A Comparative Study between Traffic Flow and Red Light Infraction by the Motorcyclists in Dhaka City

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Abstract— Motorcycles have become one of the popular modes of transportation in Bangladesh like other developing countries in south and Southeast Asia recently. One of the most common traffic rule infraction by the motorcyclists of Bangladesh is Red Light Violation. To compare this phenomenon with traffic flow a video survey is conducted on four different locations of the Dhaka city i.e. Science Lab, Shahbag, Farmgate and Mouchak at four different times 8:30 AM to 9:00 AM, 9:15 AM to 9:45 AM, 11:00 AM to 11:30 AM and 10:00 AM to 10:30 AM respectively. To conduct traffic count, vehicles were classified into light vehicles, heavy vehicles, motorcycles and non-motorized vehicles because of the Highway Capacity Manual (HFA, USA) in analyzing flow (Q) and capacity (C). From the survey two types of violation was observed (1) at the beginning of the Red Light and (2) at the end of the Red Light. It has been observed that Type 1 violation is more prominent in the early morning hours whereas type 2 is more frequent as the day progresses. The study also links these two types of traffic infractions with traffic degree of saturation (Q/C) of the road. With higher Q/C Type 1 violation is observed more and with lower Q/C Type 2 violation occurs most.

Index Terms— Degree of Saturation, Highway Capacity Manual, Modes of Transportation, Motorcyclist, Red Light Violation, and Statistical Approach, Traffic Congestion.

1 Introduction

Motorcycle is now becoming an easy way of transportation, in many developing countries like Bangladesh. In Dhaka city (the capital of Bangladesh) the number of motorcycle is increasing in recent years, because it can moves by occupying very smaller area in the road than car, bus etc during traffic jam.

This large number of motorcycle mixed with other types of vehicles creates a complex and dangerous traffic operation. Many motorcycle accidents are caused due to this complicated operation especially in the intersections. Traffic engineers rely heavily on traffic signal to control the traffic movement in the intersection. Safe signal operation requires a high degree of voluntary driver compliance, and many drivers do not comply with red lights. Although traffic lights are installed to regulate and minimize the conflicts among vehicles, the risk of collision is still exist among the intersecting vehicles, affecting as well other road users, including pedestrians and motorcyclists. When a motorcyclist approaches an intersection, whether the rider stops before the stop-line or not depends on the motorcycle approach speed and distance from the intersection. In most cases when a person is committed to a red light violation, the driver was traveling at a speed greater than the posted speed limit which would in turn affect the stopping distance or they tried to "beat the light."

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The easy way to understand the potential danger at signalized intersection is studying the red light violation by motorcyclists in Dhaka, Bangladesh. Dhaka city has become a good representative to conduct this research because of the existence of non-lane mixed traffic flow on its roads. This study was motivated by an urgent need to address the safety of motorcyclists on the roads of Dhaka City due to high proportion and remarkable characteristics of motorcycles.

2 Objective

The objective of this study was to evaluate whether degree of saturation of an intersection approach affects the red light violation by motorcyclists. Two types of red light violation was observed, firstly, at the beginning of the red and secondly, at the end of the red.

3 Scopes and Limitations

The observation was only conducted only for half an hour in each intersection. The survey was also done during a working day. Duration of the observation should be long and survey should be conducted on several working days as well as on weekend to compare the trend between traffic flow and the red light violations by motorcyclists more accurately. The cycle time was not fixed. But for simplicity we let the fixed cycle time. Only two types of red light violation as stated in the objectives were observed.

4 Literature Reviews

It is hard to find previous studies on red light violation by motorcyclist. Research based on red light violations generally concerns on passenger car and bus. This is quite understandable since most studies were conducted in developed countries in which motorcycling is usually only for leisure and therefore

consisting of insignificant number of trips. In this paper only some closely related references can be reviewed.

