Determinants for Modal Shift of School Children from Private Vehicles to Public Transport: A Case Study in Metro Manila, Philippines

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Abstract. Most studies advocate that to reduce the reliance on private cars and other private vehicles, alternative forms of mode should be made attractive. This study aims to explore the factors and consideration of parents that influence their willingness to shift away from private cars for their child's trip to school. A total of 109 parents from various schools in Metro Manila, who use their own private cars for their child's school commute, have participated in the survey. Using a logistics regression, the sex of the student, distance of house to school, and quality of public transport vehicles were found to be the significant factors in influencing their willingness to shift away from private cars. When the Covid-19 pandemic happened, more parents became unwilling to use the public transport. Findings from this study indicate that the improvement of the quality of public transport may be the most effective in inducing mobility behavior towards sustainable transport. Furthermore, policy formulations need to be designed with consideration of promoting safe and healthy journeys using the public and active transport, especially in the new normal.

Keywords: Modal shift, Logistic Regression, Sustainable Transport, Inclusive Transport

1. INTRODUCTION

According to the United Nations (UN), as of 2018, more than half (55%) of the world's population or 2.31 billion people lives in urban areas and is expected to increase to 68% by 2050. Furthermore, they have noted that future increases in the size of the world's urban population are expected to be highly concentrated in just a few countries, particularly in Asia (United Nations, 2018). With this anticipated growth in urbanization, sustainable development is necessary for the pace of urbanization and the needs of the growing urban population, such as housing, social services, transportation, power, water, and other infrastructure, to meet.

Sustainable development recognizes that development is achieved through the balance between different and competing needs against an awareness of the environmental, social, and economic limitations the society face (Rogers et al., 2008; Muralikrishna & Manickam, 2017). Achieving sustainable development entails significant transformation of the way we build and manage our urban spaces. As identified by UN, one of the strategies in making cities inclusive and sustainable is to provide access to sustainable transport systems for all and improving road safety, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons (United Nations Development Programme, 2015).

As cities become more complex, dealing with problems of urban transport and urban mobility should be multi-dimensional and require a comprehensive and holistic approach. In the comprehensive framework established by the World Bank (WB) and Asian Development Bank (ADB), policies related to urban mobility fall into three (3) clusters – Avoid, Shift, Improve (World Bank and Asian Development Bank, 2012). Avoid and Shift policies both manage the reduction in the growth of motor vehicles by reducing the need to travel and getting people to shift to more sustainable modes of travel, while the Improve policies focus more on the reduction of negative effects of carbon emissions through fuel and vehicle technology

improvements. Sustainable transport planning calls for a paradigm shift as focus should be balanced between the pull and push measures (Batty et al., 2015).

A usual site in Metro Manila are the school areas congested with vehicles, occurring at peak times during the start and end of a school day, with the most common vehicles in sight are private cars, motorcycles, and tricycles. According to the Metro Manila Development Authority (MMDA), one of the reasons that cause traffic in the metropolis are the schools, particularly private schools along C-5 Road and Greenhills area, where the statistics is one student to one car, and every year there is an increase in enrollees (Ramirez, 2018).

1.1. Research Objective

Parents play a fundamental role in deciding the transport mode of their child to and from schools, mostly based on the personal and socio-economic attributes of their child and household, as well as the characteristics and perception of the parents on their surrounding environment (Shengxiao & Pegnjun, 2015).

With that, this study aims to determine the factors and considerations of the parents that will make them shift away from the use of private cars towards public transport (PT) and other sustainable modes of transport in their child's school trips. Looking at each road user and the key road features that matter for their choices can help highlight the transport barriers to modal change and identify willingness to shift to PT and active mobility. Specifically, the study aims to:

- Characterize the socio-economic and mobility patterns of the parents who use their private car for their children's trip to school in Metro Manila.
- Determine the importance of various interventions in their willingness to shift to PT and other sustainable modes of transportation.
- Compare their willingness to shift during pre-pandemic and post-pandemic (or once regular face-to-face classes resume since the pandemic began).
- Recommend possible policy and program interventions appropriate for developing strategies and guidelines to ensure that children have alternatives in their mobility, and they are safe on the roads.

1.2. Significance of the Study

Within the context of this study, it was intended to achieve two purposes: a) to understand how to move commuters in Metro Manila from private cars to other more sustainable transport modes, and b) to identify the possible interventions and conditions that the planners and policy makers can design and implement to make the alternative transport modes more attractive than private cars. This study aims to understand an important and recurring aspect of children's travel – their journeys to school, as it is vital to expose children to more sustainable mobility options, in order to potentially form future adults with more sustainable mobility decisions.

The results can help identify the factors that need to be prioritized to contribute to the realization of a sustainable transport system. The findings of the study may be used to make informed policy and program decisions to agencies concerned, both at the national and local levels, and make targeted investments through capital improvements.

1.3. Study Area

The National Capital Region (NCR), also known as Metro Manila, is considered as the political, financial, and economic capital of the Philippines. The region was chosen as the study area because of the severe congestion currently being experienced in its road network due to

high car ownership and decline in car occupancy (JICA, 2017). In addition, there are more transport modes available as alternative to private car, compared to other regions. Metro Manila is composed of sixteen cities and one municipality (Figure 1). It has a land area of 619.54 square kilometers, the smallest region in the country.
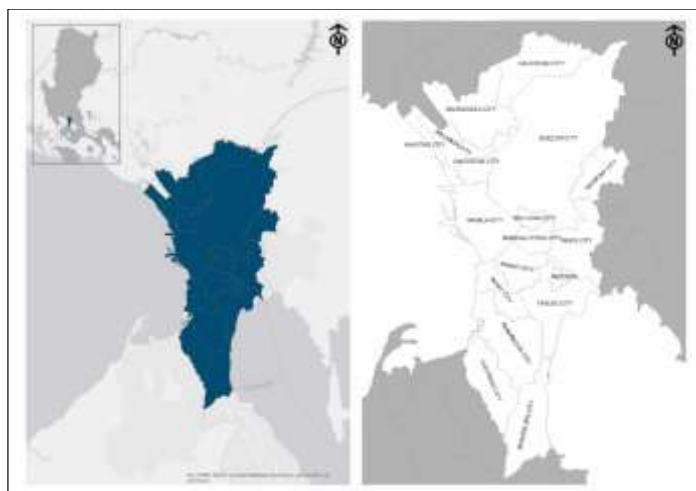

