Factors affecting travel behavior during flood events in Metro Manila, Philippines

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Abstract: This paper evaluates the influence of several factors that influence travel behavior of commuters whose trips were disrupted because of floods. Travelers may alter their travels in the form of a change in time of departure, mode or route is taken, or cancellation of the trip. Statistical tests revealed that civil status, employment type, possession and ownership of driver's license and vehicle, household characteristics, income levels, and the penalties associated with tardiness and early departure, influenced commuters' travel behavior. The paper highlights the other factors, aside from the characteristics of the flood, that may influence the behavior of travelers during their last trip that was disrupted by the flood. Penalties imposed to employees due to tardiness resulted in commuters shifting their departure times earlier. In contrast, commuters going home were not able to adjust their travels because of potential penalties. The findings in this paper also reflect the unreliability of public transportation services particularly during severe weather disturbances. Hence, a more resilient road-based public transport services to accommodate possible changes in travel behavior due to extreme weather events is suggested.

Keywords: flooding, Metro Manila, flexibility

1. INTRODUCTION

Flooding is a major issue felt in Metro Manila especially during rainy seasons. Flood waters cause property damages, fatalities, and injuries. It is also responsible for disrupting operations of road-based public transit services. In effect, passengers are left to decide whether to continue their respective journeys or wait until flood waters subside. Those who continue their journeys are often left to tread flooded areas, use informal modes of transit, or ride services that are operating beyond its intended capacity. Other travelers may get stranded at bus stops or stations that are at-grade level because of flood waters. Likewise, they may choose to wait until floodwaters subside and experience longer waiting times at terminals because of unavailable transit services. Another scenario that travelers experience during flood events is postponing their trips until conditions and transit services have returned to normal.

Literature relating adverse weather and travel behavior is abundant. Majority of these studies focused on travel behavior, transit ridership, and traffic conditions (for a review, the reader is referred to Böcker, Prillwitz, & Dijst, 2013). This research understands the lack of existing studies studying the impact of adverse weather to travel in the metropolitan region of Metro Manila, Philippines. In addition, this research highlights the need to understand changes in travel behavior as it can be accounted for in transportation network analysis. In the era of climate

change, it is expected that more frequent adverse weather conditions would make flood incidents to be more frequent. Hence, understanding the impacts of flooding on individual travels in a dense, urban, metropolitan region would be highly valuable.

Travel behavior often varies depending on the characteristics of the traveler, the household they belong in, and the environmental conditions they experience. This paper aims to identify significant characteristics that influence the behavior of individuals whose trips were previously disrupted by a flood. This paper focuses on the collected data from a survey implemented along major transport corridors in the region. Most local research on travel behavior and flooding often focus on the individual characteristics of the traveler. This study recognizes the notion that it would be more convenient for commuters to alter their trips when various constraints are relaxed. Hence, this paper introduces the concept of penalties that are imposed on employees when they arrive late or leave early from the workplace. It is argued in this paper that these constraints have a significant role especially to employees as to why they change their travel behavior, especially during disasters. The adaptive capability of the individual and its influence to travel behavior change is investigated in this paper.

This paper is divided into different sections. Section 2 reviews relevant literature about travel behavior and weather conditions. Section 3 describes the survey methodology and methods of analysis. Section 4 summarizes the results of the survey. Section 5 concludes the paper.

2. RELATED LITERATURE

Studies relating travel behavior to weather conditions often focus on the adaptation of the traveler in the event of adverse weather. These studies explore changes in mode or route (Khattak & De Palma, 1997; Koetse & Rietveld, 2009; Kontou, Murray-Tuite, & Wernstedt, 2017; Liu, Susilo, & Karlström, 2015), trip timing (Mario Cools & Creemers, 2013; Khattak & De Palma, 1997; Sakamoto & Fujita, 2015), or cancel trips (Koetse & Rietveld, 2009; Madre, Axhausen, & Brög, 2007).

Adjustments in travels of automobile and transit users occurred because of adverse weather conditions. Khattak and De Palma (1997) found that automobile commuters respond to travel times, increased accident risk and schedule delays by mode change, departure time change, and route change. Their findings showed that severe weather has a strong influence at departure time rather than in route or mode choice change. Meanwhile, car drivers were more inclined to shift to public transport modes when increased precipitation worsen traffic congestion on roads increased precipitation (Koetse & Rietveld, 2009; Liu et al., 2015). Transit commuters after Hurricane Sandy changed modes, made trip cancelations, and changed departure times to deal with the disruptions caused by the hurricane (Kontou et al., 2017). However, in some cases, heavy precipitation might entirely discourage public transport use as in the case of Northern Sweden (Liu et al., 2015). In another case, the utility of rail modes increased in the event of poor weather conditions and congested traffic conditions(Anta, Pérez-López, Martínez-Pardo, et al., 2016). Changes in trip timing were also considered by travelers affected by adverse weather. The work of M Cools et al. (2010) showed that storm and heavy rain increase the propensity of travel change while the most prevalent form of adaptation is changes in trip timing. Sakamoto and Fujita (2015) showed that Japanese commuters leaving during afternoon peak hours were most likely to shift departure times earlier to avoid congestion resulting from poor weather conditions.

