Analysis of Speed Variations Among Different lanes at Different Distances From The Point of Initiation of Jaywalking

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In partial fulfillment of the requirement for the degree of BACHELOR OF SCIENCE IN CIVIL AND ENVIRONMENTAL ENGINEERING Under the supervision of

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Declaration of Candidate

We hereby declare that the undergraduate research work reported in this thesis has been performed by us under the supervision of Prof. Dr. Shakil Mohammad Rifat and this work has not been submitted elsewhere for any purpose.

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ABSTRACT

Jaywalking mostly occurs when a pedestrian crosses at the mid-block of the roads rather than designated crossing area. In developing countries, reasoning of most pedestrian fatalities are due to jaywalking. Speed of oncoming vehicles plays a vital in case of initiating jaywalking by the jaywalkers. From literature it is observed that pedestrians start jaywalk when the vehicles are not even safe distances from them. Like other developing countries, jaywalking is a major concern of pedestrian safety due to lack of proper road crossing facilities as well as tendency of disregarding traffic laws in Bangladesh. However, no study is apparently visible in the literature where the relationship among the initiation of jaywalking with speed differential of vehicles on different lanes and distances from the starting point of jaywalking. Thus the objective of the study is to find whether there are differences of speed exists among vehicles on different lanes at a distance of 20m, 30m and 40m from the point of pedestrians initiate jaywalking. For this purpose to execute this research a jaywalking location will be identified on Dhaka-Mymensing highway, a major highway connecting the capital Dhaka city with a prime district Mymensingh in Bangladesh. Vehicles' speed data will be collected at 20m, 30m and 40m distances from the selected location where the pedestrian initiates jaywalking for all the lanes during weekdays as well as weekends. Required data will also be collected during peak and offpeak hours. The variation of time and day of a week helps to identify whether the speed of the vehicles on different lanes and the initiation of jay-walking are affected by temporal phenomena. ANOVA and T-test will be used for finding the speed differences among vehicles on different lanes and different distances. Effect of the composition of vehicles on jaywalking would also be revealed along with distance, speed differentials, lane position of the oncoming vehicles. The result of this study will answer: does significant speed variation exists among the different lanes of oncoming vehicles when pedestrians start jaywalking and what would be the situation of speed variations at 20m, 30m and 40m distances. The policy makers associated of ensuring safer roads will get an idea about the perception of the pedestrians' starting of jaywalking based on the differences of speed of the vehicles on different lanes along with consideration of distance, vehicle type, time and day of week. The study would also inform the authority about unsafe speed and distance for the jaywalkers of crossing the roads. Based on this findings of this study they can fix different speed limit for different lanes and to identify distance where to put road cautionary signs and fixing the location of zebra-crossing to prevent pedestrians' jaywalking.

Chapter 1: Introduction

1.1 Background

There is an old saying “The streets are like a tiger's mouth.” It really represents the present scenario of pedestrian crashes in both developing and developed countries. These events have occurred due to illegal crossing which is known as jaywalking at unsignalized and uncontrolled mid blocks where pedestrian facilities are less in amount. But, illegal pedestrian crossing situations at uncontrolled mid-block crosswalks are more hazardous in developing countries as compared to developed countries, due to the inadequacy of proper infrastructure and the aggressive driver behaviour (Kadali & Vedagiri, 2016).

In developing countries like china more than 50% of total urban accidents are related to pedestrian. In Qatar many pedestrians were killed in traffic crashes mostly taken place in urban areas. In case of developed countries, the scenario remains almost same. In 2009 about 4092 pedestrian and 59000 people are killed and injured respectively. So, this gives an alarming statistic which is on every 2 hours one pedestrian was killed and on every 9 min one pedestrian was injured (Traffic Safety Facts,2009). The situation is more severe in developing countries due to high percentage of total journey made on foot, lack of pedestrian facilities as well as poor road user behaviour and knowledge.

So, developing countries like Bangladesh having a large population density it becomes a regular phenomenon. In our country most of journeys made on foot as large portion of total population remains under poverty. Besides pedestrian crossing facilities are not available to all the places. So, from the statistics we can see that pedestrian represents up to 70% of total road accident facilities. The study conducted in 2008 shows that pedestrian contributes 63% of total road accidents, 32% injuries and involved in 20% of all reported accidents. So, pedestrian safety becomes one of the key issues in our country.

To ensure pedestrian safety we need to understand the pedestrian behaviour in case of decision making for the initiation of jaywalking. So, this study will show the importance of lane conditions at different locations from the point of initiation of jaywalking on case of decision making of pedestrians. Though several studies have been conducted to understand pedestrian behaviour (such as age, gender, gap acceptance as well as variation in speed and mode of transportation). But less amounts of studies were conducted on lane conditions at different locations from point of initiation of jaywalking. This is one of the most important issues which directly impacts gap acceptance of pedestrian, initiations of jaywalking irrespective of age and gender. So, we have selected this factor to conduct our study.

1.2 Introduction to the study

Each year, thousands of pedestrians are killed or injured while crossing streets in the United States. Pedestrians who jaywalk across busy intersections increase their risk of being injured by an automobile. Several studies have been aimed at investigating safety programs to reduce the incidence of

Pedestrian traffic accidents. For example, Wilson and Raab (Note 2) observed few pedestrians using a crossway which traversed a street with heavy vehicle traffic. Pedestrians are a particularly more susceptible group to face accidents at the time of road using than any others road users in developing countries. In part this is due to the high proportion of journeys made on foot, a lack of footpath facilities, and poor road user behavior and knowledge. In urban areas of Bangladesh pedestrians represents often up to 70% of road accident fatalities. Current statistics revealed a deteriorating situation in Metropolitan Dhaka. For example, pedestrians as a proportion of road accident deaths increased from 43% in 1986-87 to 67% in 1991-92.

In recent years (1996-98) the number of pedestrian casualties (fatalities and injuries) has increased markedly from 443 in 1996 to 588 in 1998, an increase of about 29%.Pedestrians are now making up approximately 63% of the total road accidents, 32% of injuries and are involved in about 20% of all reported accidents. Indeed, with fatal accidents 70% was pedestrian – motorized vehicle collisions [Hoque (2002)]. Pedestrians make collisions with the non-motorized vehicles named as Rickshaw and plunge in different small, medium and fatal injuries at the time of walking the roadsides because of poor pedestrian facilities in Dhaka city.

Pedestrians are usually not able to use the footpaths due to many problems on the walkways like presence of illegal vendors, broken surface, placement of dustbins and some other structures and discontinuity of the walkway surfaces. Discontinuity of the walkway creates problem to the older and disabled persons who have to get on the walkway and get off within 15 to 20 feet distance interval in most of the cases. So these older and disabled persons also get hurt on their legs and they are frightened of using the footpath.

Some study specifically tries to wrap up variation of pedestrian accidents in different parts of Dhaka city and also explore the level of awareness of the urbanites for using the footpaths and their knowledge of safety. Finally, the study tries to set some policy options for the city or transport authorities so that the accidents can be anticipated to some extent. For pedestrian behavioral attributes, some studies indicated that the gap size decreases as the waiting time increases (Cherry, Donlon, Yan, Moore, & Xiong, 2012; Das, Manski, & Manuszak, 2005).

Other studies demonstrated that the increase in waiting time resulted in an increase in the gap size (Kadali & Vedagiri 2013a). Some studies did not indicate any significance for the waiting time (Wang, Wu, Zheng, & McDonald, 2010, Yannis et al., 2013). Several studies also suggested that the size of the accepted gap was not affected by whether a pedestrian was crossing unaccompanied or in a group (Kadali & Vedagiri 2013b, 2013c; Serag, 2014). However, other studies showed that the gap size increases with the increase in the size of the group (Sun, Ukkusuri, Benekohal, & Waller, 2002). For traffic-related attributes, it has been reported repeatedly that the vehicles' speeds have a significant influence on the gap size. Pedestrians usually tend to accept smaller gaps in the case of higher speeds (Lobjois & Cavallo, 2007, 2009; Oxley et al., 2005).The factors affecting the pedestrians' decision to cross illegally have been analyzed by numerous studies and using different methods such as crash records (King, Soole, & Ghafourian, 2009; Kim, Ulfarsson, Shankar, & Kim,

2008) and field measurements (Yannis, Papadimitriou, & Theofilatos, 2013; Shaaban, Muley, & Mohammed, 2018; Zhao, Malenje, Tang, & Han, 2019). In general, there are many benefits of using field measurements, especially if crash data are not available, difficult to obtain, or do not have sufficient information. From the perspective of gap acceptance behavior for pedestrians making illegal crossings, field measurements studies have focused on identifying the significant factors affecting behavior such as pedestrian attributes (gender, age, etc.), pedestrian behavioral attributes (pedestrian path, waiting time, etc.), and traffic-related attributes (vehicle speed, lane change, etc.).The significance of many of these factors has been a debatable topic, according to previous studies.