Porter and Berry (2001) found that about 20% of the respondents were running one or more red lights when entering the last ten signalized intersections based on phone survey on 880 licensed passenger cars drivers [8]. It was also observed that younger respondents were more likely to be violators. Drivers were more likely to run red lights when alone and when in a hurry. Drivers perceived and received few consequences for running red lights. More than 10% had been involved in a red light running crash [8].

Retting et al (1998) observed that in the USA, 3% of all fatal crashes between 1992 and 1996 involved red light running. Urban areas are at greater risk for red light running crashes [11], [12], [13]. Retting et al (1995) found that red light running was involved in 22% of urban crashes [12],[13]. Red light runners do more than run red lights. They are more likely to be unbelted (Porter and England, 2000) and to have more driving violation on their records (Retting and Williams, 1996).

In many European countries, the sequence of the traffic signal is green-flashing green- amber-red-red/amber. From about 5000 cycles observed in Switzerland, Austria and Germany, it was found that the flashing green increases the numbers of early stops, as drivers tend to underestimate the duration of the time to end of amber (Köll et al, 2004) [6].

Mannering et al (1995) found that motorcyclist have a reasonable grasp of the factors that increase the likelihood of accident involvement. These factors include exposure (miles ridden), regularly riding above the speed limit, and passing vehicles on the shoulder or passing between lanes of traffic [9].

5 Methedology and Data Collection

With high proportion and remarkable characteristics of motorcycle, Dhaka is a good representative to conduct this research. Several candidate road sections were on-site observed to conduct this research. But the study sites were selected from following criteria:

- Advantage locations exist not near the intersection to permit discrete observation of traffic operations and thus to avoid abnormal behavior; and
- The locations must not be near bus stop, petrol station, etc. to keep off modification maneuvers from road users.

It is difficult to find out proper locations satisfying all criteria above. Several locations were investigated in the preliminary survey. However, among them, only 4 satisfied the criteria and were applied for data collection.

With the help of two video cameras the survey is accomplished. The first camera was placed in such a way so that it was possible to capture the queue and the flow of the observed approach to conduct a traffic count as well as red light violation count by playing back the video afterward [5]. To identify the beginning of red and green the second video was placed to capture the traffic light [5].

To conduct traffic count, vehicles were classified into light vehicles, heavy vehicles, motorcycles and non-motorized vehicles because of the Highway Capacity Manual (HFA, USA) in analyzing flow (Q) and capacity (C). The cycle time was not fixed but the timing was near about 5 minutes. So we assumed our cycle time fixed and the duration was 5 minutes. Therefore we conducted our observation for 6 cycles (half an hour) at each intersection. Video survey was done at different time of a certain day at four stated signalized intersections to better understand the relation of flow with violation.

In order to establish the number of motorcycles keep moving at the beginning of red period (type 1) and the number of motorcycles that made movement earlier than the beginning of green period (type 2), separate counts were conducted [5]. All motorcycles that queue beyond the stop line were categorized as type 2 violation [5]. For each type of violation the count was aggregated per cycle [5].

Q and C were analyzed using Highway Capacity Manual (HFA, USA). Q/C was calculated for each cycle. Percentage of motorcycles that fall into each type of violation was also calculated for each cycle [5]. A Pearson correlation analysis was then conducted between Q/C and the percentage of each type of violations [5]. The analysis contains of both pooled (4 times 6 cycles) and individual period (6 cycles each).

6 Data Analysis

Table 1 summarizes location of intersection with time of

TABLE 1
Percentage of Violation (Type1 and Type 2) with Corresponding Q/C for Different Intersection