Figure 1. Location Map of Metro Manila

Based on the 2020 Census of the Philippine Statistics Authority (PSA), the region's population has increased from 12.877 million in 2015 to 13.484 million in 2020, and accounts to 12.37% of the country's total population. Its population has increased by 0.97% annually from 2015 to 2020, slower than the 1.58% increase from 2010 to 2015. It is the most densely populated region with 21,765 persons per square kilometer, about 60 times higher than the national average. In 2015, it was reported that the region had a daytime population of 16 – 18 million (Porio et al., 2019), meaning there was an additional five million people in the region during normal business hours, in contrast to the resident population.

According to the 2015 MUCEP study, 11.5% of the total households in Metro Manila are car owners, and among these, 10% own more than one car. The average number of owned cars per household is 1.1. Although the region has the shortest length of road networks, it has the highest road density with 12.77 kilometers per square kilometer. In relation to this, the region has recorded the largest number of registered vehicles among all the regions in 2016, with 2.4 million or 26% from the total 9.25 million registered vehicles nationwide (Metro Manila Development Authority, 2018).

The road-based transport services found in Metro Manila include public utility buses (PUB), public utility jeepneys (PUJ), Asian Utility Vehicle (AUV), taxis, tricycles, and pedicabs. All are owned and operated by the private sector but are regulated by the LTFRB, except for the tricycles, which are being regulated by the local government units (LGU). The PUB serves both intra and inter-regional trips, while the PUJ and AUV (UV Express) provide only intra-city services in Metro Manila (NEDA, 2014). In 2013, ride sourcing transport services, also called as Transport Network Vehicle Service (TNVS), were introduced in Metro Manila (Napalang & Regidor, 2017). In addition to private cars and taxis, this type of service was also offered using motorcycles. Unlike in the other regions, the rail-based transportation in the Philippines is currently being used only in Metro Manila, extending to some portions of the surrounding regions. It has four existing transit lines, with a total of 81.05 kilometers (Department of Public Works and Highways, 2021).

2. REVIEW OF RELATED LITERATURE

2.1. Neighborhood and Surrounding Environment

Most of the studies reviewed have reported that school accessibility - distance and urban form - are two of the highly regarded factors in determining the mode choice for students. An increase in the distance between home and school triggers an increase in the percentage share of private vehicles (Mcmillan, 2007; Rith et al., 2020). Theoretically, some urban planners advocate the development of compact communities to reduce travel distances between the origin and destination, increase the areas that can be reached by transit and lessen motor vehicle travel. This is in comparison to the sprawl development, wherein common destinations, such as schools and commercial centers are located on major roadways, accessible only by private cars (Litman, 2020). The density of an area could, therefore, influence the vehicle ownership and vehicle-mile travelled (VMT) per capita since trips are shorter and alternatives to the automobile are available (Ewing et al., 2017).

On the other hand, several studies conclude that a walkable or bikeable distance does not entail that people will just shift to walking without the presence of appropriate pedestrian infrastructures, particularly sidewalks and bicycle lanes, and an effective network of walkways (Tran et al., 2015; Pachoco Camena & Castro, 2019). Similarly, a positive impression on PT must be established to provide alternatives to private car with the similar level of service, such as comfort, convenience, reliability, and frequent services (Rith et al., 2018; Raoniar et al., 2019; Queiroz et al., 2020).

In addition to infrastructure and service quality, the perception of parents towards safety and security are also seen as crucial in the mobility of their children, particularly on the surrounding environment they are regularly exposed to (Jansson, 2019). The parent's desire to protect their children from crime, accidents, unsafe roads, and disorderly bus drivers have increased the likelihood of driving their children to school (McDonald & Aalborg, 2009; Badri & ElMourad, 2012) and to be less interested in the campaign for sustainable transport (Nasrudin & Nor, 2013).

2.2. Individual and Household Level

For most studies on modal choice, the child's age and sex are the significant predictors. For every one year of age, children were more likely to change from being driven to an active school travel (Mammen et al., 2014). Parents with older children believe that their children could take safer decisions while choosing a travel mode (Raoniar et al., 2019) and are more willing to allow their child to engage in active mobility since the children are perceived to possess the cognitive maturity and capacity to navigate their way to school (Mammen et al., 2014). As for the child's sex, parents with a girl child prefer cars as the trip mode compared to parents with a boy child, which are more inclined towards using PT and two-wheeler (Larsen et al., 2009; Raoniar et al., 2019).

Moreover, the household income plays a pivotal role in the mode choice. With an increase in the income of the household/parent, the more they preferred the faster, reliable, comfortable, and safer modes such as car and school bus, while the odds of using the slowest modes decreased (Raoniar et al., 2019; Rith et al., 2020).

2.3. Policy and Institutional Review

Recognizing that planning and development of urban transport is a multi-disciplinary institutional framework, former President Benigno Aquino III reconstituted the Inter-Agency

Technical Committee on Transport Planning (IATCTP) in 2011, through Memorandum Order No. 25, for the formulation of comprehensive and integrated plans towards sustainable economic growth, and to avoid duplication of efforts among the agencies involved in transport programs and projects. Included in the Committee as members are representatives from National Economic and Development Authority (NEDA), Department of Transportation (DOTr), Department of Public Works and Highways (DPWH), Metropolitan Manila Development Authority (MMDA), Philippine Ports Authority (PPA), Maritime Industry Authority (MARINA), Philippine National Railways (PNR), Light Rail Transit Authority (LRTA), Civil Aviation Authority of the Philippines (CAAP), and from the academe, National Center for Transportation Studies of the University of the Philippines (UP-NCTS).