For the pedestrians' attributes, some studies showed that gender is a significant factor contributing to pedestrian behavior. Female pedestrians were found to violate traffic rules less frequently than males (Guo, Gao, Yang, & Jiang, 2011; Hamed, 2001; Rosenbloom, 2009; Rosenbloom, Nemrodov, & Barkan, 2004; Tiwari, Bangdiwala, Saraswat, & Gaurav, 2007; Tom & Granie, 2011). Other studies showed a different finding, where females were found to be less likely to comply with the traffic rules (Ren, Zhou, Wang, Zhang, & Wang, 2011). Additionally, some studies showed that older pedestrians comply more with the traffic rules than younger pedestrians, (Granie, Pannetier, & Gueho, 2013; Ren et al., 2011; Rosenbloom et al., 2004). They also wait longer than younger pedestrians at signalized crossings (Guo et al., 2011). On the other hand, other studies indicated that older pedestrians violate more the traffic rules compared to younger pedestrians (Dommes, Cavallo, Dubuisson, Tournier, & Vienne, 2014; Dommes, Cavallo, & Oxley, 2013; Dommes & Cavallo, 2011; Holland & Hill, 2010; Oxley, Fildes, Ihsen, Charlton, & Day, 1997; Oxley, Ihsen, Fildes, Charlton, & Day, 2005). In some studies, age did not indicate any significant difference in the behavior of violating the traffic rules (Avinash, Jiten, Shriniwas, Gaurang, & Manoranjan, 2018; Rosenbloom, 2009).

It has been found that the pedestrians are facing almost nine types of accidents in Dhaka city.Among the different types of accidents, dart out is one of the major types which the policy makers and planners must consider for further research and investigationAwareness of road safety is very poor in Bangladesh. The City corporation authorities and some other public authorities who are supposed to manage and maintain the walkways and roads but they have not adequate programs for making people aware about road safety.

In some places, some signs and bill boards can be found for making aware people about some traffic laws and regulations. Most of the bill board or guidelines are confined for showing traffic rules and regulations for the motorized vehicles and to also locate the on street parking areas for motorized vehicles and non-motorized vehicles.

Specifically for the pedestrians, there is no such opportunity at all. Almost 100% respondents mention that they did not even take any traffic safety regulations in the school education or in the college education. However, some school going children learn it from their schools but this opportunity is only available in very few schools (especially in some private schools rather in the public schools). Although there are also some foot-over bridges in the busiest places in Dhaka City, but people always feel comfortable to cross the street without using the over bridges. While observing the foot-over bridges, it can be seen that vendors occupied the places illegally to sell their goods. For instance, people are not feeling comfortable to cross the road through climbing up and down in the presence of vendors.

The women pedestrians also claimed that they did not find any law enforcement police to evict the illegal hawkers and this is why they also used the road space to cross it. Among the five different study blocks, in only three places the zebra crossing has been observed for pedestrian crossing.

Besides, there are some signal-lights can be found for the walkers but almost 80% of them are not working properly and about 90% of the pedestrians are not obeying the signals indeed. On the contrary, only 10% of the pedestrians make their decisions based on speed of the approaching car. In particular, elderly people are more likely to make their road-crossing decision purely on the basis of distance (Lobjois and Cavallo, 2007). Under the same time gap, a fast-approaching vehicle is felt by elderly pedestrians to be at a greater distance than a slow-approaching vehicle. This incorrect perception is attributed to the fact that elderly pedestrians take only the distance gap into consideration when crossing the road. Subsequently, they make poorer decisions, based on the assumption that it is safer to cross the road when the distance gap is large regardless of whether the approaching vehicle is moving at a higher speed

When a car approaches, the time span within which a pedestrian would decide to cross a road should ideally include the time gap, the distance between the approaching car and the pedestrian, the speed of the car, and the personal mobility of the pedestrian. However, empirical research has indicated that a pedestrian's judgment relies mainly on the distance between the approaching car and the pedestrian himself or herself (Oxley et al., 2005, 2006). Connelly et al. (1998), for example, reported that 63% of the pedestrians based their road-crossing decision on the distance between the approaching car and themselves

CHAPTER TWO: LITERATURE REVIEW

The Literature review of the thesis will be organized by considering several features. First, relevant studies that examined the relationship between road patterns and it's effect over pedestrian crossing will be incorporated. Second, the key findings of various published papers on the studies related to pedestrian behavior will be summarized to help readers gain some insights about the variables and contributing factors to be used. Then lastly we will talk about traffic safety and its affect over pedestrian safety. These discussions will provide some contexts for the results in this study.

2.1 Street Pattern

2.1.1 Traditional Grid Design

In the past, the main purpose of urban streets was to serve as thoroughfares for carrying people and goods from one place to another in a safe and reliable way with a minimum delay. One common network design that is able to provide a high degree of efficiency and reliability is the traditional grid design with intersecting streets that are mostly straight thoroughfares. This rectilinear design has the advantage that if any section of the road or link has reduced capacity due to congestion, vehicle collision, repair or maintenance, traffic can easily be diverted to alternative routes thereby increasing the reliability of the road network in enabling users to get from their origin to their destination. Moreover, navigation within this type of network is simple and will minimize the workload and stress on drivers, especially those who are not familiar with the neighborhood.

However, the traditional grid design has several disadvantages when applied to residential areas. First, grid pattern requires a greater paved area than necessary to serve a residential community. Second, it requires the installation of a more expensive type of paving for all roads by dispersing the traffic equally throughout the area. Third, it creates an increased traffic hazard due to the increase in the potential for interactions between vehicular and pedestrian traffic. Last, it creates a monotonous and uninteresting architectural effect that may reduce some community amenities.

2.1.2 Livable Streets

Nowadays, however, urban streets are places where people walk, shop, meet, and generally engage in the diverse array of social and recreational activities that make urban living enjoyable (Dumbaugh, 2005). Urban streets not only contribute to improving the quality of life for many people but also enhance economic growth and innovation of the region (Florida, 2002) and increase the physical fitness and health of the people (Frank et al., 2003). According to Apple yard (1980), an ideal street should have the following characteristics in addition to facilitating the movement of people and goods from one place to another:

(1) The street as a sanctuary

(2) The street as a livable, healthy environment

(3) The street as a community

(4) The street as neighborly territory

(5) The street as a place for play and learning

(6) The street as a green and pleasant land

(7) The street as a unique historic place

Beyond acting as a thoroughfare, when an urban street possesses the above characteristics, it is termed as a “livable street”. This type of road has become popular recently because pedestrian travel and local needs are considered in its design. The prime feature of “livable street” is to reduce the negative externalities of motor vehicle use on neighborhood life. The road and traffic related issues that have an impact on neighborhood life are acceptable level of traffic speed and volume, right-of-way priorities for pedestrians, pedestrian access to streets, reduction in pedestrian crashes, acceptable noise level, sufficient parking and open space (Appleyard, 1980). Most of the characteristics that defined “livable street” are missing in the traditional grid design pattern for roads.

However, most of these previous studies defined a livable street based on their aesthetic appeal of road side features. When the issue of livability is discussed, importance is generally given to the design of roadsides. Beside the design of roadsides, the street pattern of a community area or ward surely has some influences in its livability. It is quite clear that streets in the traditional grid road design do not have the essential features required to be considered as livable streets.