Location of Intersection and Time of Study	Cycle No.	Q/C	Percentage of Violation	
			Type 1	Type 2
Science Lab (8:30 A.M-9:00 A.M)	1	1.37	5.4	6.1
	2	1.32	7.2	5.2
	3	1.23	11.3	4.8
	4	1.42	9.1	5.7
	5	1.46	4.6	6.7
	6	1.46	5.2	6.1
Shahbag (9:15 A.M-9:45 A.M)	1	1.52	11.7	7.1
	2	1.49	23.1	9.3
	3	1.51	12.3	8.5
	4	1.55	5.1	13.9
	5	1.6	5.4	15.6
	6	1.47	14.7	6.3
Farmgate (11:00 A.M -11:30 A.M)	1	1.93	5.7	11.7
	2	1.94	4.9	23.1
	3	1.9	10.8	17.2
	4	1.98	9.1	19.7
	5	1.89	22.8	5.2
	6	1.96	20.3	7.7
Mouchak (10:00 A.M -10:30 A.M)	1	2.25	6.2	15.2
	2	2.26	7.9	15.3
	3	2.22	20.7	12.3
	4	2.3	4.2	13.4
	5	2.21	5.3	14.8
	6	2.28	17.3	15.7

study, Q/C, percentage of type 1 violations and percentage of type 2 violations for each period and cycle number.

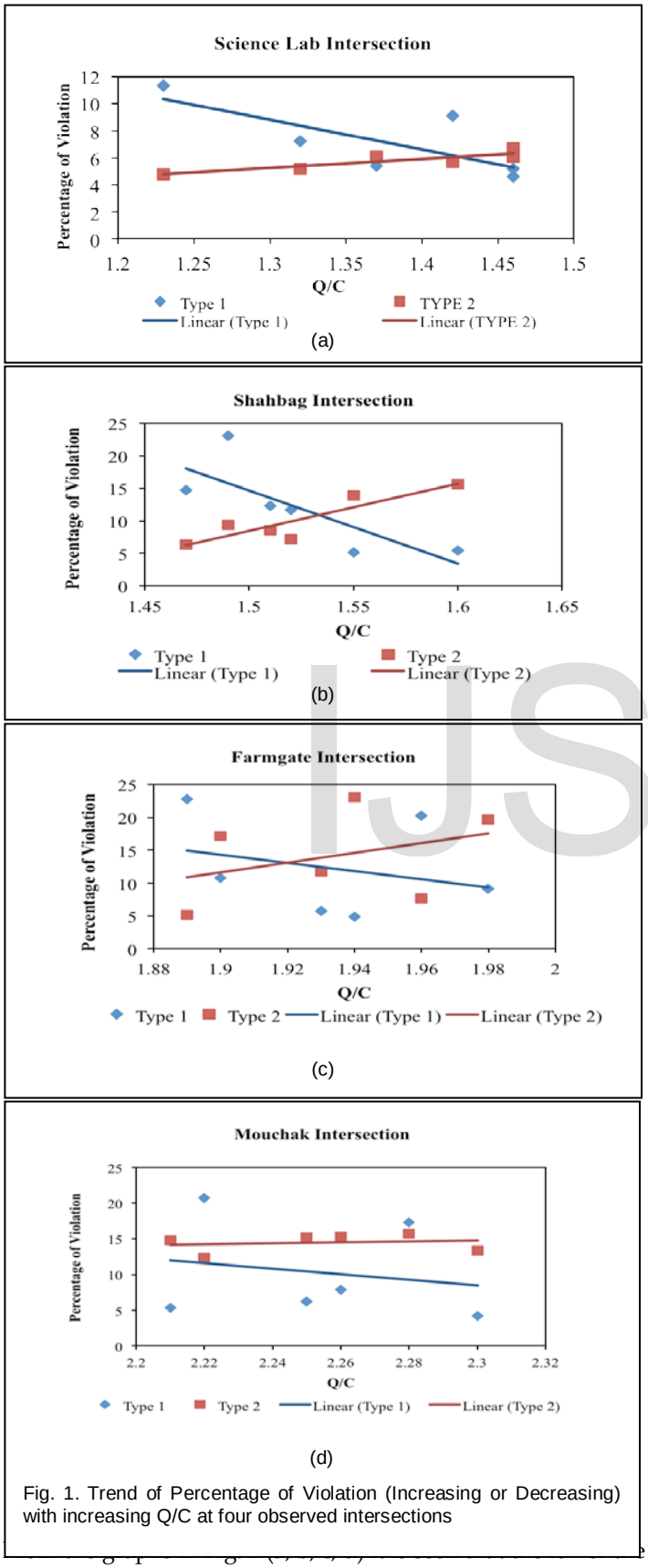

Fig. 1. Trend of Percentage of Violation (Increasing or Decreasing) with increasing Q/C at four observed intersections