Meanwhile, postponement of trips until weather conditions improved were also observed (Koetse & Rietveld, 2009). Cancellation of trips due to poor weather such as snow, rain, and strong winds was also observed in the study of Madre et al. (2007).

The work of Ibasco (2016) showed that university students in Manila City would likely go home using their usual path than delay their trips in the event of a class suspension. The research of Sunga, Diaz, & Napalang (2017) showed that an increase in precipitation intensity promotes shifting of passengers from buses, jeepneys, UV expresses, light rail (i.e., MRT) to point-to-point (P2P) buses, taxis, and ridesourcing services. Further evaluation showed that the changes in mode resulted in changes in fare, travel and waiting time, reliability, comfort and safety. An analysis of disrupted travels caused by flood showed that ankle-level flood heights increase the likelihood of travel behavior change (Abad, Fillone, & Schwanen, 2017). The same study noted that commute trips and trips that use buses as a primary mode of transport dissuade passengers from deviating from their usual travel behavior.

3. METHODOLOGY

3.1. Data collection

A questionnaire survey was conducted from September to October of 2017 during morning and afternoon peak hours along major transport corridors in Metro Manila, Philippines. Respondents were asked to answer questions referring to the previous trip they made that was affected by flooding. Components of the survey were designed to collect information such as usual travel characteristics, household and office locations, flexibility in terms of travelers' employment commitments, perception on the frequency of flood events over the last five years, and finally their socio-demographic characteristics. A total of 954 responses were collected and used in this study.

The survey began by asking respondents for perceived changes of flood events in recent years. Then, specific details of the last flood event they experienced were elicited. Flood heights were determined with respect to the respondent's body parts (i.e. 'ankle-level,' 'knee-level,' 'waist-level,' or 'chest-level') since accurate measurements of flood heights are difficult to determine. Travel behavior of respondents refers to the decision they made during the last trip that was affected by the flood. This may be a change in departure time (earlier or later), change in mode or route taken for the trip, or cancellation of the trip.

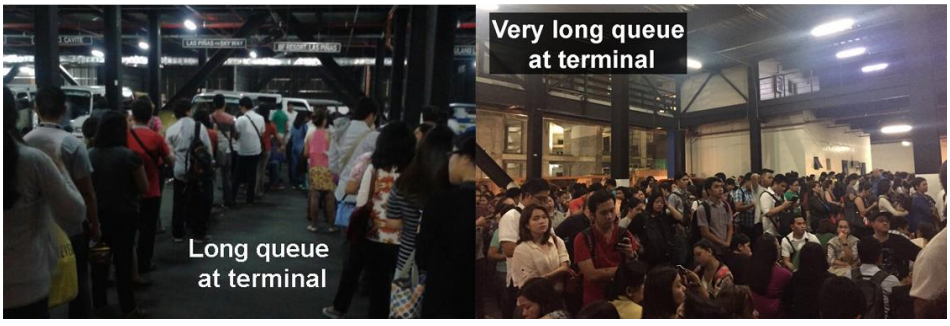

Figure 1. Picture set describing queues at public transport terminals or stops

Succeeding questions focused on detailing respondents' travels which include their origin and destination, trip purpose, modes taken, waiting and travel times for each mode taken. Finally, respondents were asked to describe their travel time, fare, queue experienced at the terminal, and traffic condition during normal (unflooded conditions) to describe the possible changes in travel conditions due to a travel disruption, i.e., flood. Usual queues and traffic conditions were determined by asking respondents to select from images presented to them that best describe the usual queue or traffic condition that they experience on a normal day as shown in Figure 1 and Figure 2. The pictures depicting usual queues were only designed to capture the number of passengers waiting in transport terminals or stops, wherever possible. Likewise, pictures depicting traffic conditions intend to describe the traffic condition that they usually experience.

Figure 2. Picture set describing travel conditions

In this paper, respondents are considered flexible depending on their ease to adapt their travels in the event of a disruption. Travel flexibility in this paper was established by asking questions related to possible constraints in travel. First, respondents were asked if they have an alternate route for the same trip that was affected by flood. If the respondent does not have an alternate route, the reason for not having an alternate route was gathered. Respondents were then asked if they have a history of tardiness or early departures from work. This was asked because it may reflect their sensitivity to the possible effects of tardiness or early departures at work. Finally, penalties imposed for tardiness and early departures were sought from the respondents.

Finally, socio-demographic details of the respondent were asked such as household and workplace locations, gender, age, civil status, educational attainment, employment type, occupation group, vehicle ownership, possession of driving license, number of children at home and going to school, number of senior citizens living with the respondent, and monthly income details both at the individual and at the household level.