In 2017, the IATCTP has formulated the National Transport Policy (NTP) to help achieve the Transport Vision of a "safe, secure, reliable, efficient, integrated, intermodal, affordable, cost-effective, environmentally sustainable, and people-oriented national transport system that ensures improved quality of life of the people" (NEDA, 2018). The focus of the policy framework will be on moving people rather than vehicles; therefore, the strategy of reducing travel time should not be equated to more roads being constructed but to aiming for more people being transported, giving priority to public mass transportation over private transport.

In tackling sustainable development, the UN has acknowledged that it should be done through a holistic interdisciplinary perspective. The United Nations Educational, Scientific and Cultural Organization (UNESCO) has launched the "Education for Sustainable Development" (ESD) in 2019 to include the discussion of sustainable development within the formal schooling system to educate citizens, especially the young generations (UNESCO, n.d.). Since 1992, the South Korea has integrated annual hours of traffic education in the curriculum of basic and secondary education. This program has strengthened children's understanding of traffic rules, of using the sidewalks and pedestrian lanes, riding school buses, finding safe routes to school and using the different forms of transportation (GADRRRES, 2017). Similarly in Japan, the safety education is being carried out as part of their school education, where the content varies depending on the age of the students and school location (Nishiuchi, 2014). The study of Kitamura (2014) on the perspective of ESD on Japanese schools has concluded that safety should start from traffic education and raising children's awareness, and then broadening the scope to daily life and disaster. The study further recommended that the schools and communities should collaborate in developing ESD-based curricula of holistic safety education and raise awareness and involvement of the parents in safety education.

In the Philippines, the basic road safety and comprehensive driver's education is still not integrated in the elementary and secondary education curricula, however, several legislative measures were already filed to establish road safety curriculum, campaign and training (18th Congress Senate Bill Nos. 451, 547 and 940, 18th Congress House Bill No. 3402). Under these proposed bills, the DepEd shall develop a curriculum that focuses on the rights and responsibilities of pedestrians and commuters in their use of all types of road transportation, road awareness, road signage, and road hazards, in coordination and consultation with other government agencies, academe and civil society.

3. CONCEPTUAL FRAMEWORK

Several research have revealed that there are various factors that influence the modal choices of parents for their children. Although most of the published studies explore the willingness of the parents to allow their children to walk or bike to school, this study acknowledges that the decision to shift from the use of private vehicles to active mobility may not happen drastically,

and a school bus is a likely replacement for private cars, mainly due to the safety and reliability of service (Ermagun & Samimi, 2015).

The study categorized the alternative modes of transport into five (5) classification: carpool, school bus, non-fixed route PT, fixed route PT, and active transport (Figure 2). The non-fixed route PT is defined in the Local Public Transport Route Plan Manual of the Department of Transportation (2017) as "a type of service that does not have a fixed route and sometimes, a fixed fare rate, wherein a trip is made only after an agreement is reached between the driver and the passenger". Examples of which are tricycles, taxis, motorcycle taxis, rent-a-car, Transport Network Vehicle Service (TNVS), etc. On the other hand, fixed-route PT "operates along a fixed route on a regular basis, follows a regular schedule and fare rates are mostly fixed". Bus, Jeepney, UV Express and Train are among this type of service.

Based on various studies, non-fixed route PT were preferred over fixed-route PT due to its accessibility, less walking time, higher flexibility, more comfort and service-hour extensions (Yan et al., 2021). The school bus, although can be regarded as a PT based on the definitions given above, is in a different category since the passengers are limited only to the children/students, and therefore, they are not required to share the space with the public. Lastly, the walking, bicycle and scooter were categorized as active transport since the trips are being made by physically active means (non-motorized).
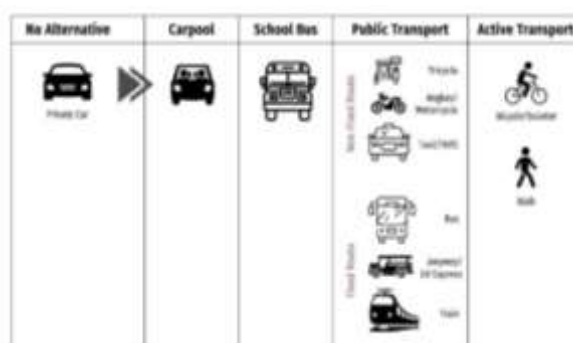

Figure 2. School Travel Mode Choice

Acknowledging that the modal choice for children is based on the complex interactions between the parental decisions and their surrounding environment, this study adopted the socio-ecological framework of Shengxiao and Pegnjun (2015) and presented the influencing factors into three (3) categories: user characteristics, trip characteristics and surrounding environment influences (Figure 3).
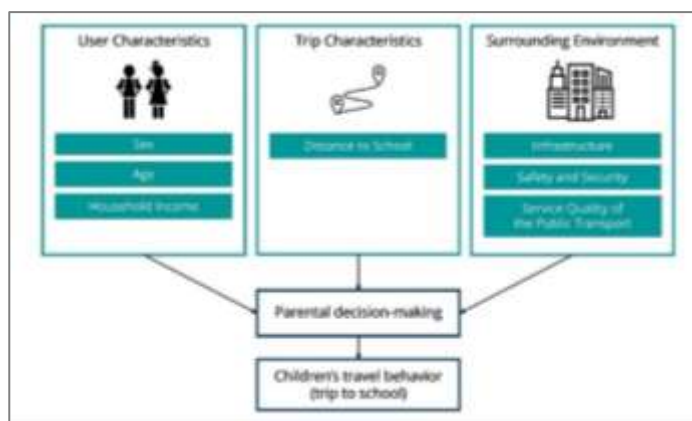

Figure 3. Conceptual Framework

The influencing factors under user characteristics pertain to the individual characteristics of the children and their household, while the trip characteristics and surrounding environment are both the external factors to which the child is regularly exposed to.

