Evaluation of cross-walk timing and the application of a standard crossing light timing formula

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Abstract

The timing of traffic lights follows the code of uniform signalling devices. As such, the timing for crosswalks is determined by dividing the width of the roadway by 4. Four (4) is a magic number that corresponds to the walking speed of an adult male of 'average' age and dates back to some time in the 1950's. Most importantly, a male of 'average' age most certainly does not represent the walking speed of children. To test this hypothesis, random groups of children were timed while walking across roadways in appropriately designated crosswalks. The random groups were divided into Solo, Pair, and Group divisions associated 1, 2 and more than two children. Roadway widths were also randomly chosen to determine if different walking speeds were associated with different roadway widths. In addition, interactions between children and between children and crosswalk guards (if present) were observed and noted to determine their impact on the walking speed of the children observed. The results of this study indicate that roadway crosswalk timing is inadequate for school aged children and results in increased risk due to children rushing (running) across the remaining distance of the roadway to access the sidewalk before the street light changes.

Keywords: Crosswalk, timing, safety, school children

1. Introduction

The purpose of this project was to assess the timing of the crossing lights for allowing pedestrians to cross the streets safely. The crossing lights around elementary, middle, and high schools were evaluated because parents have indicated that crossing times are not adequate for students or pedestrians to cross the streets safely. The time intervals between 'Walk' sign and 'Don't Walk' sign are considered too short. Initial observations indicated that, pedestrians are still in the middle of the road when the 'Don't Walk' (red hand, red stick figure) sign starts flashing red.

Based on this observation, an investigation was designed to determine the actual time to cross the roadway with the crossing lights and compare them to the theoretical time which is determined by the 4 feet per second 'loosely defined rule of thumb' presented in the code of uniform signalling devices [1].

2. Methodology

2.1. Apparatus

A Cannon ShurShot® digital camera and a Sony Digital HandCam® camera were used to document all cross-walk sites evaluated. A stop watch with snap back features was used to time all periods between the appearance of the 'Walk' signal

and the appearance of the 'Don't Walk' signal, as well as the total times recorded for crossing the intersections evaluated. In addition, a Department of Transportation (DOT) certified measuring wheel was used to measure the roadway widths at each facility evaluated.

2.2. Participants

Participants in the study included three (3) groups of children: (1) elementary school children (ages 6 – 10); (2) middle school children (ages 11 – 15); and (3) high school children (ages 16 – 18). All observations were random and no personal information was collected from the participants.

2.3. Procedure

The first task conducted was the selection of the sites for testing the crossing lights. In this case, three types of school environments were selected (elementary, middle, high school) to record sample crossing times. The time between 7:00 am and 9:00 am and between 2:30 pm and 4:30 pm were chosen because these are school zone times. Therefore, going to school and leaving school could be tested. The interval of time was then determined between the actual time from the appearance of the 'Walk' signal until the 'Don't Walk' signal started flashing and from the appearance of the 'walk' signal until the 'Don't Walk' signal became solid. An example of the 'Don't Walk sign is presented in Figure 1.

Fig. 1: "Don't Walk' signal

The location of the pedestrians on the street when the 'Don't Walk' signal started flashing was documented using photographs. The timing of the pedestrians was obtained by timing one child, two children, and groups of children at a time crossing the street. Examples of these groups are presented in Figures 2 – 4.

Fig. 2: Single child with crossing guard

Fig. 3: Groups of children at crosswalk

A baseline walking speed was determined for each group. The baseline was determined by measuring a 40 foot distance on the sidewalk and measuring 'normal' walking times prior to approaching the crosswalk (Figure 4). The 40 foot distance was used because this is a typical roadway width.

Fig. 4: Children leaving school

In theory, f the crossing time of the lights was not enough for one person to cross the street safely it would be assumed not to be safe for groups of people to cross the street. However, groups were chosen to be observed to understand the group dynamic on crossing speed.

Each crossing area was also evaluated by measuring the width of the streets to use in the calculation of the theoretical time. Theoretical time (TT) was calculated using the formula obtained

from the Texas Manual on Uniform Traffic Control Devices [1]. The formula provided is as follows with an example of its use.

TT (seconds) = Width (in feet) ÷ 4 ft/sec. (1)

Example: If the street is 60 ft wide, the time that the crossing light will allow pedestrians to cross the street would be 60 / 4 = 15 seconds, where 4 equals the 'average' stride distance per second; 4 feet/second for an adult male.

3. Results and discussion

The results are discussed by area of evaluation.

3.1. Elementary schools

In all cases evaluated, none of the signalized facilities provided sufficient time for the children to cross the street before 'do not cross' was indicated. The only exception to this observation was one additional location where a police officer was manually controlling the signalized intersection to allow the children enough time to cross the street.