3.2. Methodology

Chi-square tests of independence were applied to confirm the relationships between several factors in this study to travel behavior of respondents during flood events. In this study, the Chi-square is defined as:

$$\chi^2 = \sum_{i=1}^{k} \sum_{j=1}^{l} \frac{(n_{ij} - \mu_{ij})^2}{\mu_{ij}} \quad (1)$$

where n_{ij} is the observed frequency in the cell (i,j) and μ_{ij} is the expected frequency in the cell (i,j). This value will be compared to an asymptotic chi-square distribution with (k-1)(l-1) degrees of freedom. One of the criticisms of this test is not giving a meaningful description of the degree of dependence between variables. To address this issue, a contingency coefficient - Cramer's V, is used to provide an acceptable measure of the strength of association. It is calculated as follows:

$$R_V = \sqrt{\frac{\chi^2}{N(min(k,l)-1)}} \quad (2)$$

where R_v is the Cramer's V coefficient, χ^2 is the chi-square value, k and l are the total number of rows and columns, respectively, and N is the total sample size. The value falls between 0 (no association) and 1 (maximum association). A weak relationship between the variables is observed when Cramer's V is less than 0.1. Values falling between 0.11 to 0.30 and above 0.30, reflects moderate and strong relationships between observed variables, respectively. The test was carried out on the hypothesis that travel behavior is independent of the factors presented in the study.

4. ANALYSIS AND RESULTS

Figure 3 shows that 49% of the respondents have traveled as usual on the last flood event they experienced. Meanwhile, 51% of the respondents changed their travel behavior. The most usual form of travel adjustment is to travel earlier than usual. This is followed by delayed departures or travel later then cancellation of the trip. Changing to an alternate mode or route was least preferred by respondents with only about 2% of the respondents performing this alternative.

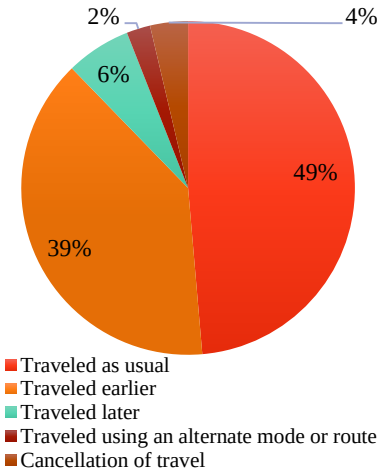

Figure 3. Travel behavior of respondents during the last flood event

The subsequent sections discussed other results of the survey and are followed by the results of the tests of independence.

4.1. Descriptive characteristics of the sample

A total of 597, or about 60% of the responses, are male. This resulted in a sex ratio of about 1.47 and is higher than the regional sex rate of 0.98 (Philippine Statistics Authority, 2017). More than half of the respondents are single, and about 64% have completed tertiary education. Respondents were mostly aged between 18 and 41. In terms of employment conditions, nearly 71% are employed full-time and goes to work not less than eight (8) hours. Nearly half (45%) of the surveyed individuals work in the service and labor sectors. Professionals, executives, government officials, and associate professionals comprise 39% of the total number of respondents. Average monthly individual income falls around P21,460.00. Meanwhile, average monthly household income falls around P62,850.00. Both monthly and household incomes are above the national and regional poverty thresholds. More than half of the respondents have at least one child (53%) or one senior citizen (60%) residing with them in the household. As public transport users were targeted in the survey, it was anticipated that about three-quarters (75%) do not own a vehicle and not more than 30% of the respondents possess a driving license. Complete summary statistics are listed in Table 1.

Table 1 Summary statistics of the respondents' socio-demographic characteristics

Variable	**Min**	**Max**	**Mean**	**Share (%)**
Age	**17**	**72**	**33.19**	
Less than 18 years old				3 (0.3)
18 to 24 years old				128 (13.4)
25 to 31 years old				363 (38.1)
32 to 38 years old				202 (21.2)
39 to 45 years old				154 (16.1)
46 to 52 years old				75 (7.9)
53 to 59 years old				26 (2.7)
60 years old and above				3 (0.3)
Gender				
Male				567 (59.4)
Female				385 (40.4)
Civil Status				
Single				490 (51.4)
Married				463 (48.5)
Employment type				
Part-time or contractual				163 (17.1)
Full-time				673 (70.5)
Engaged in business, self-employed, or self-earning				35 (3.7)
Student, unemployed, retired				83 (8.7)
Occupation group				
Managerial, executive, or government				86 (9.9)
Licensed professionals				139 (16.0)
Technicians, Asso. Professionals, research				147 (16.9)
Clerks				66 (7.6)
Service and sales worker				325 (34.1)
Plant or machine operator				33 (3.5)
Laborer				74 (7.8)
Estimated individual monthly household income (in PHP)	**2500.00**	**100000.00**	**21745.28**	
Estimated household monthly household income (in PHP)	**5000.00**	**150000.00**	**64824.42**	
Number of children in the household	**0**	**5**	**1.15**	

Number of children in household attending school	**0**	**4**	**0.88**
Number of senior citizens in the household	**0**	**4**	**0.94**

Note: 1 USD ≈ 52 PHP (2018)

Table 2. Chi-square test results of independence for socio-demographic characteristics

	Chi-square tests		Symmetric Measures	
	χ2-statistic (dof)	**p-value**	**Phi**	**Cramer's V**
Gender	2.941 (4)	0.568	0.056	0.056
Age group	34.044[a] (28)	0.199	0.189	0.199
Civil status	21.525 (4)	0.000	0.150	0.150
Employment type	76.278[b] (12)	0.000	0.283	0.163
Holds driver's license	16.461 (4)	0.002	0.131	0.131
Vehicles owned	40.662[c] (8)	0.000	0.206	0.146
Number of children	23.623[d] (8)	0.003	0.157	0.111
Number of children in school	37.871[f] (8)	0.000	0.199	0.141
Number of senior citizens	26.806 (8)	0.001	0.168	0.119
Individual income	103.480[g] (40)	0.000	0.329	0.165
Household income	147.341[h] (36)	0.000	0.393	0.196