4. ANALYTICAL FRAMEWORK

There are three (3) predictor variables under the user characteristics: age and sex of the child and the household income, while the distance of house to school under the trip characteristics. The influencing factors under the Surrounding Environment were factored in the study based on how the parents gave importance on the proposed interventions/programs with their willingness to shift to other modes of transportation, in terms of safety and security, infrastructure quality and service quality of PT (Figure 4). The Safety and Security component focused on the factor of safety from traffic accidents and security from crimes as perceived by the parents.

The possible interventions considered in the study are the provision of adequately designed sidewalks and cycling paths that are physically separated from high-speed traffic, regular road safety education for children and drivers, installation of security cameras/traffic marshals at streets and walkways near schools, provision of cheaper school bus services, use of a real-time public transport tracking application in mobile phones for better information, and modernization of public transport vehicles (air-conditioned and less crowded).
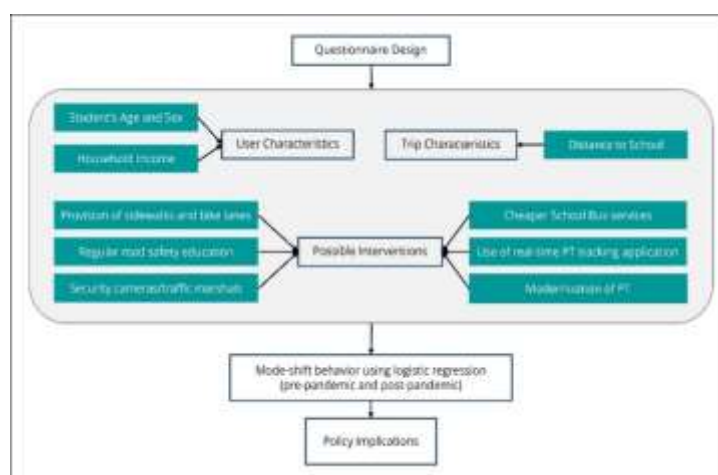

Figure 4. Analytical Framework

The design of the questionnaire followed a stated preference (SP) approach to identify how the respondents might behave in a new situation by showing them the different possible interventions that may be implemented to increase their willingness to shift to other modes of transportation. By asking their alternative transport mode/s that they are willing to use for their child's trip to school, aside from their private car, demonstrates their current willingness (pre-pandemic). In addition to this base case, the respondents were also asked about their willingness to shift post-pandemic, which refers to the resumption of the regular face-to-face classes since the pandemic began.

A logistic regression analysis (LRA) was conducted to investigate the likelihood of the parents to allow their child to use the public transport and other alternative modes from their current mode, in relation to the different predictor variables. In studying the relation between the variables, the LRA exhibits the probability of the outcome of interest by modelling the

chance of an outcome based on individual characteristics (Peng & So, 2002; Sperandei, 2014) and follows this function:

$$logit(p) = a + bX_1 + cX_2 \qquad (1)$$

where,

a : constant/intercept
b, c : regression coefficient of the X variables
X_1, X_2 : predictor variables

The regression coefficient determines the emphasis the predictor variables have on the outcome. The logit(p) model expresses the log-odds ratio or the logarithm of the odds ratio which is described as "the odds that an outcome will occur given a particular exposure, compared to the odds of the outcome occurring in the absence of that exposure" (Szumilas, 2010; Hoffman, 2019). The odds of shifting to other alternative transport modes was analyzed for each of the predictor variables.

From the results and analysis, the study aims to recommend possible policy and program interventions appropriate for developing strategies and guidelines in ensuring alternatives in the mobility of children and their safety on roads. The policy implications identified and discussed in the study aim to help planners and policy makers in designing and implementing urban conditions with attractive alternative transport modes.

5. METHODOLOGY

5.1. Questionnaire Design and Data Collection

The primary data was sourced from surveys with the respondents using a structured research questionnaire. The selection of the respondents concentrated on the parents or guardians: (1) with children aged 7 – 16 years old; (2) the children are studying in Metro Manila; (3) who currently drive or send their children to school using private cars.

The survey questionnaire is divided into three sections: personal information (*parents – city of residence, work schedule, educational attainment, occupation, household income, mode of travel to work and type of housing; students – age, sex and grade level*), trip characteristics (*distance between home and school, average travel time, average weekly transportation expense, and number of children per trip*), and preferences on mode shift (*reasons for choosing private car, preferred alternative mode pre-pandemic and post-pandemic, importance of each factor in their willingness to shift*).

Since face-to-face transactions were discouraged or limited during the data gathering period due to the pandemic, the author provided two types of self-administered survey form – in pdf format and using online google forms. Data validation function was used in the online form to ensure that the respondents will provide the correct responses, while survey forms which has error in their responses were excluded in the analysis. The conduct of the survey was done through the management of the schools located in Metro Manila and crowdsourcing. With the challenges imposed by the pandemic, a purposive sampling was employed. The survey was conducted from January to September 2021.

5.2. Data Analysis

Since the outcome variable is dichotomous (willing to shift or not willing to shift to public transport), binomial logistic regression was used to analyze the data and predict the probability of the mode-switching behavior, given the ten (10) predictor variables. The predictor variables

were tested a priori to verify that there were no violated assumptions: absence of multicollinearity, absence of influential values, independence of errors and linearity of the independent variables (Stoltzfus, 2011). Data were processed and analyzed using the Statistical Package for Social Science (SPSS) software.

