ISSN 0511-5728
The West Indian Journal of Engineering
Vol.33, Nos.1/2, January 2011, pp.34-42

Trinidad Road Users' Understanding of the New Zebra Crossing

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(Received 26 September 2008; Accepted January 2011)

Abstract: *Pedestrians are the most vulnerable road users; more so in developing countries such as Trinidad and Tobago as drivers fail to yield right-of-way to pedestrians crossing roads. Trinidad and Tobago has introduced a new zebra crossing to increase drivers' yielding rates. The crossing affords drivers to identify the crossing at a reasonable distance, and improve visibility of pedestrians in the crossing vicinity. This paper reports the result of a study aimed at exploring road users' understanding of the crossing. Some crossing elements are well understood by drivers while other elements present a challenge. Drivers support the new crossing, but most pedestrians are not satisfied with drivers' yielding rates. Through engineering, education, and enforcement improvements the crossing has a potential of improving pedestrian safety. These results will increase public education on the new crossing, and suggest crossing improvements.*

Keywords: *Zebra crossing, Pedestrian safety, Zigzag lines, Flashing lights, Trinidad and Tobago*

1. Introduction

Pedestrians and cyclists in Trinidad and Tobago (T&T) are the most vulnerable road users. While cyclist victims have declined since 1960, pedestrians have constituted 42-50 and 33-41 percent of all road fatalities and injuries respectively between 1965 and 2000 (St. Bernard and Mathews, 2003). "Pedestrian crossing the roadway" is a frequently reported scenario in crashes involving pedestrians in T&T.

Significant proportion of drivers who don't yield the right-of-way to pedestrians at conventional zebra crossings (i.e., alternate black and white transverse stripes across the street) is a major setback for conventional zebra crossings. As low as five percent drivers' yield rates were observed at zebra crossings located at mid-block in Sweden (Várhelyi, 1998). Motorists and pedestrians possess opposing views and attitudes toward pedestrian safety. While motorists blame pedestrians for risky behaviours, pedestrians blame motorists for marginalising pedestrians. King et al. (2011) have extensively documented such attitude known as group-serving bias. Redmon (2003) asserts that these attitudes change depending on whether one is a driver or a pedestrian.

Vehicle-pedestrian conflicts at conventional zebra crossings have prompted road agencies in searching for innovative engineering treatments to supplement zebra markings (Dun, 1989; Public Works, 2003). Some of these treatments have been successful than others (Public Works, 2003). In recognition of the pedestrian safety problem in T&T, the Ministry of Works and Transport initiated installation of a new zebra crossing in 2004. These crossings are expected to replace conventional zebra crossings in the long run. The purpose of this paper is to report views of Trinidad road users (i.e., both drivers and pedestrians) on the understanding of the new zebra crossing.

2. The New Zebra Crossing

Literature indicates that the new zebra crossing (see Figure 1) was proposed in 1993 for the first time (Government of Trinidad and Tobago, 1993). However, there is no evidence that this crossing ever got implemented until 2004.

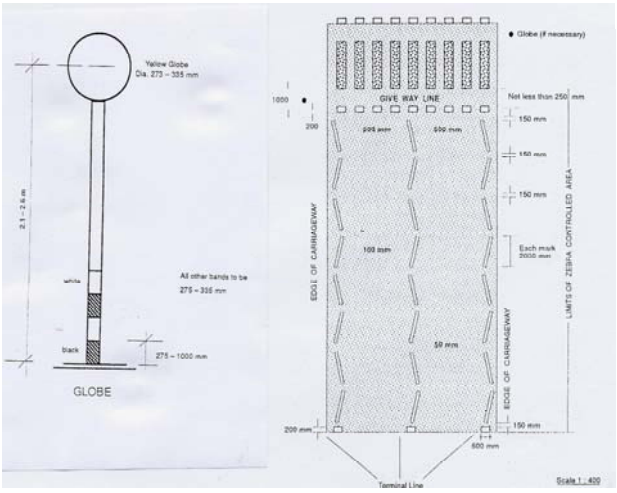

Figure 1. New zebra crossing
Source: Government of Trinidad and Tobago (2001)

According to the 1993 proposal, the crossing would have to include: 1) the conventional zebra crossing, 2) longitudinal zigzag lines, and 3) two yellow flashing globes. This crossing has some similarities to the crossings used in the United Kingdom (UK), New Zealand (NZ), South Africa, Hong Kong, and in the former British crown colonies of Singapore. In UK, the globe is known as orange belisha beacon. In NZ, the globes flashes only at night (Dunn, 1989), and they could be substituted by fluorescent beacon discs (Land Transport New Zealand, 2006).