[a] *20 cells (50.0%) have expected count less than 5. The minimum expected count is 0.07.*
[b] *6 cells (30.0%) have expected count less than 5. The minimum expected count is 0.81.*
[c] *4 cells (26.7%) have expected count less than 5. The minimum expected count is 0.44.*
[d] *2 cells (13.3%) have expected count less than 5. The minimum expected count is 2.77.*
[e] *5 cells (33.3%) have expected count less than 5. The minimum expected count is 1.57.*
[f] *1 cell (6.7%) have expected count less than 5. The minimum expected count is 3.37.*
[g] *28 cells (50.9%) have expected count less than 5. The minimum expected count is 0.02.*
[h] *22 cells (44.0%) have expected count less than 5. The minimum expected count is 0.14.*

Chi-square test results reveal that travel behavior change depends on civil status, employment type, possession of driver's license, vehicle ownership, household characteristics (number of children, number of children attending school, and number of senior citizens in the household), and monthly incomes. Also,

Table 2 showed that these significant variables also showed a moderate strength of association to travel behavior in the last flood event experienced.

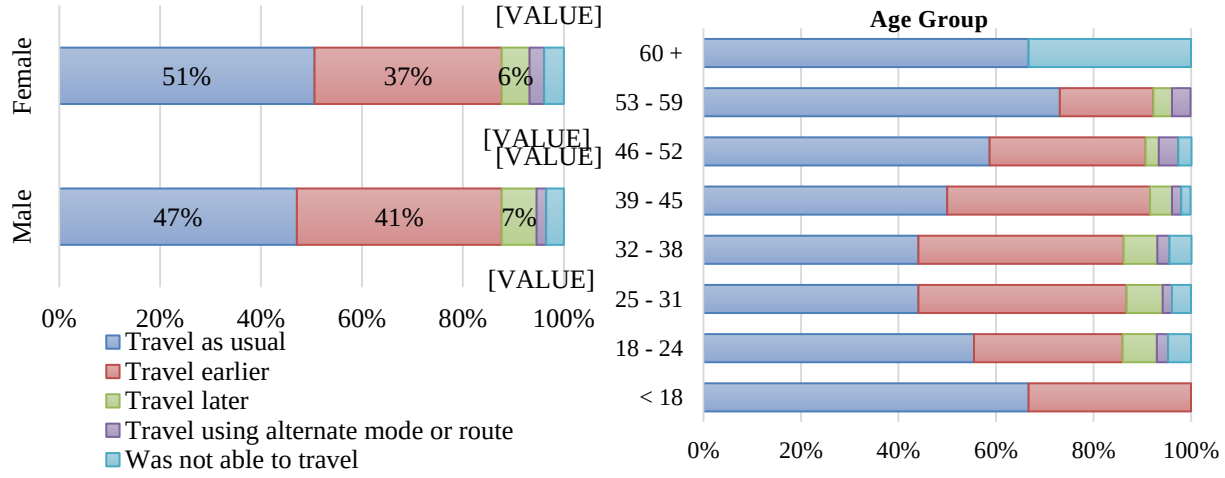

Figure 4. Distribution of travel behavior based on gender (left) and age groups (right)

Figure 4 shows the distribution of travel behavior against gender and age groups. Between genders, a greater share of those who 'traveled earlier' among men than women. A higher percentage of males have traveled earlier. This result concurs with the finding of Saneinejad, et al. (2012). The finding of differences in changing departure times between genders was also found in other studies (Khattak & De Palma, 1997; Li, Chen, Li, et al., 2018). Lastly, there seems to be no difference between males and females for other travel adjustments (later departure, use alternate mode or route, and did not travel). Statistical tests previously revealed that gender is independent to travel behavior which supported the findings of (Abad et al., 2017; Zanni & Ryley, 2015). This may imply that having different genders may not necessarily influence travel behavior during floods.

Among age groups, it is shown that those aged between 25 and 38 years old are more likely to change travel behavior than other age groups. The proportion of those who traveled as usual was higher for respondents not belonging to this age group. Locally, Sunga et al. (2017) argued that younger people are more likely to shift modes. However, this study did not find distinct differences between age groups in the change mode or route alternative. Furthermore, it was also shown that respondents above the age of 60 years old either did not travel or traveled as usual. Literature shows a similar observation of older populations not changing travel behavior (Cools & Creemers, 2013; Zheng, Brian, Saifuzzaman, et al., 2015). This result reflects the fact that older people are more likely to be at a disadvantage during disasters due to potential disabilities (Mattson, 2012).