Presented in Table 1 are the different variables included in the model with their indicators and how they were treated by the statistical software. In running a logistic regression, a reference group is needed for the categorical variables so that all odds ratios will be a comparison to the reference group (Hoffman, 2019). For this study, the reference groups were selected as those who are less likely to shift away from using private cars: the female group for the sex variable, households who are earning more than Php 41,666 per month for the income class and those who answered less important/not important for each of the identified interventions.

Table 1. List of variables analyzed and their indicators

	Predictor Variables	Indicator	Type of Data
	User Characteristics		
1.	Sex of the Child	Male (1), Female (2)	Nominal
2.	Age of the Child	7-16 years old	Ratio/Scale
3.	Monthly household income	Income Class from PSA	Ordinal
	Trip Characteristics		
4.	Distance of house to school	In kilometers	Ratio/Scale
	Preference on Interventions		
5.	Provision of adequately designed sidewalks and cycling paths that are separated from high-speed traffic	1 = very important/ important	Ordinal
6.	Mandatory/regular road safety education for children and drivers	0 = neutral	
7.	Installation of security cameras/traffic marshals at streets and walkways near schools	-1 = less important/ not important	
8.	Use of a real-time public transport tracking application in mobile phones for better information.		
9.	Modernization of public transport vehicles		
10.	Cheaper school bus services		

6. PRESENTATION AND ANALYSIS OF RESULTS

6.1. Respondents' Profile

A total of 109 respondents from various schools in Metro Manila, with valid responses, have participated in the survey. Seventy-seven percent of the respondents are mothers, while 19.3% and 3.7% are fathers and guardians/relatives, respectively (Table 2).

Table 2. Socio-Economic Characteristics of the Respondents

Predictor Variables	Count		Predictor Variables	Count		Predictor Variables	Count	
Relationship to the child			*Occupation**			*Sex of the child*		
Father	21	19.3%	Official	21	19.3%	Female	39	35.8%
Mother	84	77.1%	Professional	19	17.4%	Male	70	64.2%
Guardian/Relative	4	3.6%	Technical Professionals	12	11%	*Age of the child*		
Highest Educational Attainment			Clerical Staff	6	5.5%	7 - 9 years old	44	40.4%
Highschool Graduate	2	1.8%	Service and Sales Worker	24	22%	10 – 12 years old	32	29.4%
College Undergraduate	5	4.6%	Trader & Related Worker	2	1.8%	13 – 16 years old	33	30.3%
College Graduate	81	74.3%	Not Employed	25	22.9%	*Mode of Transport to Work*		
Postgraduate Degree	21	19.3%	*Work Hours*			Private Car	73	67%
Monthly Household Income			Fixed Time	29	26.6%	Public Transport	7	6.4%
Below Php8,333	8	7.3%	Flexible Time	56	51.4%	Walk/Bike	0	0%
Php8,334 – 20,833	4	3.7%	Not Applicable	24	22%	Motorcycle	2	1.8%
Php20,834 – 41,666	16	14.7%				Shuttle/Company Bus	1	0.9%
More than Php41,667	81	74.3%				Not Applicable	26	23.9%

Note: *No response was recorded for Skilled Agricultural, Forestry & Fishery Workers; Plant & Machine Operator & Assembler; Laborer & Unskilled Worker; and Armed Forces Occupations.

As for the highest educational attainment, 74.3% of the respondents are college graduates, followed by those with postgraduate degrees (19.3%). Out of the 109 respondents, 84 or 77.06% are employed while 22.94% are currently not employed. More than half of those who are currently employed have flexible work schedule or those who do not follow a rigid work schedule, while only 28 respondents have a fixed work schedule. Almost 90% use private car in their travel to work.

Almost 80% of the respondents belong to the income class of more than Php41,667 household income per month, followed by those with Php20,833 – 41,666 monthly income at 12.84%. Those earning less than Php20,833 comprise 8.26% of the respondents. The most represented is 7-year-old students with 17.4% of the respondents, followed by 13-year-old students at 13.8% share. The average age is 10.71 years old, and median is 11 years old. Moreover, majority (or 64.2%) of the students are male, while 35.8% are female students.

The desire line map below (Figure 5) shows the travel lines being taken by the respondents in their travel to school. Based on the survey, more than half of the trips (52.78%) are considered inter-zonal or those trips that occur between two (2) cities, as represented by the yellow line, while 47.22% are considered as intra-zonal or those studying and residing in the same city, as represented by the blue circles. On average, it will take the respondents 28 minutes for a 5.61 distance between the school and house.
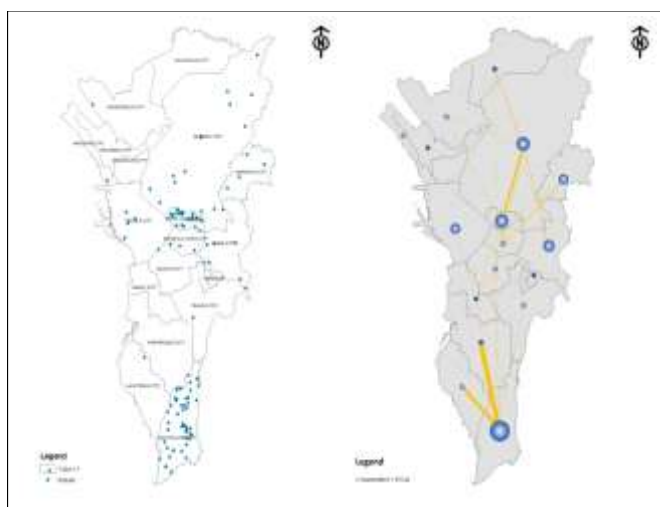

Figure 5. Distribution of schools per city (left) and Desire lines from house to school (right)

6.2. Stated Mode Choice Preferences

In order to gauge the parent's willingness to shift to other alternative modes, they were asked, "aside from your current mode, what alternative mode/s are you willing to use for your child's travel to school?". Each respondent was allowed to answer more than one option among the choices given if they are willing to shift. A total of 152 different responses were logged. The top responses are school bus and carpool with 32% and 27% share of the responses, respectively, followed by non-fixed route PT with 16% and those who are not willing to shift (No Alternative) with 12.5%. The fixed route PT and active transport got the lowest responses with 7% and 5%, respectively.

