the pathway data, we developed a tree diagram to simplify the motorization ending with private car (Table 5). Considering only the last two stages, the "taxi/rented car" is the most common stage prior to the private car; followed by "company car" and "motorcycle/scooter". In contrast to Shanghai government's policy of promoting public transportation to curb the private car use, our results indicate that most car users/buyers actually come from the taxi/rented car stage, and thus a better taxi service might be more effective in retaining people at the pre-car stage.

Within Last 4 Stages	Counts	Within Last 3 Stages	Counts	Within Last 2 Stages	Counts
BPTC	36	PTC	55	TC	94
WPTC	12	MTC	18	SC	54
PTC	4	BTC	7	MC	39
MPTC	3	STC	7	PC	36
PMTC	10	WTC	6	BC	24
BMTC	7	TC	1	WC	5
WMTC	1	TSC	33	C	3
BTC	4	MSC	11	(PT)C	2
WBTC	2	BSC	5	(BP)C	1
PBTC	1	PSC	4	(MT)C	1
MSTC	5	(PT)SC	1		
PSTC	2	BMC	20		
WTC	5	PMC	9		
BWTC	1	TMC	7		
TC	1	WMC	2		
MTSC	18	MC	1		
PTSC	10	BPC	16		
BTSC	3	MPC	7		
WTSC	2	TPC	6		
TMSC	7	WPC	5		
BMSC	3	PC	1		
(BW)MSC	1	SPC	1		
BSC	2	BC	15		
WBSC	2	WBC	4		
PBSC	1	PBC	2		
MPSC	2	TBC	2		
BPSC	1	SBC	1		
PSC	1	BWC	2		
B(PT)SC	1	WC	2		
BMC	10	TWC	1		
WBMC	7	C	3		
PBMC	2	B(PT)C	1		
SBMC	1	M(PT)C	1		
BPMC	8	W(BP)C	1		
SPMC	1	(BPS)(MT)C	1		
PTMC	5				
BTMC	1				
STMC	1				
WMC	2				
MC	1				
WBPC	12				
BPC	4				
BMPC	5				
SMPC	2				
BTPC	3				
MTPC	2				
TPC	1				
WPC	4				
BWPC	1				
PC	1				
TSPC	1				
BC	15				
WBC	4				
PBC	1				
WPBC	1				
PTBC	1				
WTBC	1				
TSBC	1				
BWC	2				
WC	2				
TWC	1				
C	3				
B(PT)C	1				
BM(PT)C	1				
W(BP)C	1				
W(BPS)(MT)C	1				
N (4+ stages) = 189 N (3 stages) = 47 N (2 stages) = 20 N (1 stage) = 3		N (3+ stages) = 236 N (2 stages) = 20 N (1 stage) = 3		N (2+ stages) = 256 N (1 stage) = 3	

←  
(consider stages backward)

Table 5: Motorization Ending with Private Car

**CONCLUSION**

The results of this analysis show that there is no common path towards car ownership in China; the situation is apparently much more complicated than is commonly supposed. Shanghai residents typically change their predominant mode of travel three or four times and appear to transition away from more “modern” forms of travel nearly as often they transition towards them. This implies that not only is widespread use of private cars not inevitable, but that there are many stages in peoples’ motorization path where government policies (for example to promote the use of buses or taxi) could be used to avoid the need for ever owning a car.

Future research could build on this analysis by using a stratified sample based on people’s age, ownership of driver license or living location to create a more robust view of motorization pathway. It would also be useful to distinguish motorization stages that occurred prior to the respondent moving to Shanghai (if they are immigrants from somewhere else) so that rural-based stages are not mistakenly mixed into the metropolitan data. Finally, it would be good to extend the sample to residents of other regions besides Shanghai because their motorization pathways may be completely different from Shanghai residents due to the huge regional variation in China.