Table 3. Cross-tabulations for travel decision and number of children in the household

Number of children in the household	***Travel decision on last flood event***					
	Traveled as usual	**Traveled earlier**	**Traveled later**	**Used an alternate route/mode**	**Was not able to travel**	**Total**
None	227 (50.7%)	154 (34.4%)	40 (8.9%)	10 (2.2%)	17 (3.8%)	**448 (47.0%)**
One	50 (40.7%)	60 (48.8%)	7 (5.7%)	5 (4.1%)	1 (0.8%)	**123 (12.9%)**

Two and above	187 (48.8%)	159 (41.5%)	13 (3.4%)	7 (1.8%)	17 (4.4%)	**383 (40.1%)**

Other factors that have a relationship to travel behavior are number of children and senior citizens in the household and income variables. Results in Table 3 reveal that the number of children in the household has a low association to travel behavior. Households with exactly one child have higher shares of travel adjustments. As with previous findings, the most likely travel adjustment is by leaving at an earlier time. This shows the effect of having children in the household and its implications for adults' activity travel (Paleti, Copperman, & Bhat, 2011). Further, it was also argued before Filipino workers with families would want to choose the travel mode with the least travel time (Sunga et al., 2017). As such, earlier departure manifests the need for travelers to attain the lowest travel time possible.

Table 4. Cross-tabulations for travel decision and number of senior citizens in the household

Number of senior citizens in household	***Travel decision on last flood event***					
	Traveled as usual	**Traveled earlier**	**Traveled later**	**Used an alternate route/mode**	**Was not able to travel**	**Total**
None	204 (52.2%)	150 (38.4%)	19 (4.9%)	10 (2.6%)	8 (2.0%)	**391 (41.0%)**
One	113 (45.0%)	115 (45.8%)	11 (4.4%)	6 (2.4%)	6 (2.4%)	**251 (26.3%)**
Two and above	147 (47.1%)	108 (34.6%)	30 (9.6%)	6 (1.9%)	21 (6.7%)	**312 (32.7%)**

Senior citizens in the household have influenced travel decisions of Filipinos in the last flood event they reported. Table 4 showed that having senior citizens in the household decreased the shares of those who did not alter their travel decisions. Furthermore, households that have more than 2 senior citizens in the household had the most shares of respondents that traveled later. This may reflect the roles of senior citizens in the household. Culturally, as the eldest in the household, senior citizens assume the head of the family. In effect, travelers may not be compelled to adjust their travel to fulfill filial commitments immediately.

Incomes at the individual and household levels showed to have moderate associations to travel decisions of the respondents. It is believed that income reflects the spending capability of individuals and may reflect the ease of changing travel behavior of individuals (Lu, Zhang, Peng, et al., 2014; Sunga et al., 2017). In terms of individual monthly incomes, respondents that have incomes between P5,000 to P14,999 have the lowest shares of those that traveled as usual. Meanwhile, respondents earning above P30,000 have higher shares of those that traveled as usual. This paper shares the view of Li et al., (2018) and contrasts the findings of Mannering & Hamed (1990) regarding changes in departure time of higher income earners.

4.2. Normal vs. Disrupted (flooded) travel experience of respondents

Figure 5 shows that about 75% of the respondents that were surveyed noted that the last flood height they experienced reached ankle-level. Meanwhile, 70% of them also remarked that the flood events they experienced lasted less than an hour. The flood-affected trips were mostly commute trips, with home-to-work trips representing about half of the total responses. The frequency of these work-related trips was assumed to be at least five (5) times a week.

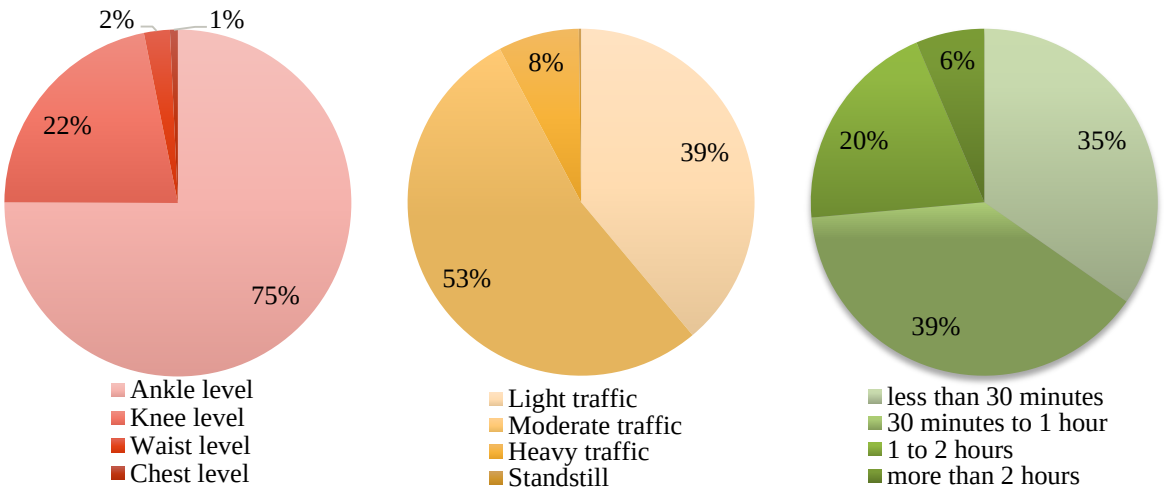

Figure 5. Shares of respondents describing the flood height they experienced (left) the duration of the flood (center), and the increase in travel time due to flood (right)

With the aid of the picture guide shown in Figure 1 and Figure 2, it was shown that about 97% of the respondents said that they usually experience long queues and about 92% experience light to moderate traffic conditions for the same travel. The distribution of travel times of respondents at undisrupted conditions are shown in Figure 6. The figure suggests that the average travel time during normal conditions vary between 1 to 2 hours.