The 1993 proposed crossing was amended in 2001 by: 1) replacement of a yellow globe with two circular amber (yellow) wigwag signals (also called flashing beacons or simply flashers), facing opposite directions of traffic (see Figure 2), and 2) explicitly defining the right-of-way for a pedestrian at the crossing (Government of Trinidad and Tobago, 2001). A conventional advance warning sign was amended by additional words "ZEBRA CROSSING" (see Figure 3) in 2004 when the first series of new zebra crossings were launched (Guardian, 2004).

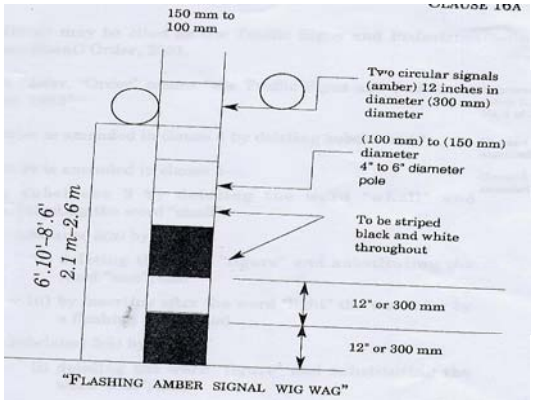

Figure 2. Flashing lights on black and white posts
Source: Government of Trinidad and Tobago (2001)

Figure 3. Advance sign at new zebra crossings

The resulting crossing has a unique image, offers ample time to drivers to react to pedestrians, and is visible to drivers under most weather conditions. These features are vital in increasing average driver's yielding behaviour.

When the first series of the new zebra crossing were launched, these guidelines on their use were provided to the public (Guardian 2004):

1) The pedestrian has the right-of-way, and therefore the driver must stop to permit the pedestrian to cross the roadway;
2) A maximum vehicle speed of 25 Km/h when approaching the crossing;
3) Although pedestrians have right-of-way still they should exercise care and caution when using the crossings.

These guidelines were the first to accord a pedestrian the right-of-way when crossing the roadway at zebra crossings in the country. Prior to these guidelines pedestrian were accorded right-of-way only at pedestrian crossings controlled by light signal or by the police officer (Ministry of Works, 1972).

3. Data Collection: The Questionnaire Survey

Data were collected using triangulation method involving administration of questionnaire survey to drivers, interviewing pedestrians, and field observations. Statistical Package for Social Sciences (SPSS) software was employed for data analysis. Influences of demographic factors on questionnaire responses were tested by their predictive significance through logistic regression analysis.

A mail questionnaire survey was administered to the general motorists. A self-addressed, business-reply envelope was enclosed within the questionnaire package to enable respondent mail back the questionnaire at no extra postage cost to them. A one-page questionnaire consisted of 10 short and multiple-choice questions soliciting information in three areas of: 1) respondent's demographic factors; 2) driver's understanding and yielding behaviours at zebra crossings, and 3) assessment of pedestrian crossing problem in the country.

Approximately 1,000 questionnaires were distributed to drivers in three regions of Trinidad (north, central, and south), each region receiving approximately the same number of questionnaires. The distribution of questionnaires was conducted at the entrance gates of three shopping centres, one in each region. It was expected that majority of shoppers at these centres would constitute local residents. Out of 1,000 questionnaires, one hundred and ninety were returned. Mail questionnaire surveys are usually associated with lower response rates than alternative methods such as roadside survey or personal interview. These alternative methods could not be used because of large number of questions in the questionnaire.

4. Data Analysis

4.1 Demographic Factors

Driver's demographic factors solicited in the

questionnaire include gender, age, and period of driving experience. Table 1 summarises demographic factors statistics in which 55% were females. It is noted that age and driving experience are highly correlated. Drivers with longer driving experience would have learned from the past the driving environment, and therefore they are expected to be safer drivers.