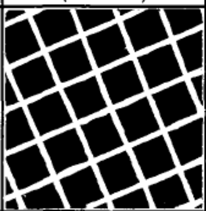
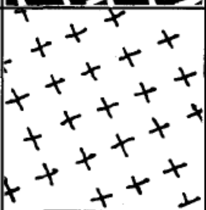
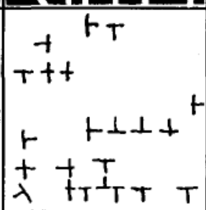
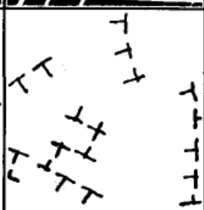
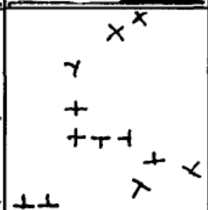
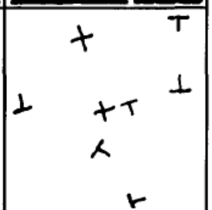
2.1.3 Classification of Different Street Patterns

In the successive postwar decades, planners and developers greatly expanded the street network design principles of the reform movement, increasing the degree of hierarchy, curvilinearity, and disconnectivity in residential neighborhoods. South worth and Owens (1993) provide a spatial analysis of the design characteristics of San Francisco Bay area suburban communities that were developed at different points in the century. The authors formulated design typologies for eight study areas at three scales: the community, neighborhood, and individual streets. Figure 2.1 shows a typology of the different street networks found in their study areas.

As the figure illustrates, over time, street network design patterns in the San Francisco Bay area transitioned from the rigidly geometric to the extremely disconnected and curvilinear and the observations are representative of broad dramatic changes in residential design over the past fifty years in different North American cities. The following five types of street pattern are examined in the study by South worth and Owens (1993): (a) Gridiron; (b)

Fragmented Parallel; (c) Warped Parallel; (d) Loops and Lollipops; and (e) Lollipops on a Stick. The characteristics of these five types of street patterns are briefly described below for better understand of their inherent properties.

Figure 2.1: Theoretical Neighbourhood Street Patterns

	Gridiron (c. 1900)	Fragmented Parallel (c. 1950)	Warped Parallel (c. 1960)	Loops and Lollipops (c. 1970)	Lollipops on a Stick (c. 1980)
Street Patterns					
Intersections					
Lineal Feet of Streets	20,800	19,000	16,500	15,300	15,600
# of Blocks	28	19	14	12	8
# of Intersections	26	22	14	12	8
# of Access Points	19	10	7	6	4
# of Loops & Cul-de- Sacs	0	1	2	8	24

Note: This table refers to the 100-acre unit of analysis illustrated in the diagrams. Intersections were defined as junctions of two or more through routes. Junctions with cul-de-sacs were not treated as intersections because cul-de-sacs do not lead anywhere outside the immediate area.

2.1.4.1 Gridiron

The open grid forms the structural core of many North American towns and cities. It is a simple system of two series of parallel streets crossing at right angles to form a pattern of equal-sized square or rectangular blocks. Grid type pattern is non-hierarchical, strongly interconnected, readily expandable, and offers a wide variety of possible routes through it and of access points in and out. Figure 2.1 shows that this pattern has more land devoted to streets, as well as more blocks, intersections, and points of access than the other four patterns. Although the grid maximizes infrastructure costs, this pattern offers the shortest trip lengths and the largest number of route choices of any of the patterns. It also creates the most walkable neighborhood. This pattern dominated in the pre-World War II era when pedestrian travel was high, auto ownership was relatively low, and street construction standards were less automobile oriented than they are today (Southworth and Owens, 1993) .

2.1.4.2 Fragmented Parallel

Fragmented parallel pattern has been relatively popular since the 1950s. Though orthogonal in shape, this pattern varies from traditional grid in several aspects. The blocks are reconfigured into long, narrow rectangles and L shapes. The streets, rather than being carried through, tend to corners. This limits the degree of interconnection, the choices of routes through a neighborhood, and the number of access points in and out. The long narrow blocks provide optimal frontage for residential building lots. Though this pattern has almost equal street length as the grid iron, it reduces the number of blocks and access points compared with the grid network. Among the first kinds of neighborhoods to be built for automobile owners, this pattern reveals the diminishing value of pedestrian access and growing interest in longer blocks to provide more frontage for house lots (Southward and Owens, 1993). Due to reduced number of access points, this pattern promotes self-contained private subdivision with limited connectivity.

2.1.4.3 Warped Parallel

Warped parallel pattern is formed when a parallel curvilinear pattern is present in the long, narrow blocks, T intersections and L corners of the fragmented parallel. Relative to fragmented parallel, it restricts the visual length of the street. This street pattern does not adopt topography since they are seen on the flat land. Leftover spaces in this pattern are filled in by occasional cul-de-sacs. The degree of connection, route choices, and access points are similar to the fragmented parallel pattern, but the curving streets make user orientation more confusing in these neighborhoods. The transition to an automobile subdivision becomes more pronounced in this pattern with significant reductions in intersections, street lengths, blocks, and access points (Southworth and Owens, 1993). As a whole, the pattern seems more unified and reflects a clearer conceptual basis than the fragmented parallel approach.

2.1.4.4 Loops and Lollipops

In this pattern, the parallel structure of the previous pattern is distorted by the presence of greater number of loops and cul-de-sacs. Loops and lollipops create a non directional pattern of streets that tend to loop back on themselves. Interconnection is limited to several through streets not readily apparent in the plan. Blocks tend to be odd-shaped and frequently penetrated by street stubs. As this pattern has limited route choices and few access points, it increases privacy and the maze-like pattern is disorienting. This pattern, with its higher percentage of lots on short streets, succeeds, however, in creating quiet streets that are relatively safe for children. It limits pedestrian access because of the abundance of loops and cul-de-sacs. All these factors combine to increase auto trips and concentrate them on the few existing arterials, which result in unprecedented traffic congestion in many younger urban edge communities (Southworth and Owens, 1993). Thus, at the community scale this pattern is proving undesirable for both the automobile driver and the pedestrian.

2.1.4.5 Lollipops on a Stick

Lollipops on a stick pattern are quite opposite to the open gridiron in terms of connectivity. This pattern is formed by branching off dead end cul-de-sacs from a few easily recognized through streets. It maximizes privacy but interconnection is very limited. Blocks are few and large. A repeated parallel pattern of penetrating street stubs provides access to block interiors. This pattern limits intersections, route choices, and access points very much. This limited access design maximizes the number of house lots on short dead-end streets and hampers the pedestrian movement to a great extent (South worth and Owens, 1993).

2.1.4.6 Summary of Street Pattern

In summary, from the study by South worth and Owens(1993) it is evident that the gridiron layout, built in neighborhoods at the turn of the century, contains the most amount of street frontage, the greatest number of intersections, the greatest number of blocks, the greatest number of access points, and the total absence of loops and cul-de-sacs. In contrast, the postwar communities examined by the authors contain street networks with fewer intersections, blocks, and access points and a greater number of loops and cul-de-sacs. In the view of the authors, these trends reflect an increasing desire to improve neighborhood traffic safety, especially for children, and increase residents' sense of privacy. This factors hugely contributes to jay-walking and car crashes.

2.2 Factors Affecting Pedestrian Crossing Behaviors

It is obvious that pedestrians, in most cases, attempt to select the fastest and most direct route from their origin to their preferred destination. However, route planning must take into account the features of the traveling environment, physical abilities, some level of risk (real or perceived), among other factors. For example, suppose that Route A is .5 miles in length and that Route B is 1 mi in length. While Route A is shorter in absolute distance, it includes two steep hill segments, and Route B is flat. Given these environmental characteristics, a young and physically fit pedestrian would likely select Route A. However, an older adult with a physical impairment might select Route B for its terrain advantages. It is improbable that people use complex decision-making processes to determine which route to walk to reach a specific location. Rather, pedestrians are likely to plan a general route and rely on other factors to make smaller in-route choices, such as where to cross the roadway. For example, one person may "always" cross at a specific location, and for this reason, he or she will rely on habit and cross there again on subsequent trips. Another pedestrian may have mobility issues and will cross at the most accessible location. It is probable that pedestrians rely on a set of heuristics or tendencies when selecting when and where to cross the roadway. Here, the study team explores some of the intrinsic pedestrian characteristics that can influence route choice and crossing behaviors.