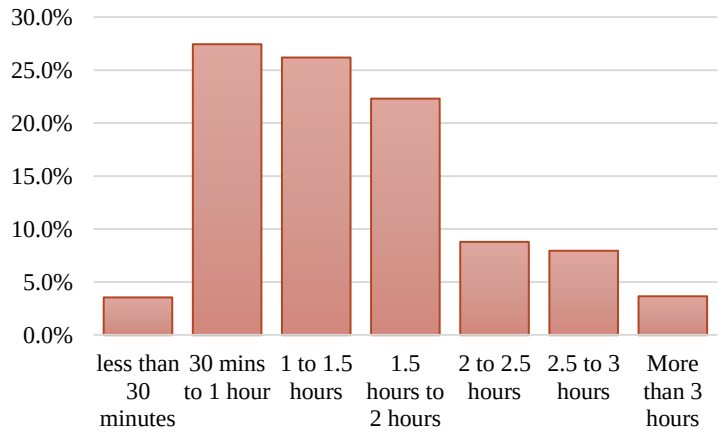

Figure 6. Distribution of travel time of respondents under undisrupted travel conditions

It is anticipated that poor weather and flood conditions would result in increases in travel time. The data reflected this and Figure 5 showed that about 65% of the respondents recorded a change in travel time of more than 30 minutes. Hence, it would be interesting to find out the constraints of individuals when traveling.

4.3. Traveler flexibility during poor weather conditions

The ability of the traveler to adapt to changing weather conditions is also affected by their time constraints in their daily activities. In adverse weather conditions, individuals may still need to travel to perform their required activities that day. Employees may be constrained to attend to their work commitments by arriving at the workplace at a specific time. Likewise, students

attend classes following specific schedules. These constraints are compounded when penalties are imposed if these commitments were not met. Because of these constraints, this research will look at the number of working hours and the penalties imposed for tardiness and early departures and its potential impact to the decision made by travelers in that flood-affected trip. The authors believe that relaxed company policies on tardiness and early departures would give travelers some flexibility especially during adverse weather conditions.

Majority of the respondents reported that penalties are incurred whenever they arrive late or depart early from work. From the data, the most usual form of penalty for tardiness and early departures is in the form of deductions from their compensations. Ironically, the imposition of penalties did not seem to motivate travelers to alter their usual travel behaviors even in the event of a flood.

Table 5. Cross-tabulations for penalties for tardiness and travel decision

	Travel decision on last flood event					
Penalty for tardiness	**Traveled as usual**	**Traveled earlier**	**Traveled later**	**Used an alternate route/mode**	**Was not able to travel**	**Total**
Adjust or offset working hours	5 (0.52%)	3 (0.31%)	0	0	0	**8 (0.08%)**
Compensation deduction	**333 (34.91%)**	229 (24.00%)	48 (5.03%)	5 (0.52%)	21 (2.20%)	**636 (66.67%)**
Put in employee record	73 (7.65%)	71 (7.44%)	4 (0.42%)	9 (0.94%)	5 (0.52%)	**162 (16.98%)**
No penalty	53 (5.56%)	70 (7.34%)	8 (0.84%)	8 (0.84%)	9 (0.94%)	**148 (15.51%)**

Table 6. Cross-tabulations for penalties for early departures and travel decision

	Travel decision on last flood event					
Penalty for tardiness	**Traveled as usual**	**Traveled earlier**	**Traveled later**	**Used an alternate route/mode**	**Was not able to travel**	**Total**
Adjust or offset working hours	6 (0.63%)	2 (0.21%)	0	0	1 (0.10%)	**9 (0.94%)**
Compensation deduction	**318 (33.33%)**	171 (17.92%)	49 (5.14%)	5 (0.52%)	20 (2.10%)	**563 (59.01%)**
Put in employee record	57 (5.97%)	23 (2.41%)	2 (0.21%)	8 (0.84%)	4 (0.42%)	**94 (9.85%)**
No penalty	83 (8.70%)	177 (18.55%)	9 (0.94%)	9 (0.94%)	9 (0.94%)	**288 (30.19%)**

Furthermore, cross-tabulations in Table 5 and Table 6 revealed that respondents still chose to travel as usual even at the risk of compensation deduction for tardiness (34.91%) and early departures from work (33.33%). The results did not offer any explanation as to why travelers did not adjust their travels even at the risk of incurring penalties.

It can be argued that travel behavior would also vary depending on the purpose and importance of the trip. As such, subsequent analyses of travel behavior and penalties for tardiness or early departures were performed for analyzing travel behavior with respect to trip purpose.