Table 1. Respondents' demographic factors

Parameter	N	Min.	Max.	Mean	SD
Age	180	17 yrs	75 yrs	38.6 yrs	14.3 yrs
Driving Experience	174	1 yrs	55 yrs	17.3 yrs	12.7 yrs

Correlation criterion	*Correlation coefficient*		
	Age vs. Experience	*Age vs. Gender*	*Gender vs. Experience*
Pearson	0.914[a]	-0.107	-0.161
Kendall's tau-b	0.777[a]	-0.062	-0.109
Spearman's rho	0.906[a]	-0.075	-0.131

Remarks: [a] Significant at the 0.01 level (2-tailed)

Young drivers have not accumulated sufficient driving knowledge and experience, which leads them to high-risk taking behaviour that may degrade road safety. Literature indicates that age is more significant than experience, since older drivers who are similarly inexperienced have lower crash rates (Cooper et al., 1995). Males were reported as higher risk takers than female drivers (Hemenway and Solnick, 1993), with men being more likely than women to report having driven after drinking, regularly exceeding the speed limit, and running a red light.

4.2 Drivers' Understanding of the New Zebra Crossing

Traffic Control Devices (TCDs) are designed by engineers for road users (such as drivers, pedestrians, and cyclists). Sometimes road users understand TCDs differently from the intended meaning by engineers (Stokes et al., 1996; Ford and Picha, 2000). Drivers' correct understanding of the meaning of a TCD is a prerequisite for its effectiveness. Some standards such as the Manual on Uniform Traffic Control Devices (MUTCD) in USA identify "conveyance of a clear, simple meaning" as one of the five requirements that should be met by a TCD (Federal Highway Administration, 1988).

Three questions tested drivers' understanding of three main crossing elements: 1) zebra markings, 2) zigzag line markings, and 3) flashing lights. A coloured photograph of the crossing was part of the questionnaire for easy reference. Respondents were also asked whether their understanding of the meaning of transverse markings is based on drivers' understanding of traffic laws or/and through driving experience.

4.2.1 The Meaning of Zebra Markings

One hundred and eighty-seven interviewees responded to the question on the meaning of zebra markings. Gender, age, and driving experience were not statistically significant predictors of respondents' understanding of zebra markings (i.e., p-values of 0.652, 0.070 and 0.756, respectively). Distribution of responses is summarised as part of Table 2 from which the following are noted:

1) The proportion of drivers who understand that zebra markings means "stopping" is higher than for those who understand it to mean "slowing down". This pattern is consistent in both cases of when the "pedestrian is about to enter the crosswalk", i.e., 60% versus 9% respectively and when the "pedestrian is in the crosswalk", i.e., 23% versus 5% respectively;
2) The presence of drivers (about 3%), who understand zebra markings to mean "nothing" to the driver, is a matter of concern. Zebra markings at pedestrian crossings are among the oldest TCDs used worldwide to facilitate pedestrians cross roads legally and safely. It would be expected that all drivers would at least understand that these markings mean something to the driver.

Table 2. Drivers' understanding of new zebra crossing

Crossing Issue	Responses %
Meaning of Zebra Marking to the Driver (N=187)	
Stop for a pedestrian who is about to enter the crosswalk	60
Slow down for a pedestrian who is about to enter the crosswalk	9
Stop for a pedestrian who is in the crosswalk	23
Slow down for a pedestrian who is in the crosswalk	5
Mean nothing to the driver	3
Meaning of Zigzag Lines (N=176)	
Slow down	34
Proceed with caution	59
No parking	1
Stop	3
None	3
Meaning of Flashing Lights (N=187)	
Prepare to stop	88
Changing green to red	3
Only for Pedestrians	1
None	8
Reasons why drivers not yielding for pedestrians at zebra crossings (N=160)	
Do not see the pedestrian within enough time	73
Slowing is enough for pedestrian to cross the road	16
Pedestrian take long time to cross the road	8
Expect pedestrian to yield to motorists	3

Fifty percent of drivers indicated that their

understanding of zebra markings is influenced by their awareness of traffic laws. Twenty six percent thinks their understanding is a result of their driving experience or intuition alone, while the remaining 24% considers it is a result of both traffic laws and driving experience. Majority (i.e., 74%) of drivers understands that pedestrians are governed to some extent by existing traffic laws. It is assumed that drivers are referring to T&T traffic laws as the questionnaire could not identify respondent's country of residence. Non-resident drivers are likely to be ignorant of some T&T's traffic laws.