2.2.1. Gender

Overall, males are more likely to be involved in vehicle crashes than females. (National Highway Transportation Safety Administration (NHTSA), 2011.) This trend remains consistent with pedestrian fatalities. In 2009, the male pedestrian fatality rate was 1.86 per 100,000, compared with .82 per 100,000 females. In total, 69 percent of the pedestrian fatalities were male. This gender difference is consistent across all age groups. (NHTSA, 2011) This evidence suggests that gender plays a role in pedestrian crossing decisions to some degree. This idea is further supported in a study by Holland and Hill (2007). The authors presented participants with a variety of potentially dangerous crossing scenarios. In each of the scenarios, women reported perceiving more risk than their male counterparts. Furthermore, the females were less likely to indicate an intention to cross the roadway. Taken together, these data suggest that, in general, males and females view and act on potential safety hazards in the roadway environment differently. These gender differences might prove useful in targeting interventions and education toward different groups.

2.2.2. Age

Age also plays a role in pedestrian–vehicle collisions. In 2009, pedestrians 65 and older had the highest rate of fatalities, 1.96 per 100,000. Moreover, older adults constituted 19 percent of all pedestrian fatalities. (NHTSA, 2011) On the opposite end of the spectrum, pedestrians 15 years and younger accounted for 25 percent of all pedestrian injuries and 7 percent of pedestrian fatalities in 2009. (NHTSA, 2011) Many factors could result in these age-related fatality trends. One possibility is that younger and older pedestrians make riskier road-crossing choices. However, multiple studies have shown that when participants are presented with potentially dangerous crossing scenarios, older adults are 8 less likely to indicate that they would be likely to attempt the crossing.(Holland, C., Hill, R.,2007) Thus, it appears, at least in regard to intention to cross the road, older adults are not necessarily making more risky choices. In fact, this suggests just the opposite. One can logically draw the conclusion that those who are less likely to engage in risky crossing behaviors are also less likely to be involved in pedestrian–vehicle collisions. If older adults are less inclined than younger adults to intend to make risky crossings, then other factors must contribute to their large proportion of the total pedestrian fatalities. This appears to be the case. While older adults constitute 19 percent of all pedestrian fatalities, they only make up 8.5 percent of the total injuries. (NHTSA, 2011) These data imply that older adults are less likely to be struck by a vehicle. However, when an older adult is involved in this type of collision, it is more likely to result in a fatality. It has been suggested, for example in Barton and Morrongiello, that children have not fully developed the cognitive reasoning skills to cross the street safely. (Barton, B.K. and Morrongiello, B.A.,2011) It is certainly a possibility that children make riskier crossing decisions. It is also likely that smaller children are more difficult to see from the drivers' perspective. This condition makes it more difficult for a driver to proactively avoid collision with this special group of pedestrians. Age differences in pedestrian injury and fatality rates may help to direct educational interventions to increase safe crossing behaviors. Further, age-related differences may help engineers to target different interventions for different age groups. For example, sidewalk markings outside elementary schools may lead children to walk to pedestrian-activated crosswalks. In addition, crosswalk activation buttons could be lowered to child level or made visually more attractive to push. Longer protected crossings could also be employed near senior citizen

2.2.3. Gap Acceptance

Some studies indicated that the gap size decreases as the waiting time increases (Cherry, Donlon, Yan, Moore, & Xiong, 2012; Das, Manski, & Manuszak, 2005). Other studies demonstrated that the increase in waiting time resulted in an increase in the gap size (Kadali & Vedagiri 2013a). Some studies did not indicate any significance for the waiting time (Wang, Wu, Zheng, & McDonald, 2010, Yannis et al., 2013). Several studies also suggested that the size of the accepted gap was not affected by whether a pedestrian was crossing unaccompanied or in a group (Kadali & Vedagiri 2013b, 2013c; Serag, 2014). However, other studies showed that the gap size increases with the increase in the size of the group (Sun, Ukkusuri, Benekohal, & Waller, 2002). For traffic-related attributes, it has been reported repeatedly that the vehicles' speeds have a significant influence on the gap size. Pedestrians usually tend to accept smaller gaps in the case of higher speeds (Lobjois & Cavallo, 2007, 2009; Oxley et al., 2005).

2.2.4. Road-crossing judgment

Under the same time gap, the remaining time decreased as the speed of the oncoming vehicle increased (Table 1). In addition, when oncoming vehicle speed increased, the subjective road-crossing confidence level of the participants actually increased,possibly because pedestrians make their road-crossing decisions based mainly on distance (Oxley et al., 2005, 2006; Connelly et al., 1998; Lobjois and Cavallo, 2007). However, in the post-experiment interviews, 96.90% of the participants reported that a fast-approaching vehicle would put pressure on them and might force them to cross the road more quickly. Such discrepancy could be explained by conflicting judgments. Subjectively, pedestrians understand that vehicle speed is an important consideration when making road-crossing decision; while objectively, they are not sensitive to changes in the oncoming vehicle speed, probably due to the lack of an effective visual depth cue for judging the speed of the approaching vehicle. This phenomenon causes them to rely excessively on distance when making their judgment.

2.2.5. Environmental Factors

Many factors contribute to whether people attempt to cross the roadway at a specific location at a specific time. However, features of the roadway environment have been largely ignored when examining these causal factors. Here a study of U.S. Department of Transportation (2014) discusses foot travel in three components: trip originators, destinations or attractions, and affordances.

2.2.5.1. Trip Originators

Trip originators are areas where pedestrians begin trips. Some originators tend to generate more trips than others. For example, a house generates a finite number of trips. However, other originators generate countless pedestrian trips. Some of these high trip generating sources are places such as shopping malls, Metro/subway stations, and bus stops. These high trip originators require special attention with regard to pedestrian flow. One can easily imagine how pedestrian travel patterns might differ between a bus stop placed in the middle of a block and a bus stop placed at the corner of an intersection.

2.2.5.2 Trip Destinations

Trip destinations are end points of pedestrian trips, whether they are final destinations or attractions (e.g., coffee shop) en route. Often, destinations are also trip originators. Take the example of a shopping center. Many people may consider the shopping center the completion of their trip, that is, their destination. However, when people leave this locale, the shopping center becomes the trip originator. As a result, designers must attend to both how pedestrians enter and exit such locations.

2.2.5.3. Affordances

Simple risk perception is not an adequate source of determining whether or not one should cross the roadway at a given location at a given time. If risk perceptions were adequate, pedestrians would not take such potentially harmful actions. Instead, it is likely that people rely on action-oriented perceptions of affordances. An affordance refers to the qualities (real or perceived) of the environment (or object).

These qualities/properties determine how the environment/object can be used. For example, a chair of sufficient size and stability affords sitting or climbing upon. Along similar lines, a gap in traffic of sufficient distance may afford crossing of the roadway. Affordances are egocentric. This means that a chair that affords sitting to a child may not afford sitting for an adult. Similarly, a gap in traffic may afford crossing for an able-bodied young adult but not for an older adult with mobility impairment. It is very important to note that although these qualities of the environment are directly perceived, they may or may not be real. As a result, the affordances of an environment can lead a person to take an incorrect or unsafe action. For example, imagine an elongated door handle with the word “push” above it. A user will likely directly perceive that the door handle appears to afford pulling and will attempt to pull the door open. This is an “incorrect” action in the sense that the door must be pushed to open.

When they act upon perceived affordances, people generally produce a behavior that is adequate, this is, unless the affordance leads the user to perform an unsafe action. According to this perspective, behavior is goal-driven (e.g., I want to cross the street) rather than avoidance-driven (e.g., I don’t want to be struck by that car). This results in generally adequate choices (e.g., I can cross the roadway now). Of course, irregular outside influences have the potential to increase the 11 salience of avoidance-driven choices (e.g., seeing a police officer during a known target jaywalking enforcement zone).