Table 7. Cross-tabulation of travel decision and tardiness penalties with respect to home-to-work trips

Purpose	*Penalty for tardiness*	*Travel decision on last flood event*					
		Traveled as usual	**Traveled earlier**	**Traveled later**	**Used an alternate route/mode**	**Was not able to travel**	**Total**
Home to Work	Adjust or offset working hours	**4 (57.1%)**	3 (42.9%)	0	0	0	**7 (1.5%)**
	Compensation deduction	139 (43.4%)	**148 (46.2%)**	21 (6.6%)	1 (0.3%)	11 (3.4%)	**320 (68.4%)**
	Put in employee record	29 (40.3%)	**38 (52.8%)**	2 (2.8%)	2 (2.8%)	1 (1.4%)	**72 (15.4%)**
	No penalty	22 (31.9%)	**39 (56.5%)**	1 (1.4%)	5 (7.2%)	2 (2.9%)	**69 (14.7%)**

Table 8. Cross-tabulation of travel decision and early departure penalties with respect to work-to-home trips

Purpose	*Penalty for tardiness*	*Travel decision on last flood event*					
		Traveled as usual	**Traveled earlier**	**Traveled later**	**Used an alternate route/mode**	**Was not able to travel**	**Total**
Work to Home	Adjust or offset working hours	**1 (100%)**	0	0	0	0	**1 (0.4%)**
	Compensation deduction	**144 (77.4%)**	20 (10.8%)	13 (7.0%)	2 (1.1%)	7 (3.8%)	**186 (67.1%)**
	Put in employee record	**10 (52.6%)**	3 (15.8%)	0	5 (26.3%)	1 (5.3%)	**19 (6.9%)**
	No penalty	17 (23.9%)	**41 (57.7%)**	5 (7.0%)	3 (4.2%)	5 (7.0%)	**71 (25.6%)**

Analysis of trips that were affected by flood according to respondents showed that home-to-work trips were adjusted by leaving earlier. Both Tables 4 and 5 reflect the constraints experienced by employees. It was shown in Table 7 that the penalties ‘compensation deduction’ and ‘put in employee record’ influenced travel behavior by shifting departure times of respondents to an earlier time. It was also shown that respondents whose employers that do not impose penalties also made travel adjustments. Hence, this paper supports the claim that employment commitments have a role in influencing travel behavior due to the imposition of penalties.

Regarding work-to-home trips, Table 8 shows that employees are obliged to complete their working hours despite knowing that the adverse weather conditions would affect their travels. Only 23% of the respondents have left earlier to avoid the said impacts. It shows that the penalties imposed to employees when they depart earlier limited their ability to adjust their travels even during adverse weather conditions. In effect, the penalties influenced their decision to travel as usual. Results from Table 8 also shows that when employers do not impose any penalty, commuters would respond and adjust their travels accordingly. Meanwhile, the majority of school-to-home trip makers ‘either traveled as usual’ or ‘traveled later.’ School-to-home trips, which are performed by students, concur with the findings of Ibasco (2016).

Overall, the imposition of penalties to early departures and tardiness and travel behavior are related. Chi-square tests of independence results in Table 9 prove the dependence of these variables. Moderate to strong relationships were observed for the imposition of penalties to the travel behavior during flood events. further, the type of penalties imposed also showed moderate

to strong relationships to travel behavior. This suggests that imposition of penalties influence travel behavior during adverse weather. It was also shown that having fixed working hours is independent to travel behavior during flood events. This is not significant to the decision making of travelers because only a few can adjust the number of working hours performed in a single day (see Table 5 and Table 6). All of the results of travel behavior with respect to employment agree with the findings of Li et al. (2018).

Table 9. Chi-Square test results of travel decision and employment constraints

	Chi-square test		**Symmetric Measures**	
	χ2-statistic (d.o.f)	**p-value**	**Phi**	**Cramer's V**
Having fixed working hours	5.793[a] (4)	0.215	0.078	0.078
Penalty for tardiness (Yes/No)	14.989[b] (4)	0.005	0.125	0.125
Penalty for early departures (Yes/No)	102.587 (4)	0.000	0.328	0.328
Type of tardiness penalty (all trip types)	41.799[c] (12)	0.000	0.209	0.121
Type of early departures penalty (all trip types)	123.459[d] (12)	0.000	0.360	0.208
Type of tardiness penalty (home-to-work trips only)	25.734[e] (12)	0.012	0.234	0.135
Type of early departures penalty (work-to-home)	107.206[f] (12)	0.000	0.622	0.359

[a] *2 cells (20.0%) have expected count less than 5. The minimum expected count is 2.15.*
[b] *1 cells (10.0%) have expected count less than 5. The minimum expected count is 3.30.*
[c] *7 cells (35.0%) have expected count less than 5. The minimum expected count is 0.18.*
[d] *7 cells (35.0%) have expected count less than 5. The minimum expected count is 0.21.*
[e] *11 cells (55.0%) have expected count less than 5. The minimum expected count is 0.12.*
[f] *7 cells (77.8%) have expected count less than 5. The minimum expected count is 0.16*.

This paper also looks at the individual resilience of the traveler by identifying their ability to adapt to poor weather conditions by using an alternate route. As such, the questionnaire asked respondents if they have an alternate route that they can use for the trip that was affected by flood.

It is significant to note that majority of the respondents surveyed said that they did not have an alternate route. About half of those that did not have an alternate route said that their current route is either the most convenient or the only route that is available to them. Convenience, in this study, refers to the ease with which the traveler can travel using the route. Availability may refer to the idea that their current route is the only way that they can travel for that trip. Looking at the distribution of travel decisions, those who did not have an alternate route were more prone to make travel adjustments in the form of traveling earlier or later. Conversely, those who have an alternate route were more likely to travel as usual. Having an alternate route reflects the ability of the individual to adapt even in adverse weather conditions (Kim, Pant, & Yamashita, 2013). Hence, respondents who have an alternate travel route may be more confident about traveling because of this ability to adapt to poor travel conditions caused by flooding.