Q/C, the higher the percentage of motorcyclists that keep on moving at the beginning of red (type 1 violation). Lower Q/C facilitates higher speeds thus enables the use of the amber time or even all red time to cross the intersection [5]. On the other hand the higher the Q/C, the higher the percentage of motorcyclists those move earlier than the beginning of the green period (type 2 violation). Higher Q/C encourages motorcyclists to wait their turn in front of stop line and using available gaps during the inter-greens [5].

Information from Table 1 was then used to calculate the Pearson correlation coefficients as stated in the previous chapter. The summary of the correlation coefficients were tabulated in Table 2. From Table 2, it can be seen that in case of Science Lab and Shahbag, correlation coefficient between Q/C and percentage of violation was significant at least at significant level of 1.6 (except overall sample/type 2) although only one fourth of the overall sample was used. This was because the Q/Cs of the early morning observation period were relatively low whilst in the other observation periods they were relatively high [5]. So the relationship could only be sufficiently clear if Q/Cs were low [5]. Percentage of violation vs Q/C graphs can also illustrate the relationship between them.

TABLE 2
SUMMARY OF CORRELATION COEFFICIENTS

Location	No. of Cycles	Correlation Coefficient Between Q/C and Percentage of Violation	
		Type 1	Type 2
All	24	0.078 (0.713)	0.659 (0.0004)
Science Lab	6	-0.754 (0.083)	0.888 (0.018)
Shahbag	6	-0.782 (0.066)	0.896 (0.016)
Farmgate	6	-0.283 (0.587)	0.364 (0.478)
Mouchak	6	-0.192 (0.716)	0.194 (0.713)

It can be seen from Table III through V that the Q/C, percent-

TABLE 3
MEAN DIFFERENCE WITH Q/C FROM OBSERVATION LOCATION

Location of Intersection	Mean Percentage of Violation	Mean Difference with Percentage of Violation from Observation Location		
		Shahbag	Farmgate	Mouchak
Science Lab	7.13	4.92	5.13	3.13
Shahbag	12.05	-	0.22	1.78
Farmgate	12.27	-	-	2.00
Mouchak	10.27	-	-	-

TABLE 4
MEAN DIFFERENCE WITH PERCENTAGE OF TYPE 1 VIOLATION FROM OBSERVATION LOCATION

Location of Intersection	Mean Percentage of Violation	Mean Difference with Percentage of Violation from Observation Location		
		Shahbag	Farmgate	Mouchak
Science Lab	5.77	4.35	8.33	8.68
Shahbag	10.12	-	3.98	4.33
Farmgate	14.10	-	-	0.35
Mouchak	14.45	-	-	-

age of type 1 violation and percentage of type 2 violation at Shahbag, Farmgate and Mouchak intersections were not statistically different, whilst the Q/C, percentage of type 1 violation and percentage of type 2 violation at Science Lab intersection in most cases were statistically different with values for other intersections [5].

7 Conclusion

Two types of red light violation were found, (1) at the beginning of red and (2) at the end of red. The type 1 was dominant during the early morning observation, whilst type 2 was dominant at the other three locations. The analysis shows that the lower the Q/C, the higher the percentage of motorcyclists that keep on moving at the beginning of red (type 1 violation). Lower Q/C facilitates higher speeds thus enables the use of the amber time or even all red time to cross the intersection. On the other hand the higher the Q/C, the higher the percentage of motorcyclists those move earlier than the beginning of the green period (type 2 violation). Higher Q/C encourages motorcyclists to wait their turn in front of stop line and using available gaps during the inter-greens.

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