2.3. Road-Traffic Safety

The Road-Traffic system is a complex interaction among three components e.g. road and road environment, vehicles and road users. It is seldom that an accident results from a single cause. There are usually several influences affecting the situation at any given time. These influences can be separated into three groups: the human element (usually as a driver of a vehicle, but also as a pedestrian or cyclist), the vehicle element, and the highway element. Researchers estimate that 85% of all causative factors involve the driver, 10% involve the highway and 5% involve the vehicle (Bryer, T. E. 1993.). An accident is described as a failure in the interaction between these three components. For example, the driver may fail to obey a red light or to adhere to safe speed for the prevailing conditions; a vehicle's brake or steering system may fail; the road may fail to drain properly or a traffic light may malfunction. In all these cases, the direct cause of the accident appears to be a clear failure in one of the three components: road, vehicle and human. Brief descriptions of these factors are presented below:

2.3.1 Road Factors

Various studies comprising on-sight in-depth field investigation, systematic safety check and audit, comprehensive analysis of accident report, eyewitness and victim interview, drivers' observation and opinion survey as well as expert opinion survey have been conducted by different organizations, agencies or by individual to identify the causative factors of road accident in Bangladesh. Those studies revealed that the principal contributing factors of accidents are default land use and road network planning, adverse roadway roadside environment, poor detailed design of junctions and road sections (Mahmud S. M. S., M. S. Hoque, and A. S. Qazi. 2009).Hazards associated with roads and roadsides were particularly predominant. Adverse roadway elements contributing to highway accidents were substandard road way alignment or geometry, lack of shoulders and shoulder defects, absent or inappropriate pedestrian facilities, narrow and defective lanes and bridges/bridge approaches, roadside hazards, undefined pavement center and edge lines, poor sight distances and visibility, unmarked and inappropriate design of intersections, serious delineation deficiencies along the route, haphazard bus shelters/stops, and others. In many of these cases "running-off-road" accidents involved vehicles leaving the carriageway and falling down the unprotected steep drops into ditches, accounting for nearly 60 percent of total, " running-off-road" and "out-of control" accidents mainly due to the less surface friction/skid resistance capacity between road surface and vehicle tyre in particular wet weather condition. Roadside trees were involved in about 20 percent of these accident types (Hoque, M. M. 2004)

2.3.2. Vehicle Factors

Vehicles may have defect in the brake system, the steering system, the lighting system along with smooth tires etc. Studies carried out in developed countries have indicated that between 2 to 8.5 percent of accidents are directly caused by faulty vehicles. (ADB, 1996) The most common defects of vehicles in Bangladesh are worn out tires, loose wheels, overloaded axle, faulty brake and indicator lighting system etc. A physical condition survey was conducted on large sized vehicles at roadside and terminals in and around Dhaka city using a prescribed survey form in 2007. Total sample size was 500. The study revealed that only 42 percent of trucks and buses observed had complete defect free lighting system and a night time survey on long distance buses found one thirds with one or no rear lights. Vehicle lighting is a very important safety aspect especially where street lighting, road marking and signs are inadequate and driving practice is poor (Bangladesh Gazette. 2005.)

2.3.3 Human Factors

Excessive speeding, overloading, dangerous overtaking, reckless driving, carelessness of road users, failure to obey mandatory traffic regulations, variety of vehicle characteristics and defects in vehicles and conflicting use of roads. In addition, driver incompetency, low level of awareness of the safety problems, inadequate and unsatisfactory education, safety rules and regulations and traffic law enforcement and sanctions are also the major cause of accident. It is difficult to quantify what factors are responsible for how many accidents due to the fact that a large number of contributory factors which are not covered by the current accident reporting form of Bangladesh police. (Hasan, T. 2004.)

CHAPTER 3: DATA AND METHODOLOGY

Introduction:

This chapter describes the data collection procedure, formulation of data and the methodology used in the effect of jaywalking for differential speed Linear regression models will be used to identify the different factors affecting the sustainable transportation modes. Three models will be developed for three different transportation modes. The formulation of these models will help us to understand how these models can be employed to fulfill the main objective of the study; that is, to identify the effects of neighborhood characteristics on public transit ridership, bicycling and walking as well as the elasticity of the variables will be calculated. The sources of database used in this study are discussed before describing the mathematical formulation of the model, its assumptions and estimation procedures.

3.1 Main Steps in Methodology

Site Selection:

Jaywalking mainly occurs where legal crossing is not available. People try to shorten their path mostly for any kind of journey. In Asian countries jaywalking is very common. And Bangladesh is also not different from them, in fact it occurs severely here. Jaywalking rate depends on type of area mostly. If the city or any particular place is very crowded and if the road crossing facility is very poor then jaywalking will occur fiercely. In our study we have taken Dhaka-Mymensingh Highway. From this wide area we have taken a single location on the basis of its significance, jaywalking rate and other factors. The selected site is placed on the

highway and it is non-signalized, no over bridge, no traffic control for pedestrian crossing. A typical such kind of road is shown in Figure 1.

In order to achieve the objective of the study, suitable statistical analysis needs to be selected. The analysis will be done using speed data of different vehicles for different lanes while jaywalking. This analysis will give us the idea about the most significant factor which affects jaywalking mostly. The result of the final analysis will then be analyzed to find the critical factors contributing to jaywalking. The methodology can be divided into three main steps:

(a) Collection and processing of speed data to develop table for statistical analysis.

(b) Selection of statistical analysis to express significance of the speed differential of vehicles on different lanes and distances along with temporal variation.

(c) Analysis and interpretation of statistical result; that is, engineering judgment of factors contributing to jaywalking at the selected location of Dhaka-Mymensingh Highway. Finally, to check the relative significance of independent variables from the final result, the significance of the variables will be calculated.

3.2 Description of Data

3.2.1 Differential speed due to different distances:

Distance between the pedestrian and vehicle plays an important role for differential speed. If the distance is much more less then driver will automatically reduce the speed of the vehicle. On the contrary pedestrian mostly prefers to jaywalk when any vehicle is coming at low speed. High speed on less distance often occurs accident. And sometimes it's not the driver's fault behind the accident as the pedestrian come across the vehicle all of a sudden. Then it becomes very difficult for the driver to slow down the speed of the vehicle. The following figure shows the fatality for jaywalking in Bangladesh

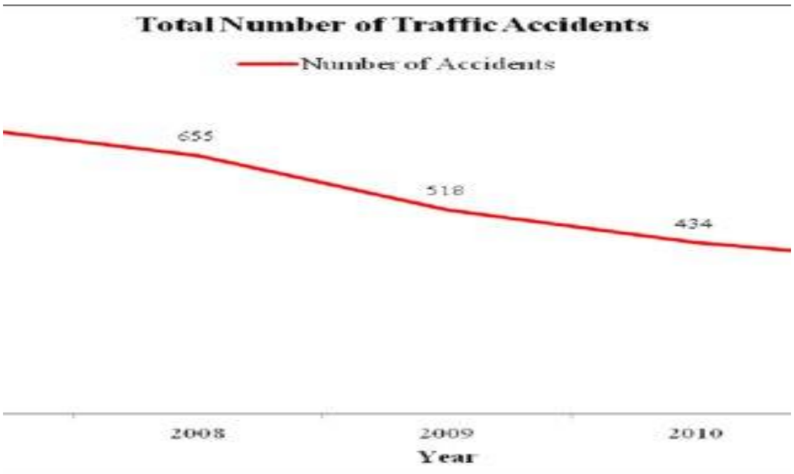
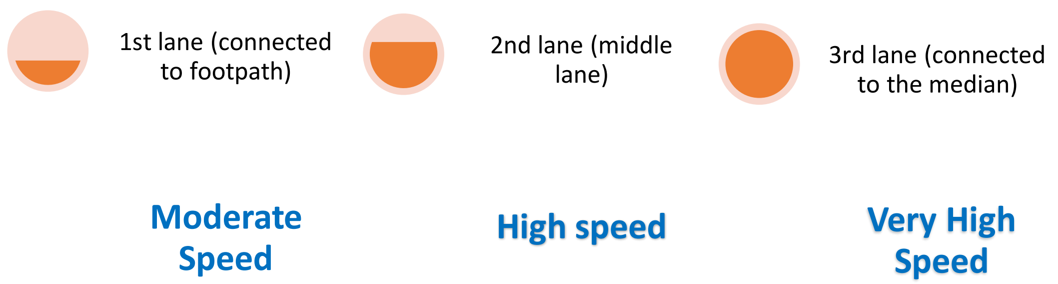


Fig. 3.1: Auto ownership rate (CARTAS, 2013)

The above figure shows the accident rate of Bangladesh from the year 2008 to 2010 due to jaywalking.