4.2.2 The Meaning of Flashing Lights

Flashing lights indicate the location of the new zebra crossings so that a driver would prepare to yield right-of-way to the pedestrian. Inclusion of "prepare to stop" as one of the answers on the questionnaire was to translate the meaning of flashing light. Summary of the results given in Table 2 indicates that 12% of respondents misunderstood the meaning of flashing lights. Gender, age, and driving experience were not significant predictors of whether the drivers understand correctly the meaning of flashing lights (i.e., p-values of 0.441, 0.594 and 0.824, respectively). Misunderstanding of flashing lights by some drivers could be attributed by the application of similar flashing lights at signalised intersection when signals are operating in a safe mode.

4.2.3 The Meaning of Zigzag Lines

Zigzag lines are used in T&T, UK, NZ, Hong Kong, Singapore, and South Africa to restrict parking at zebra crossings. In South Africa they are used also to restrict changing lanes, and pedestrians. Pedestrians are prohibited from crossing within the zigzag lines zone (Ribbens, 1996).

Table 2 indicates that zigzag lines were the most misunderstood element of the new zebra crossing with only one percent of drivers indicating the correct answer of "no-parking". Gender, age, and driving experience were not significant predictors of driver's understanding of zigzag lines (i.e., p-values of 0.997, 0.38 and 0.405, respectively). Literature indicates that the meaning of zigzag lines has been illusive to others, locally as well as internationally. A T&T local newspaper associated zigzag lines with a meaning of "warn motorists to slow down and exercise caution" (Peters, 2004). It is noted that coincidentally over 90% of respondents in this survey understand zigzag lines to mean one of these two meanings given in the newspaper.

In Australia where zigzag lines at zebra crossings are used as an advance warning for the crossing, and are marked different from other countries (see Figure 4), only 35% understood correctly their meaning (Australian Road Research Board, 1989). This prompted reconsideration of use of zigzag lines at zebra crossings in Australia. Queensland, Australia prohibited the use of zigzag lines in 2002 because it was not a recognised standard and was considered a potential source of confusing motorists, thereby increasing the risk to pedestrians and motorists (Queensland, 2002).

Figure 4. Zigzag markings used for warning
Source: Abstracted from Queensland (2002)

4.3 Drivers' Yielding Behaviours

The second question asked what respondents thinks a driver is required to do when a pedestrian is waiting to cross the road at a marked crossing. The majority (i.e., 99%) indicated that they would at least slow down to allow pedestrian to cross the road, 92 percent indicating they would stop. All three factors of age, gender, and driving experience were not significant (i.e., p-values of 0.613, 0.731, and 0.232 respectively) in predicting driver's understanding of this issue. Table 3 compares drivers' yielding rate reported in the questionnaire with those observed in the field. It is noted that self-reported values are higher than field observed values, suggesting a self-reported bias.

Table 3. Drivers' self-reported and field observed yielding rates

Yielding type	Field observed - Flashing lights (%) [1]			Self-reported (%)	
	On	Off	All	What would you do?	What is a driver required to do?
Stop	22	4	14	83	92
Slow	61	71	66	14	7
Nothing	17	25	20	3	1

Source: [1] Mutabazi and Dindial (2007)

The third question asked how often drivers yield for pedestrians at a pedestrian crossing. The fourth question asked how often they see fellow drivers yield for pedestrians at pedestrian crossings. Results of these two questions are reported in Table 4. Age, driving experience and gender factors were not statistically significant. A significant shift on reported drivers' yield

behaviour between "self-reported" and "reporting of fellow drivers" could be due to the fact that all drivers generally have higher opinion about their own performance as compared to other drivers' performance (i.e., 'optimism bias') (King et al., 2011). Average values between "self-reported" and "reporting of fellow drivers" presented in the last row of Table 4 were adopted to account for such bias reporting, showing that drivers yield to pedestrian occasionally ("sometimes") than "always".