Comparing their willingness to shift with the age and sex of the child, parents of female students are more willing to shift with 94%, compared to the parents of male students with 84.31% (Figure 6). Parents of female students prefer the school bus, non-fixed route PT and carpool as an alternative to private cars. Similarly, the parents of male students prefer the school bus and carpool. As expected, respondents with children aged 7-9 (15.87%) and 10-12 years old (14.29%) have higher percentage of not willing to shift ("No Alternative") as compared with the older children with only 6.38% (Figure 7). For all age levels, the top responses as the preferred alternative modes are school bus and carpool, as well as PT with non-fixed route for students aged 7-9 years old. Unexpectedly, there were parents of younger students (aged 7-12 years old) who selected active transport as their preference for alternative mode, while none for older students.

For all income groups, the school bus and carpool were seen as the most preferred alternative to private cars. In terms of travel distance, similar with other studies, the survey result shows that active transport is more preferred for short distances (Rith et al., 2020), in this case, for distances of less than 2.3 kilometers, while public transport is seen as preferred for distances between 4.35 and 5.11 kilometers. For distances of more than 5.11 up to 6 kilometers, the school bus and carpool are seen as good alternatives to private cars. As the distance further increase (more than 6 kilometers), respondents prefer to continue using their own cars (No Alternative).
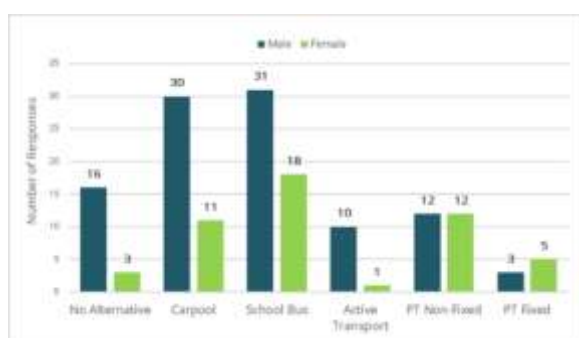

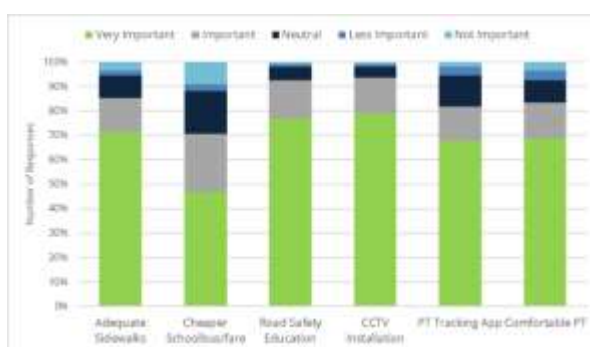Figure 6. Preference of alternative modes, by sex of the child

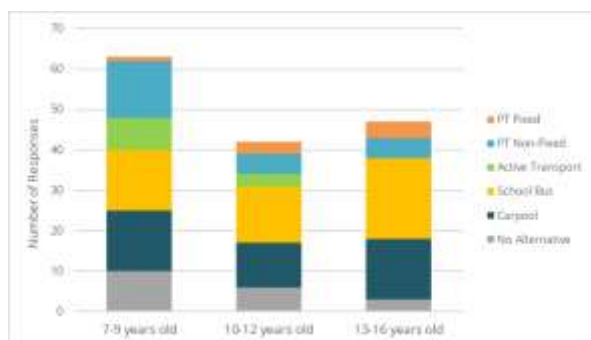Figure 7. Preference of alternative modes, by age of the child

Figure 8. Preferred Alternative Mode
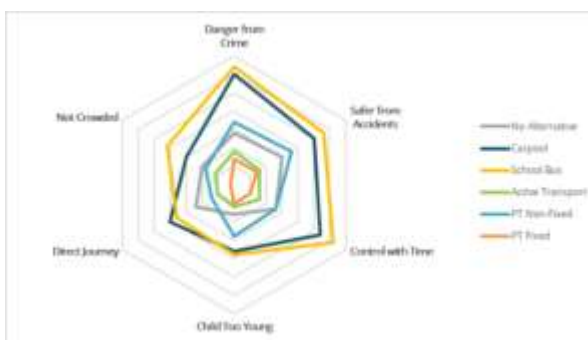vis-a-vis Reason for Choosing Private Car

Figure 9. Importance of Different
Interventions on the Willingness to Shift

In terms of the reasons for choosing car as their main transport mode, those who are not willing to shift to other alternatives have highlighted their concern on safety from accidents, and security from crimes and strangers, as well as the more direct journey and more control on when to depart when using private cars (Figure 8). Those who want more control with their departure time and want to ensure security from crimes have chosen school bus and carpool as their alternative.

Figure 9 presents the rating of the parents for each of the listed interventions based on their importance. Consistent with the identified reasons of the parents in using private car, they put more importance on the road safety education and CCTV installation in relation to their willingness to shift to other alternative mode of transport. On the contrary, the provision of cheaper school bus services/fare received the lowest percentage, among the listed interventions.

6.3. Mode-Shift Behavior

The dependent variable in the study has two (2) decision options, of which majority (90 out of 109 respondents) are in the willing to shift group; whereas 19 cases are in the not willing to shift group. The classification tables (Tables 3 and 4) present the grouping of the subject as willing to shift if the projected probability of the event happening is ≥ 0.5, while it will be grouped as not willing to shift if the probability is < 0.5. From these tables, it can be observed that the overall success rate of the model has increased from 82.6% accuracy in Block 0 (null model or no explanatory variable) to 88.1% accuracy in Block 1 (with effect of the independent variables).