3.2.2 Differential Speed due to different lanes:

While jaywalking lane is one of the major factor that affects to the decision process of pedestrian to jaywalk. Different lanes possess different speed. Our location includes 3 lane road. If we do numbering the lanes, the closest lane to the footpath is the first lane and the middle lane is second lane and the lane connected to the median is the third lane. While any vehicle is at first lane they tend to drive in slow speed as it is connected to the footpath and people will very often the services of transportation. Boarding and alighting mainly occurs in this lane. The following figure shows the speed variation at different lanes.



3.2.3 Differential Speed due to different type of vehicle:

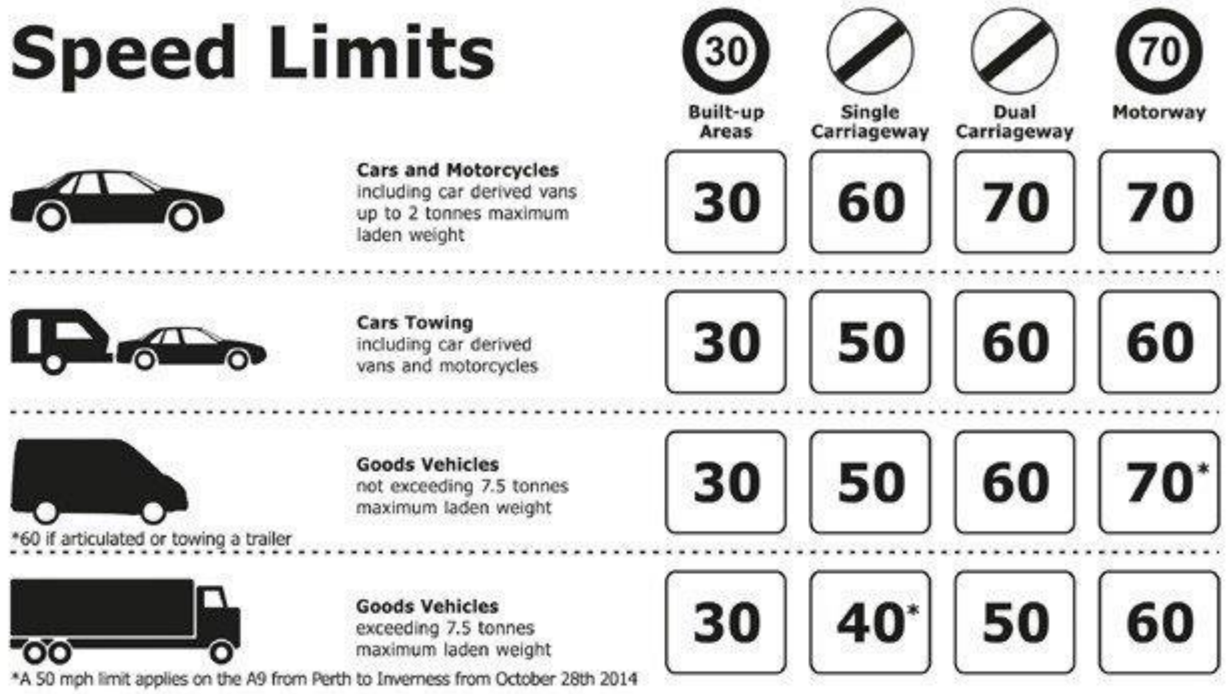


Figure 3.2: speed at different lanes

Vehicular speeds are different in different lanes. Because lanes define whether the vehicle can move slowly or fast. Mainly the nearest lane to the footpath poses slow speedy vehicle and middle lanes are for high speedy vehicles.

Street patterns are also very much important factor. It should be remembered that while differentiating among these patterns, several characteristics are often discussed, including length of roads, number of intersections, number of access points, number of loops and cul-de-sac, etc. However, two neighborhoods may have many of these features in common but still have a different layout or pattern. For example, a neighborhood with a fragmented parallel pattern may have approximately the same amount of roads, intersection, etc. as another neighborhood with a warped parallel design. Nevertheless, the orientation of the pattern may still play a vital role in determining crash occurrences when all else being equal.

Since most of the social economic and demographic data were collected from the Canadian Population Census, the community areas defined by the census were used as the basic unit of analysis for street patterns. The street maps of different community areas defined by the Census were extracted from the street directory for the City of Calgary. Based on the street maps, the research team first classified the street pattern of each unit using the classification scheme shown in Fig. 3.3. It was found that there were very few units with fragmented parallel pattern and this category was merged with grid-iron pattern since it contained mainly straight roadways. Also, the two street patterns with the lollipop designs were merged into one to simplify the classification scheme.

Chapter 4: Site Selection and Data Collection

4.1 Site Selection:

This section will let us know about the analysis for selecting site in our coverage area. Actually our study area is from Abdullahpur to Chowrasta,Gazipur which is an important part of Dhaka-Mymensingh Highway. This is a very busy road. So, we have taken it as our study area. For Collecting data, we have made a survey based on some important factors like number of stoppages, markets, educational institutions, religious institutions, resturants, health facilities, industries, collector roads, filling stations, Shopping mall, number of people crossing those sites during peak and of peak hours. Based on these factors we calculate importance value for every selected sites. To do so we categorized the factors in 3 types such as low, moderate, severe. For example, if a site having one industry with small number of employee and congestion, we will categorize it as low. And for low impact we put 1 as importance value, 2 for moderate, 3 for severe situation. Primarily from the field survey we have selected 6 points where we conducted our survey for detailed analysis. These are listed below.

- Cherag Ali
- Shafiuddin road
- Targach
- Sultan Medical Road
- Board Bazar Road

=

Fig: Jay-Walking into Dhaka-Maymenshingh highway.

We will discuss about these selected sites in detail below. First of all we will know about cherag Ali

Cherag Ali:

This site has 2 collector roads named Squibb road and Samaj Kallan road. Both these roads collect people and transports from different industries and deliver these to Dhaka – Mymensingh Highway. There are 3 banks named Al-Arafah Islami Bank Limited, NRB Bank Limited and Pubali Bank Limited along with Atm facilities. Also 2 different markets are present. One is used to sell raw meat, fish and another one is used to sell daily accessories like clothes, electronic products etc. There is also a shopping mall named Tokyo Tower. Number of jaywalking events occurred is 460 in 45 min during evening peak. So, considering all these factors this site has got 11 as importance value. The detailed calculations are shown in a table below.

Shafiuddin Road:

It is one of the most important sites that we have selected primarily. Because There are two important educational institutes named Shafiuddin Sarkar Academy and College and Tongi Government college. Both of them are renowned educational institutions in Gazipur. So, students from different parts of Gazipur come to study here. Almost 8000 enrolled students along with 170 teaching professionals are the member of shafiuddin Sarkar Academy and College. Besides, there are two collector roads which collect students and people and deliver it to Dhaka – Mymensingh Highway. There is also a branch of jamuna bank and a shopping mall. Number of jaywalking events occurred is 257 in 45 min during evening peak. Considering these factors this site has got 11 as importance value.

Fig: Shafiuddin Road

Targach:

According to importance value this site has got 3rd highest value. Because there are two garments (Ananta and moonlight garments) one market, one collector road, one medical college and hospital, one filling station as well as a restaurant. Tairunnessa memorial medical college and hospital has 500 bedded multidisciplinary hospital complex. It has also been recognized nationally and internationally as a center of excellence for heart diseases and research. Ananta Garments has about 2500 employees. The only collector road also delivers a lot of people and transports collected from different factories to Dhaka-Mymensingh Highway. As there is a filling station, we sometimes find a queue of vehicles creating congestion. This factor plays a very important role in decision making for jaywalking. Number of jaywalking events occurred is 421 in 45 min during evening peak.

Sultan Medical road:

Main reason for primarily selecting this place is the presence of sultan medical care and an empty space used for organizing political meetings. Besides, there are 3 different types of factories having 70-80% female workers and district bus counters. Most of the buses serving Dhaka- northern part of Bangladesh collect their passengers of this region from these counters. Also, there is mobile market which is one of the biggest mobile markets in Gazipur. Maximum number of female workers and unorganized political meetings are the main reasons of initiating jaywalking in this site. Number of jaywalking events occurred is 242 in 45 min during evening peak. This place's importance value is 10.