Table 4. Reported frequency on drivers' yielding for pedestrians at zebra crossings

Driver category	Driver's frequency for stopping for pedestrians		
	Always[1]	Sometimes[1]	Never[2]
Reporting of fellow drivers (N=187)	29%	67%	4%
Self reported (N=188)	55%	41%	4%
Average	42%	54%	4%

Remarks: [1] Statistically significant; [2] Not statistically significant

The fifth question asked respondents the reason when they do not yield for pedestrians (see Table 2). Approximately three-quarters (73%) of 160 respondents indicated that late detection of pedestrian in a crosswalk is the major reason for failure to yield. Similar reason was reported in Redmon (2003)'s study in which drivers indicated sight obstruction and night environment as contributing factors.

Eight percent do not yield because they think that pedestrians take long time to cross roadways. Pedestrians taking long time to cross roadway was also reported by Redmon (2003). Sixteen percent reported that slowing down is enough while three percent expects pedestrian to yield to motorists. These results indicate the notion in which motorists think that roads are exclusively for vehicles, and therefore yielding to pedestrian is considered a courtesy.

"Pedestrian take long time to cross the road" and "expect pedestrian to yield to motorists" may represent aggressive habit on the part of the driver. Studies have reported significant differences between male and female drivers with regard to distraction and aggressive driving behaviour (Shinar and Compton, 2004; Lesch and Hancock, 2004). In this study however, there was no significant difference between genders on the drivers' aggressiveness.

4.4 Effectiveness of the New Zebra Crossing

Public and stakeholders' support is essential for sustaining a project for long term. Effectiveness of the new crossing is defined in terms of its ultimate goal of reducing pedestrian related crashes. Eighty two percent of respondents think that marking crossings will increase pedestrian safety. These results indicate that drivers appreciate the effectiveness of the project in improving pedestrian safety in the country. Only the respondents' age factor was statistically significant (i.e., $p<0.001$) in predicting driver's response. Drivers who are one year older are 1.045 times more likely to support the crossing (i.e., odd ratio = 1.045 with 95% CI between 1.033 and 1.057).

4.5 Pedestrian Survey

A non-structured survey was carried out by interviewing experienced pedestrians at the new zebra crossings. Four school principals and two school crossing guards at six different schools were willing to provide their comments on the effectiveness of the new zebra crossings. These schools were among the early places where new zebra crossings were installed. These interviewees were considered to represent views of most school children using those crossings on a daily basis.

All interviewees were of the opinion that the new zebra crossings were not effective, because most drivers do not yield to pedestrians. Some school principals had taken or were contemplating to take extra measures to improve safety of school children using the crossings. One pedestrian was of the view that flashing lights should be of red colour instead of yellow, to differentiate the use of yellow & red light colours at signalised intersection with the use at zebra crossings. However, increased drivers' yielding behaviour was associated with flashing light operation of the new zebra crossing (Mutabazi and Dindial, 2007). It is likely that such improvement was below interviewees' expectations. Some of the school principals had lobbied to get new zebra crossings installed at their schools, and therefore their expectations might have been higher.

4.6 Field Observations

Field visits to the 21 new zebra crossings were the source of unpublished information about this crossing application and usage in Trinidad. In this section we discuss drivers' behaviour other than yielding rate which has been reported elsewhere (Mutabazi and Dindial, 2007). In many instances vehicles were seen parking, stopping and overtaking within the crossings against restrictions by zigzag lines as provided by article 54 of the Highway Code (Ministry of Works, 1972). Tall commercial vehicles parked at a crossing not only hinder visibility of pedestrians in the crossing, they could also hinder the visibility of post-mounted flashing lights. Some drivers were seen honking to pedestrians who are already in the crossings as if pedestrians had no right of using the crossings. Table 5 compiles key observational information, survey and interview of Trinidad road users with respect to the new zebra crossing.

5. Discussion and Recommendations

This section discusses existing gaps in the understanding and safety of the new zebra crossing.

Table 5. Trinidad road users and improved midblock zebra crossings

Crossing Issue	Observations	Survey and Interviews of Road Users
Effectiveness of new zebra crossing	Flashing lights at Trinidad's new zebra crossing had a significant effect on drivers' yielding to pedestrians (i.e., 83.5% versus 75.1%) (Mutabazi and Dindial, 2007).	All six interviewees from six schools see the new zebra crossing as not effective.
		Majority (i.e., 82%) of drivers in a survey believe that the new crossing will be effective in reducing pedestrian accidents.
Zigzag lines	Drivers were often seen violating zigzag lines restrictions at the new zebra crossings.	Only 1% of drivers surveyed knew the correct understanding, and over 90% gave the same meaning as in the local newspaper article.
	Local newspaper published the article with wrong meaning of zigzag lines (Peters, 2004).	
Zebra markings		Majority (i.e., 83%) of drivers surveyed understood to stop for pedestrians, and 14% to slow down
Flashing lights	Prior to introduction of improved zebra crossing, flashing lights were only used at signalized intersection operating in safe mode.	Majority (i.e., 88%) of drivers understood correctly the meaning of flashing lights
		Some road users interviewed suggest that red-flashing lights should be used instead of yellow.