Table 3. Classification Table of Block 0:
Beginning Block

Table 4. Classification Table of Block 1:
Method = enter output

Table 5. Influence of the predictor variables to the model

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Sex_Student(1)	-2.256	1.082	4.157	1	.041	.110
	Age_Student	.108	.132	.673	1	.412	1.115
	School_Km	-.204	.069	8.743	1	.003	.815
	Income_Class			1.704	3	.636	
	Income_Class(1)	-.383	1.558	.060	1	.806	.682
	Income_Class(2)	18.663	19564.978	.000	1	.999	127413881.6
	Income_Class(3)	-1.317	1.013	1.690	1	.194	.268
	Sidewalks_rev			2.044	2	.360	
	Sidewalks_rev(1)	-.206	5.039	.002	1	.967	.814
	Sidewalks_rev(2)	-3.463	4.274	.657	1	.418	.031
	RoadSafetyEduc_rev			.274	2	.872	
	RoadSafetyEduc_rev(1)	2.172	5.232	.172	1	.678	8.778
	RoadSafetyEduc_rev(2)	.113	3.278	.001	1	.973	1.119
	CCTV_rev			1.742	2	.419	
	CCTV_rev(1)	.706	4.595	.024	1	.878	2.025
	CCTV_rev(2)	3.686	3.046	1.464	1	.226	39.868
	TrackingApp_rev			.170	2	.918	
	TrackingApp_rev(1)	-.146	4.024	.001	1	.971	.864
	TrackingApp_rev(2)	.399	4.104	.009	1	.923	1.490
	ModernPT_rev			8.714	2	.013	
	ModernPT_rev(1)	4.082	2.128	3.680	1	.055	59.284
	ModernPT_rev(2)	5.489	1.860	8.713	1	.003	242.019
	CheapSB_rev			3.796	2	.152	
	CheapSB_rev(1)	-3.241	1.981	2.676	1	.102	.039
	CheapSB_rev(2)	-2.020	1.897	1.133	1	.287	.133
	Constant	.088	3.293	.001	1	.979	1.092

a. Variable(s) entered on step 1: Sex_Student, Age_Student, School_Km, Income_Class, Sidewalks_rev, RoadSafetyEduc_rev, CCTV_rev, TrackingApp_rev, ModernPT_rev, CheapSB_rev.

To determine the significance of each predictor variable in the model, a Wald chi-square statistic was conducted. Based on the results (as presented in Table 5), only the sex of the student (Sex_Student), distance of house to school (School_Km) and modernization of public transport vehicles (Modern_PT) were significant predictors of the willingness of the parents to shift to other transport modes in their child's travel to school ($\rho > 0.05$). These will be discussed one by one in the succeeding sections.

6.3.1. User characteristics

In contrast with most studies (Carver et al., 2013; Mammen et al., 2014), the result of the study suggests that the age of the student and household income do not influence the willingness of the parents to use public transport in their travel to school. Among the user characteristics, only the sex of the student is significant. From the regression results, the odds of allowing male students to use other transport mode is 0.110 times lower than that of allowing the female students, when controlling for all other variables.

This result is different with the usual conclusion of other studies that male students have higher likelihood to be allowed to use other alternative modes as compared with their female counterpart, particularly on two-wheeler vehicles (Larsen et al., 2009; Raoniar et al., 2019), but similar with other studies that females have a higher likelihood to use any public transport and walking over car and bicycle usage (Ng & Acker, 2018; Harbering & Schluter, 2020). Moreover, it should be noted that most of these studies have explored the willingness of the parents to allow their children to shift to active mobility only (walk or bike to school). In the study of Rith et al. (2019), although the sex variable has a little correlation with the dependent variable, it showed that male school children are leaning towards the use of non-motorized transport (a correlation of 0.06), while public transport for female school children (-0.05 correlation).

6.3.2. Trip characteristics

From the regression results, holding all else constant, a kilometer increase in the distance between house and school, there is 1.23 higher odds that they will not shift to other transport modes. Out of the thirty-eight schools found in the survey results, only six or 16% of the

schools are within a gated/private subdivision, while thirty-two or 84% are not and can easily be accessed by public transport. Using the google maps, the distance of the schools to a nearby road with access to public transport was measured, and the average distance of the schools not located within a private subdivision to public transport is 100 meters. The data on the type of housing was collected as a proxy data for the urban form. Based on the survey results, 58.7% of the respondents are residing in a sprawling development (single detached house, whether within a gated subdivision or not), while 41.3% are residing in a compact development (condominium, townhouse, and apartment). From the survey results, respondents who are enrolled in schools not within a gated subdivision have more variation in its preferred alternative mode of transport, as compared to those enrolled in schools within a gated subdivision. Similar trend is observed for those residing in compact neighborhoods, where there are more respondents who prefer the public transport (with non-fixed route) and active transport than those who are not willing to shift (no alternative).

6.3.3. Possible interventions for modal shift

Interestingly, among the proposed interventions provided in the questionnaire, only the quality of public transport vehicles was significant in the model. Presence of a dedicated bicycle lane and sidewalks, although perceived safer for most studies, is not significant in the model of this study (Nevelsteen et al., 2012). Even though security from crime and safety from accidents are identified as the main reasons in choosing private cars as the main mode of transportation, the installation of CCTVs, was also found not significant in the consideration of parents to shift to other transport modes.

From the regression results, an upgrade in the quality of public transport vehicles can increase the likelihood of shifting to other alternative modes by 242 times. This finding indicates that the improvement of the quality of public transport vehicles may be the most effective intervention in inducing mobility behavior towards the public transport, particularly for the case of the children. This may imply that the respondents (parents) are more sensitive to the perceived attributes of PT service/vehicles, as compared to the physical attributes of the surrounding environment such as sidewalks and bike lanes.