Board Bazar:

This place is considered as one of the main trade centers in this region. There are two collector roads, five restaurants, one central mosque, two markets and two educational institutions. Considering the factors though it seems to be most important place but the presence of traffic police box makes this less vulnerable to jaywalking. So, number of initiating jaywalking is less than the expected number. Normally every local bus stops here. Also, there are branches of 4 different banks. besides, some renowned doctors have chambers here. The two collector roads are specially used as bypass road. One of them connects chawrasta with board bazar and another one connects joydebpur with board bazar. There is a police station in this collector road. Though there is no pedestrian crossing facilities like foot over bridge or zebra crossing but all the pedestrians and drivers remain very careful during crossing this place. The students of Islamic university of technology have a great contribution in total initiations of jaywalking. Because we all know young people has more tendency of jaywalking. Number of jaywalking events occurred is 420 in 45 min during evening peak. For having these important factors this place has got the second highest importance value.

Fig. **Board Bazar**

Signboard:

This site has the highest importance value among all the selected sites. The main feature of this place is its two collector roads and two nearby garments which are situated within 150 feet of this place. Besides these two garments there are more than 8 industries which are directly contributing in the initiation of jaywalking here. Also, there is a high rise building named KK tower which is used by the nonresidential students of Islamic University Of technology. One of the collector roads connects Bade kalemeshor and kamarjhuri area to Dhaka – Mymensingh Highway which is also used as bypass road to visit Tongi river and Haricane area. And the other one connects kalagach road, jhajor and joydebpur railway station to main road. Both the collector roads collect people as well as transports from nearby industries and deliver those to Dhaka- Mymensingh highway. There are three educational institutions named Teachers training center for vocational curriculum, Bangladesh Open university and California preparatory school. Elite garments and Riaz garments company limited are to major garments company running within 150 feet. Elite garments have about 1500-2000 employees. There are also 3 confectioneries, one mosque, one market used for selling raw foods) and one ATM booth facility of AB bank. Number of jaywalking events occurred is 654 in 45 min during evening peak. Considering all these issues this place has got the highest importance value.

Fig: Signboard

4.1.1: Site Selection Factors

Table: Calculation of importance value considering all the factors.

Crossing Point	Factor jaywalking	Bus Stop	Industry	Educational Institute	Collector Roads	Market	Importance	Remarks
Board Bazar	2	3	2	3	3	3	16	Sign board Is selected
Sign Board	3	3	3	3	3	3	18	
Sultan medical road	1	1	2	3	1	1	9	
Targach	2	2	3	2	2	2	13	
Shafiuddin road	1	2	1	3	2	2	11	
Cherag Ali	3	2	1	2	2	1	11	

Impact Type	**Importance value**
Low	1
Moderate	2
High	3

Table 4.1: Collected data of number of jaywalking events occurred in 30 min for the mentioned place.

Crossing Point	**Number of jaywalking events**
Board Bazar	420
Sign Board	654
Sultan medical road	242
Targach	421
Shafiuddin road	257
Cherag Ali	460

Number of jaywalking events	**Impact Type**	**Importance value**
0-299	Low	1
300-450	Moderate	2
450<	High	3

4.2 Data Collection

For data collection method we actually used radar gun to calculate the speed. A radar speed gun (also radar gun and speed gun) is a device used to measure the speed of moving objects. It is used in law-enforcement to measure the speed of moving vehicles and is often used in professional spectator sport, for things such as the measurement of bowling speeds in cricket, speed of pitched baseballs, and speed of tennis serves.

A radar speed gun is a Doppler radar unit that may be hand-held, vehicle-mounted or static. It measures the speed of the objects at which it is pointed by detecting a change in frequency of the returned radar signal caused by the Doppler Effect, whereby the frequency of the returned signal is increased in proportion to the object's speed of approach if the object is approaching, and lowered if the object is receding.

The steps are divided into three parts.

Data collection steps:

- Lane wise, at different distances (20 m, 30m and 40m)
- Three times a day:

    1. Morning Peak (7:30 am - 8:30 am)
    2. Off Peak (10:30 am -12:30 pm)
    3. Evening Peak (6:30 pm -7:30 pm)

- Five days in a week:

    1. Sunday
    2. Monday
    3. Tuesday
    4. Thursday
    5. Friday

CHAPTER 5: RESULTS AND INTERPRETATION

5.1 Introduction

The main goal of this chapter is to understand the of speed variations among different lanes and different distances from the point of initiation of jaywalking.

We did three types of analysis, we calculated the difference between weekend-weekdays, peak-off peak and different distance (20m, 30m and 40m).

5.2 Results

The results of the analysis are shown in table bellow. In this experiment we did t test to compare the data of difference between lanes. Only variables with at least a ninety percent confidence level have been retained in the model.

The aim of this study is to find out the decisions making process for the jay walkers in different lanes. The study gives us the speed of the vehicle in the time of crossing the road while jay-walking. This gives us the idea that how much risk pedestrians are willing to take in the time of jay walking. We used the speed value to find t value. This result gives us a overview that how in a highway peoples perception of jay walking works. However this experiment may not give us an accurate result because there are many variables in this experiment.

Table 5.1:

40 m					
Weekdays					**Weekend**
Lane vs	**Sunday**	**Monday**	**Tuesday**	**Thursday**	**Friday**

lan e										
	P(equal)	**P(Unequal)**	**P(equal)**	**P(Unequal)**	**P(equal)**	**P(Unequal)**	**P(equal)**	**P(Unequal)**	**P(equal)**	**P(Unequal)**
L1 - L2		0.614	0.798	0.768	0.5858	0.548	0.5648	0.565	0.356	0.376
L2 - L3	0.619	0.334	0.07	0.066	0.1863	0.655	0.9679	0.734	0.110	0.236
L3 - L1	0.337 0.163	0.156	0.023	0.603	0.6467	0.970	0.7009	0.970	0.454	0.504
30 m										
	P(equal)	**P(Unequal)**	**P(equal)**	**P(Unequal)**	**P(equal)**	**P(Unequal)**	**P(equal)**	**P(Unequal)**	**P(equal)**	**P(Unequal)**
L1 - L2	0.998	0.933	0.499	0.467	0.4403	0.4557	0.116	0.038	0.455	0.435
L2 - L3	0.711	0.669	0.442	0.155	0.4184	0.275	0.599	0.649	0.395	0.207
L3 - L1	0.641	0.603	0.164	0.441	0.2971	0.1754	0.122	0.640	0.645	0.624
20 m										
	P(equal)	**P(Unequal)**	**P(equal)**	**P(Unequal)**	**P(equal)**	**P(Unequal)**	**P(equal)**	**P(Unequal)**	**P(equal)**	**P(Unequal)**
L1 - L2	0.512	0.51	0.189	0.213	0.4061	0.3465	0.499	0.503	0.105	0.044
L2 - L3	0.285	0.603	0.463	0.452	0.6498	0.5652	0.176	0.509	0.671	0.671

L3 - L1	0.115	0.115	0.638	0.602	0.4223	0.7782	0.474	0.277	0.046	0.044

Table 5.1: Comparison of Average speed deference between lane1, Lane2, Lane3 of 20m, 30m, 40m for Weekdays and Weekends.

In this table we find out the differences between weekdays and weekend mean speed variation.. This gives us the characteristics of the decision making process. For example, For Monday we get significant differences in average speed between lane 1 and lane 3 for equal variances. For 30m in Thursday we get significant differences in average speed between lane 1 and lane 2 for unequal variances. For 20m Friday we get significant differences in average speed between lane 1 and lane 2 unequal variances. And For Friday we get significant differences in average speed between lane 1 and lane 3 for both equal and unequal variances. We can see from this chart that, people tends to take more risks in weekends than weekends.