Walking times for this school age group (6 – 10 years of age) averaged 2 feet per second, which is ½ of the standard formula presented in the Code of uniform Signalling Devices [1]. This indicates that children walking alone, crossing without a crossing guard, would only get halfway across the street before the signal indicated 'don't walk'.

3.2. Middle schools

As with the elementary schools, none of the signalized facilities provided sufficient time for the children to cross the street before 'do not cross' was indicated. The only exception to this observation was one additional location where a police officer was manually controlling the signalized intersection to allow the children enough time to cross the street.

Walking times for this school age group (11 - 15 years of age) averaged 2.5 feet per second, which is nearly ½ of the standard formula presented in the Texas Manual on Uniform Traffic Control Devices [1]. This indicates that children walking alone, crossing without a crossing guard, would only get a little more than halfway across the street before the signal indicated 'don't walk'.

3.3. High schools

As with the both the elementary schools and the middle schools, none of the signalized facilities provided sufficient time for the children to cross the street before 'do not cross' was indicated. The only exception to this observation was one additional location where a police officer was manually controlling the signalized intersection to allow the children enough time to cross the street.

Walking times for this school age group (16 - 18 years of age) averaged 3.0 feet per second, which is nearly 3/4 of the standard formula presented in the Texas Manual on Uniform Traffic Control Devices [1]. This indicates that children walking alone, crossing without a crossing guard, would only get a 3/4ths the way across the street before the signal indicated 'don't walk'.

3.4. Theoretical time vs. actual time

Theoretical time, as calculated using the formula in the Texas Manual on Uniform Traffic Control Devices [1] and actual times recorded during street crossing were compared. Table 1 presents the results of the comparison.

For example comparison, three street widths were used for all three (3) age groups (90 ft., 60 ft., and 40 ft.). The signal timing formula obtained from Texas Manual on Uniform Traffic Control Devices [1], was used to calculate the theoretical time. The actual time used the average walking speed of each group. As can be seen, there are significant differences between the theoretical time and the actual time.

According to the formula obtained from the Texas Manual on Uniform Traffic Control Devices [1] the walking speed pedestrian to cross a street is 4ft/second. The discrepancy between the calculated time and the actual time presented in Table 1 indicates that this velocity is too fast for children and not to consider handicapped pedestrians or the elderly who may need more time to cross the street.

Table 1
Comparison of theoretical time and actual time for street crossing

Location	Width (ft)	Theoretical Time	Actual Time	Difference
Elementary school (2'/sec)				
1	90	22.50	45.00	-22.50
2	60	15.00	30.00	-15.00
3	40	10.00	20.00	-10.00
Middle School (2.5'/sec)				
2	90	22.50	36.00	-13.50
2	60	15.00	24.00	-9.00
3	40	10.00	16.00	-6.00
High School (3'/sec)				
1	90	22.50	30.00	-12.50
2	60	15.00	20.00	-5.00
3	40	10.00	13.33	-3.33

4. Conclusions

From the results of this study, it is evident that the crossing lights evaluated, were not safe for child pedestrians in any age group

It would appear that the formula used for determining the time set for street crossing is inappropriate. Regarding this formula, denominator times will be different depending on age and mobility. For example, children will have a shorter stride distance per second than adults as will wheelchair users.

4.1. Impact of single and groups of children

The impact of walking alone, in pairs, or in groups had a significant impact on walking speed. Logically, children walking alone had the fastest average walking speed (measured in ft/second). When children walked in pairs, the average walking speed was reduced by approximately 1/3. The greatest impact on walking speed occurred when children walked in groups with an average reduction in walking speed of 50%.

Further, when individual students walked with a crossing guard, their speed was reduced by 50% because usually the guard would start up a conversation with the child. However, when crossing guards were present, group walking speeds were only reduced by 1/3.

Another interesting observation is that children were more likely to drop something they were carrying when they were walking in groups. When the child went to retrieve the item they dropped, most often the group stopped to see what had happened and encourage the child to retrieve their item.

5. Recommendations

Recommendations for implementation are as follows.

(1) The crossing time for the lights should use the walking speed of the pedestrians that will be using the facility.

(2) Adjust the time so that 'Don't Walk' sign starts flashing when pedestrians are about halfway on the street.

(3) An auditory display should accompany every crossing light, so the pedestrians will have both visual and auditory displays. The display should be at ½ duty cycle during the crossing time and increase to a ¼ duty cycle when the don't walk appears to indicate time to cross is over.

(4) An additional visual display of the time remaining to cross the street should also be provided to indicate the time remaining before the traffic signal changes.

(5) Change the formula for calculating theoretical time of the crossing lights. Based on the preliminary research reported here, the denominator time should be about 2 ft/second for elementary schools,

2.5 ft/second for middle schools and 3.0 ft/second for high schools.

(6) Provide crosswalk training to students.

References

[1] Texas Manual on Uniform Traffic Control Devices (TMUTCD), Texas Department of Transportation, Austin, Texas, USA