6.3.4. Post-pandemic modal shift

In most countries during the pandemic, there has been a reduction in the public transport ridership since the use of private cars and other transport modes have become a more attractive alternative to observe social distancing and curb the transmission of the viruses (Lau et al., 2003; Das et al., 2021; Eisenmann et al., 2021). To determine if there is a significant difference between their responses pre- and post-pandemic, a Within Subject Non-Parametric Test was conducted. Since the dependent variable is categorical and binary (i.e., willing to shift and not willing to shift), the McNemar's test is most appropriate (Smith & Ruxton, 2020). Based on the test statistics in Table 6, from being not willing to shift pre-pandemic, there were five (5) respondents who are willing to shift to other alternative modes post-pandemic. However, there were 18 respondents who are willing to shift pre-pandemic that are not willing to shift post-pandemic. The change in the proportion of those who are willing to shift pre and post pandemic was statistically significant with a ρ-value of 0.011, which is less than the statistical significance level of 0.05. Therefore, it can be inferred that the pandemic had an impact on the preference of the parents to stick with the private car over the use of other alternative modes.

Table 6. Result of McNemar's Test (Pre-Pandemic and Post-Pandemic)

Before Pandemic	After Pandemic	
	Not Willing to Shift	Willing to Shift
Not willing to shift	14	5
Willing to shift	18	72

	Before and After Pandemic
N	109
Exact Sig. (2-tailed)	.011[b]

a. McNemar Test
b. Binomial distribution used.

7. CONCLUSIONS

Encouraging private car users to shift to other alternative modes, particularly to public transport, for most part of their journeys has been difficult, as several barriers impede the attainment of this objective. Various studies have concluded that the Filipinos were strongly biased toward car use and car owning (Van et al., 2014; NEDA, 2015). Numerous studies have concluded that, in addition to the socio-economic factors, attitudes and perceptions play a very important role in choosing a transport mode. Through the stated preference (SP) approach in the survey, the study had identified some of the factors that may influence the willingness of the parents to shift away from using their private cars in their children's commute to school and engage more on sustainable transportation.

Findings from this research indicated that the improvement of the quality of public transport vehicles may be the most effective intervention in inducing mobility behavior towards the public transport, particularly for the case of the children. And the experiences during the Covid-19 pandemic have put much emphasis on the need for a lesser crowded public transport vehicles with better seats, cooler atmosphere, and cleaner environment, as there is a significant difference in the willingness of the parents to shift to other alternative transport modes between pre-pandemic and post-pandemic scenarios. Policy formulations need to be designed with consideration of promoting safe and healthy journeys using the public transport, especially in the new normal.

Dealing with urban mobility, solutions require a comprehensive and holistic approach, therefore, focus should be on the balance of pull and push measures. Since car ownership cannot be totally controlled by the government and policy makers, the best way to control is their car use by providing other alternatives with the similar level of service. The improvement in the quality of PT vehicles should be to provide a more comfortable and convenient trip, reducing the disparity in their experiences between riding their own private car and the public transport. In addition to the number coding schemes and area-wide parking management, the public transport, shared transport modes and non-motorized transport should be given priority in the use of public assets, particularly roads, and incorporated in the planning and design of transport projects. To achieve paradigm shift, more attention and efforts should be in place to encourage commuters to shift from personal motor vehicles to other more sustainable modes of transportation.

8. RECOMMENDATIONS AND FUTURE STUDIES

As the government transitions from vehicle-mobility to people-mobility, social acceptance must be sought through the active involvement of the public, especially women, children, the elderly, and those with special needs to ensure successful implementation of the programs and projects. In the ADB's new paradigm for sustainable urban transport, the planning process is aimed to be improved through governance and the focus is on creating an enabling environment. All stakeholders, from the technical experts up to the end users should participate in the policy-making process to ensure that plans and projects reflect actual needs (Asian Development Bank, 2009). Detailed understanding about the preference and attitude of private car users towards public and active transport is of great significance, especially on the planning

and development of transport infrastructure and system. These variables can help policy makers and urban planners to design and create the conditions that would encourage and motivate car users to shift to more sustainable transportation. The range of solutions towards more sustainable transportation may be expanded and tailored to a particular population or situation, particularly to the vulnerable sector (Hasselwander et al., 2021).

Furthermore, with the school bus as the most preferred alternative to private cars, particularly for longer distances, the schools can implement an effective School Bus Program for its students, instead of depending on private operators. This can be a better option for a safer and more secured commute to school and does not require adult supervision. Similar with the Safe Routes to School program, the determination of the school location and planning for the children's transportation should be an extensive collaboration between the parents, school officials, city officials, transport authorities, urban planners, and policy makers to ensure a multi-sector approach in the provision of a good environment around schools (Larsen et al., 2009; Draisin & Vincenten, 2020). This can be a good starting point in promoting alternative transport modes, regardless of the distance the children travel between their house and school.

Due to the pandemic, the administration of survey became limited and therefore, the number of respondents is quite small. Although the results may not represent the whole population of parents in Metro Manila, who uses their private car for their child's trip to school, the survey results and information gained in the analysis served as a good reference in understanding the mobility patterns of school trips and preferences of parents for their children's safe commute. Once regular face-to-face classes resume, the study can be improved by inviting more respondents to participate in the survey and observe how the model and significant factors will change. More predictor variables can also be included in the model and may deliver more robustness in the interpretation of results and conclusion.

The study also served as a starting point for future research efforts, particularly on the specific service attributes of the public transport that are important and attractive to car users, to help urban planners and transport officials design and create the conditions that would pull them towards public transportation and/or active mobility (dell'Olio, Ibeas and Cecin 2011). Moreover, future studies can also look into the possible influence of the urban form of both the residence and school location, such as population density, distance to public transport, actual crime rates and accidents statistics, in the willingness of the parents to shift to other transport modes. Although the study tried to capture the urban form of their residences through proxy data, future studies can delve deeper on these factors.

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