40m						
Lane vs Lane	**Morning Peak**		**Off Peak**		**Evening Peak**	
	P(equal)	**P(Unequal)**	**P(equal)**	**P(Unequal)**	**P(equal)**	**P(Unequal)**
L1 - L2	0.690	0.690	0.409	0.016	0.527	0.530
L2 - L3	0.548	0.584	1	0.225	0.803	0.794
L3 -L1	0.388	0.421	0.042	0.001	0.608	0.807
30m						
	P(equal)	**P(Unequal)**	**P(equal)**	**P(Unequal)**	**P(equal)**	**P(Unequal)**
L1 - L2	0.09	0.077	0.479	0.470	0.32	0.346
L2 - L3	0.11	0.095	0.212	0.190	0.45	0.447
L3 -L1	0.931	0.932	0.052	0.052	0.141	0.147
20m						
	P(equal)	**P(Unequal)**	**P(equal)**	**P(Unequal)**	**P(equal)**	**P(Unequal)**
L1 - L2	0.797	0.795	0.535	0.533	0.818	0.825

L2 - L3	0.254	0.27	0.170	0.175	0.597	0.600
L3 -L1	0.182	0.200	0.064	0.064	0.81	0.812

Table5.2: Comparison of Average speed deference between lane1, Lane2, Lane3 of 20m, 30m, 40m for Morning Peak, Evening Peaks, Off Peak

In this table we can have the idea about the off peak and peak hour difference for lanes.

For 40m Off peak hours we get significant differences in average speed between lane 1 and lane 2 for unequal variances. And for Off peak hours we get significant differences in average speed between lane 1 and lane 3 for equal and unequal variances. From this cart we can see that its risker to the jaywalkers point of view in weekends

40 m														
lane vs lane	Bus		Mini-Truck		Truck		Car		Auto		Motor-Cycle		Rickshaw	
	P (equal)	P(unequal)	P (equal)	P(unequal)	P (equal)	P(unequal)	P (equal)	P(unequal)	P (equal)	P(unequal)	P (equal)	P(unequal)	P (equal)	P(unequal)
L1 - L2	0.051	0.004	0.212	0.036	0.917	0.001	0	0.434	0.502	…	…	…	0.028	0.92
L2 - L3	…	…	0.72	0.177	…	…	0.625	0.563	…	…	…	…	…	…
L3 - L1	…	…	0.250	0.288	…	…	0.060	.2	…	…	…	…	…	…
30 m														
lane vs	Bus		Mini-Truck		Truck		Car		Auto		Motor-Cycle		Rickshaw	
	P (equal)	P(unequal)	P (equal)	P(unequal)	P (equal)	P(unequal)	P (equal)	P(unequal)	P (equal)	P(unequal)	P (equal)	P(unequal)	P (equal)	P(unequal)

lane														
L1 - L2	…	…	0.417	0.204	0.722	0.861	…	…	0.466	0.712	0.429	0.578	0.010	0.058
L2 - L3	…	…	…	…	…	…	…	…	…	…	…	…	0.493	0.545
L3 - L1		…	…	…	…	…	…	…	…	…	…	…	…	…
20 m														
lane vs lane	Bus		Mini-Truck		Truck		Car		Auto		Motor-Cycle		Rickshaw	
	P (equal)	P(unequal)	P (equal)	P(unequal)	P (equal)	P(unequal)	P (equal)	P(unequal)	P (equal)	P(unequal)	P (equal)	P(unequal)	P (equal)	P(unequal)
L1 - L2	0.114	0.050	…	…	0.080	0.239	0.223	0.339	0.064	0.133	…	…	…	…
L2 - L3	0.663	0.063	…	…	…	…	0.929	0.912	…	…	…	…	…	…
L3 - L1	0.55	0.723	…	…	…	…	0.322	0.022	…	…	…	…	…	…

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Table 5.3: Comparison of Average speed deference between lane1, Lane2, Lane3 of 20m, 30m, 40m for Variation of Transportation

In this table we will gate the value from Average speed deference between lane1, LaneLane3 of 20m, 30m, 40m for Variation of Transportation. For example in 40 m, Bus(unequal variance), Mini-truck(unequal variance), Truck(unequal variance), Rickshaw(equal variance) show significant differences in average speed for lane1 and lane2.. Rickshaw(equal variance) show significant changes in average speed between lane 1 and Lane 2 Car(unequal variance) all other studied vehicles show significant changes in average speed between lane 1 and lane 2.. In 20m for the combination of lane 3 and lane 1 unequal variance of car shows no significant change in average speed . Between lane 1 and lane 2 as well as lane 2 lane 3 we get significant differences in average speed for Bus and Car. Auto shows significant changes in average speed for lane 1 and lane 2 combination. From thi table we can find that people tend to take more risks when there is light traffic like rickshaw auto in lanes.

Chapter 6: Conclusion

6.1: Introduction

From this study we have come to know that lane conditions at different locations from the point of initiation play very important role in case of initiation of jaywalking. The result shows the impact of weekdays-weekends, peak-off-peak hours as well as variation with the modes of transportation in initiation of jaywalking. For example, if there are vehicles in both lane1 and lane 2 having significant difference in average speed, people will try to initiate jaywalking. Because if speed of the vehicle in 2^{nd} lane is less that that of 1^{st} lane, people may think if they can cross the 1^{st} lane then they will be able to cross the road easily. So, presence pf vehicles on different lanes play important role in case of jaywalking.

Again, presence of vehicles at different locations (such as 20m, 30m, 40m) from the point of initiation plays also a vital role in case of initiating jaywalking. We can illustrate this scenario by the following example. If there is a motorcycle at 40 m in the 1st lane and a bus at 20m in 3rd lane having significant difference in average speed, people will try to initiate jaywalking. As the vehicle in 1st lane is far away then the vehicle in 3rd lane so they think that they can easily cross the 1st and 3rd lane. So, vehicles at different locations from point of initiation has great impact in decision making of jaywalking.

From the study we have also found that weekdays and weekends have impacts on initiation of jaywalking. Like people will try to take more risks for the presence of vehicles at 20m from the point of initiation in weekends. As there is less amounts of vehicles with high speed in weekends so they try to take more risks in crossing the road. Whereas in weekdays presence of vehicles at 30m and 40 m people take more risks to initiate jaywalking.

Now in case of off-peak and peak hours people try to take more risks during off peak hours. As there is less amounts of vehicles during off peak hours so their speed remains very high. So, people take more risks thinking like that vehicles will cross those lanes before they have reached to those lanes. So, we can say that off peak and peak periods play important roles decision making for the initiation of jaywalking.

Also, for different modes of transportation decision making of jaywalking may vary. For example, people have the tendency to take more risks if they see rickshaw on any lanes. Again, if they motorcycle with high speed, they will take more risk considering vehicle will cross them before crossing the lane.

So, the most important thing for the policy maker, transportation engineers as well as planners is the understanding of people's attitude which is very much rely on the lane conditions at different locations from the point of initiation of jaywalking to prevent this event. Other factors like importance of built infrastructure, age, gender, income of people in that community shoul also be considered.

6.2: Recommendations

In order to promote pedestrian facilities like speed breakers, zebra crossing, foot over-bridges this type of study which is very much related with pedestrian behaviour should be done. Otherwise, the goal of making these infrastructures will not be fulfilled. As for example, during the data collection in our study there was a foot over-bridges which is 100 m distance from the point of data collection. But people didn't use that foot over-bridge. At last it requires to demolish that bridge. So, if this type of is not conducted before starting any development projects related to pedestrian will not be fruitful at all.

So, the results of this study will provide policy makers as well as transportation planners and engineers with important information for selecting the best suited facility at the appropriate place. As well as they can limit the speed of vehicle on that specific highway. Also, they can select different modes of transportation to avoid these types of events like jaywalking, accidents. Besides by applying the knowledge provided by this study different pedestrian facilities can be built in different highways having almost similar properties to this highway.

6.3: Limitations and Future Research

This research has been conducted considering several limitations. Some of the factors like age, gender, median width, shoulder width, sidewalk facilities which may have significant importance case of initiating jaywalking are not considered in this study. Besides, the study has been after a pandemic situation which seems to be over. So, we could take less numbers of data. Actually, this is the main limitation of this study.

But the main contribution of this study is that it creates a scope for further study on the presence of same kinds of vehicles on different lanes. If significant differences can be found from the further study then policy makers as well as planners will be able to provide dedicated lanes for some specific modes of transportation within a certain speed limit. Besides, sidewalk facilities that is not consider in this study can be studied further to determine the impact on initiation of jaywalking.

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