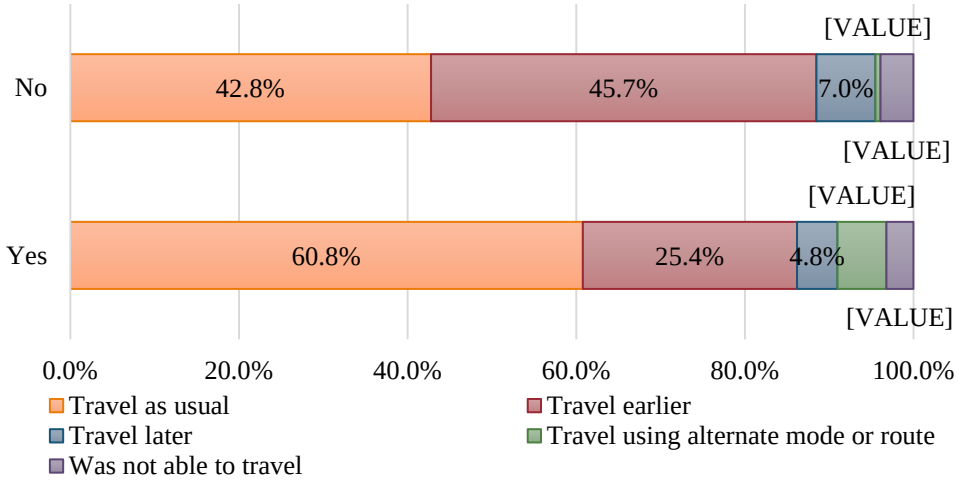

Figure 7. Distribution of travel decision based on those respondents who have an alternate route

Table 10. Chi-Square test results of travel decision and alternate route availability

	Chi-square test		Symmetric Measures	
	χ2-statistic (d.o.f)	**p-value**	**Phi**	**Cramer's V**
Alternate route	62.199 (4)	0.000	0.255	0.255

5. CONCLUSION

This paper used collected data from a survey of 954 travelers in Metro Manila that were previously affected by flooding. From the data, extensive cross-tabulations and tests of independence were performed to identify dependence of travel behavior to various characteristics of the traveler. Symmetric measures such as Phi and Cramer's V values were calculated to show the strength of association. There were five (5) alternatives that the respondent was asked to choose from. Among the 5 alternatives, four (4) pertain to adjustments to travel behavior. Adjustments to travel behavior in this study refer to change in departure times: earlier or later, change in travel mode or route, and cancelation of trips. It was shown in this paper that responses were generally split between those who have made an adjustment to their trips and those who traveled as usual. However, it did not show the extent of how flooding affected their trips. As such, descriptive analyses of the responses were performed.

Results showed that about half of the respondents had adjusted their travels in their last trip that was affected by flood. The different characteristics that influenced their travel decisions were extensively determined in this paper. It was shown that several characteristics such as civil status, type of employment, car and driving license ownership, household characteristics, and income levels have an association to travel behavior. Further, the flexibility of travelers in terms of the imposition of penalties on tardiness and departures and the availability of an alternate route of the traveler also showed some association to travel behavior. These findings show that the disturbances in travel caused by flooding is extensive and have various effects depending on the characteristics of the traveler. As a general recommendation, flood mitigation projects and programs geared towards reduction of street flooding is suggested.

As travel conditions worsen, the need for more reliable public transport services is amplified. It can be said that transit services in Metro Manila are unreliable during weather disturbances because the majority of travelers have experienced increases in their travel times. In

effect, some travelers felt the need to alter their travels accordingly. The different adjustments made by travelers offer an insight on how these disruptions affect different transit users. As many travelers who were affected by flood shifted their departures to an earlier time, public transit operators, in the future, should anticipate the high demand for services, especially during peak hours. The paper also revealed that about 70% of the respondents do not have alternate travel routes and the majority of these respondents were forced to make necessary adjustments in their trips. Hence, it is recommended to review the extent of the public transportation services in the study area.

Additional findings of this paper showed that relaxed policies on tardiness and early departure promote flexibility of travel in the event of a disruption. Hence, it is recommended to investigate the possibility of reducing penalties because of tardiness and early departures in the event of flood incidents. Furthermore, it is also recommended to assess the viability of telecommuting especially to areas that have high flood hazards. With telecommuting, the risks of traveling during flood events are reduced without delaying essential activities in the workplace.

The results of this paper offer an extensive insight to likely future work on understanding travel behavior of individuals whose trips were affected by flood in Metro Manila. In the era of climate change and frequent meteorological disasters, travel behavior research plays a vital role in maintaining transport systems functioning. As such, for future steps, it is recommended to perform analysis of travel behavior using the significant variables in this study to show how much these variables affect travel behavior of individuals.

ACKNOWLEDGEMENTS

The authors extend their sincerest gratitude to the Department of Science and Technology (DOST) for funding this research through their Engineering Research for Development and Technology (ERDT) program.

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