It recommends how these gaps could be filled. Effectiveness of the new zebra crossing, like any other road safety program, can be improved through a combination of engineering, education, and enforcement measures.

5.1 Engineering Measures

Crossing location and highway design guidelines, flashing light signal characteristics, mode of operation, and parking management are the engineering measures that might improve the new zebra crossing safety.

1) Crossing Location & Highway Design Guidelines

The new zebra crossing could serve better its users (pedestrian and motorists) by meeting their needs and expectations. Choice of location for the new zebra crossing presents a challenge requiring consideration of multiple factors such as driver's sight distances, short distance to cross the roadway, pedestrian volumes and desired walking lines. Current guidelines suggest that these crossings be located on low speed roads (i.e., < 65 Kph). This being the only documented criterion, most of the crossing location decisions depend on engineer's judgement.

Most drivers indicated that late detection of pedestrians in the crossing is the main reason why drivers fail to yield. Adequate sight distance to the driver at pedestrian crossings is an engineering solution through sound roadway geometric design and selection of crossing locations. Objective-oriented guidelines for location of zebra crossings need to be developed.

2) Flashing Light Signal Characteristics

This section discusses engineering measures that can improve signal conspicuity (attention attracting property), crossing visibility, reliability, life-cycle cost, and credibility. The new zebra crossing uses incandescent amber lights continuously flashing at 60 cycles per minute. Flash rates faster than 60 cycles per minute were found to increase conspicuity, while strobe light signals were better than incandescent (Ruden and Coleman, 1979). Faster flashing Light Emitting Diode (LED) beacons increased drivers' yielding behaviour in Florida (Shurbutt et al., 2008). LED signals offer economic advantage as they consume low energy and require lower maintenance costs.

Red signal attracts drivers' attention than yellow signal. At unsignalised intersection red signal and beacon devices produced higher motorist yielding behaviour to pedestrian than in-roadway signs, yellow overhead flashing beacons, pedestrian crossing flags, and in-roadway warning lights (Turner et al., 2006). In a laboratory study, red flashing lights were found better in attracting subjects (Ruden and Coleman, 1979). Use of red flashing signals will differentiate flashing lights at signalised intersection and those at the new zebra crossings thereby creating and preserving a unique image for this crossing.

3) Signal Mounting Height and Position

Flashing lights at the new zebra crossing are post-mounted at a height of 2.1 to 2.6 m from the ground. Overhead flashing lights could solve visibility problem created by tall trucks parking in the vicinity of the crossing.

4) Mode of Operation

Flashing lights at the new zebra crossings operate continuously regardless of the demand for crossing. Pedestrian activation can lower operating costs and increase crossing credibility. Increased driver yielding to pedestrians at crosswalk with actuated flashers in Chattanooga, Tennessee, was attributed to flashers actuation (Van Winkle and Neal, 2000). Fitzpatrick et al. (2006) reported several studies that have indicated intermittent flashing beacons providing a more effective response from motorists than continuously flashing beacons.

Sparks and Cynecki (1990) found that continuous

flashers offer no benefit for intermittent pedestrian crossings in an urban environment, and that actuated warning flashers may be beneficial in a high-speed rural environment with unusual geometrics, high pedestrian crossings, and unfamiliar drivers. Some agencies prefer activated flashing over continuously flashing beacons, for the fear that the later may eventually lose its effectiveness.

The new zebra crossing uses conventional electrical power supply. Use of solar power instead of conventional power would make the crossing feasible in rural locations where there is no conventional power supply or where power get interrupted frequently.

5) Parking Management

Misunderstanding of zigzag lines by majority of drivers demonstrates a phenomenon in which engineers design and place traffic control devices, which are not properly understood by road users. Frequent parking, stopping, and overtaking within the crossing limits degrade pedestrian safety. Engineering solutions such as supplementing zigzag lines with standard "no-parking" signs that are familiar to road users, and implementing of parking management in the vicinity of a crossing should be beneficial if considered.

5.2 Education Measures

To minimise vehicle-pedestrian crashes, it is recommended to enhance public education related to understanding the meaning of new zebra crossing elements, traffic laws, and fellow road users' attitudes. Such initiatives will require public education system suitable for each type of road users (such as novice versus experienced, local versus non-resident, and school children, etc.). Introducing knowledge of new zebra crossing in driver licensing curriculum, information pamphlets at car rental outlets, media, and public campaigns are among the methods worth of consideration.

1) Crossing Elements

Road user's behaviour at the crossing cannot be better than road user's understanding of the meaning and/or purpose of crossing elements. It is likely that misunderstanding of zigzag lines by Trinidad motorists is due to lack of appropriate education. Parking restriction by zigzag lines markings in T&T is a new concept and unfamiliar. Newspaper articles either gave incorrect meaning of zigzag lines (Peters, 2004) or did not address zigzag lines at all when the crossing was introduced to the public (Guardian, 2004). It is recommended to enhance education to drivers on the meaning and intended purpose of the following crossing elements, listed on the decreasing order of misunderstood: zigzag lines; flashing lights and zebra markings.

2) Traffic Laws

Legislation and operational guidelines governing the new zebra crossing were found partially documented in the government legislative documents and in the media print documents (refer Section 2 above). They specify pedestrians' right-of-way, maximum vehicular speed, and caution to pedestrians. It is recommended that these guidelines in the media be incorporated into law and appropriate penalties for infringement be established.

3) Road Users' Attitude

Late detection of pedestrian was cited by drivers as the reason for drivers' failure to yield. This could be attributed to drivers' distraction or poor crossing and pedestrian visibility. The same reason could also be used as an excuse by drivers who do not want to reveal their unsafe driving practices. Likewise, drivers thinking that a slowing down of a vehicle is sufficient, that pedestrian take long time, and that pedestrians should yield to motorists suggest marginalisation of pedestrians by drivers.

Improving crossing visibility was discussed earlier under engineering measures (in Section 5.1). Pedestrians who have never been behind the wheel as drivers might not understand properly drivers' attitudes, tasks and responsibility. Educating pedestrians on drivers' attitudes and how to be noticeable by drivers will improve pedestrian safety. Some examples include avoiding darting, wearing reflective clothes at night, and eye contact with a driver before start crossing.

5.3 Enforcement Measures

Engineering and education measures alone may not be sufficient to guarantee that road users will behave in the safe manner unless they are willing to change their behaviour. Drivers' attitude of marginalising pedestrians needs enforcement to supplement education and engineering measures to influence driver behaviour change.

Effective enforcement in the context of T&T may focus on improving enforcement system and improving its transparency. Use of new information and hardware technologies will greatly improve the system. Selection of what specific enforcement programme(s) will require is a pre-analysis of the existing system. Simplified driver citation and court procedures are among the programs that may need improvement.

6. Conclusions

Zebra marking and flashing light elements of the new zebra crossing are relatively well comprehended by drivers. The opposite is true for zigzag lines element. Educating drivers and other stakeholders is likely to enhance comprehension of these elements. Observed drivers' yielding rates were lower than "self-reported" rates, and drivers think they are less risky than their colleagues. However, higher proportion of drivers

reported that they yield to pedestrians "sometimes" than the proportion who yield "always". Existence of a significant proportion of drivers who possess the attitudes that marginalise pedestrians implies the need for specific education and enforcement measures towards such behaviours.

The new zebra crossing is a promising TCD with flashing lights improving drivers' yielding rates although pedestrians expect higher rates. Drivers are appreciating the effectiveness of the crossings to alleviate pedestrian safety problem, and experience from field observations indicates opportunities for crossing improvement through the combination of engineering, education, and enforcement measures.

This paper highlighted road users' understanding of the new zebra crossing. It offers guidelines to educate new zebra crossing stakeholders (such as drivers, pedestrians, policy makers, road safety educators and enforcement agencies) in the bid to reduce road fatalities involving pedestrians. Education measures suggested supplement a general observation by Furlonge (2004).

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