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Importance of Pedestrian Start-Up Times at Signalised Crosswalks

Sewmini Jayatilake
University of Peradeniya, Sri Lanka

Niroshana Premachandra
Road Development Authority, Sri Lanka

Vasantha Wickramasinghe
University of Peradeniya, Sri Lanka

1. Introduction

The total time required for pedestrians to cross the road is the summation of the time required to traverse the crosswalk and the pedestrian start-up time. But most signal time calculations do not pay attention to start-up time. This may result in dangerous situations caused due to pedestrian-vehicle interactions.

Pedestrian start-up time is the difference between the time at which the pedestrian stepped off the curb to cross the road and the time at which the pedestrian signal phase turns into green. If the pedestrian steps off the curb during red phase, then it is early start-up time. If the pedestrian steps off the curb during green phase, it is delayed start-up time.

Pedestrian behaviour varies according to several factors. Knoblauch et al. (1996), have considered weather, age, gender, curb height etc. and data were categorised accordingly. But Golani and Damti (2007), have considered the behaviour of a group of pedestrians. In this research, age, gender, group size and the familiarity of the pedestrians to the signal phase were considered. When considering the results of Vujanic et al. (2014), 17.5% pedestrians have started crossing during red phase. The highest number of offenders of both genders is under the age of 30 and the majority is male.

This paper shows the importance in considering start-up times of pedestrians at signalised crosswalks.

2. Objectives

The objectives are primarily to find the start-up times of pedestrians crossing at signalised crosswalks, and secondly to find the variation of start-up time by age, gender, group size and pedestrian's familiarity with signal phase.

3. Methodology

Signalised crosswalks with time indication were selected at intersections, and at each location video surveying was done. Using the captured video data, images were extracted with an accuracy of 0.1s. In finding the start-up times, pedestrians at the front line who are waiting for the pedestrian's signal phase to turn into green were considered. Start-up times were calculated using the extracted images while observing the age, gender and group size of each pedestrian. The next analysis of start-up time was done using 'Easy fit' software and start-up times were graphically interpreted. 'Z test' was carried out to check whether there is a significant difference between data gathered in two main cities in Sri Lanka (i.e., Kandy and Colombo). Kandy has recently installed pedestrian signals while Colombo is having a long history of signalized pedestrian crossings. Probability analysis was done for early and delayed start-up times under each factor separately. Finally, a matrix of probability values was created.

4. Results

A total of 194 pedestrian crossing phases with 1,420 pedestrians were captured and considered in Kandy, and 158 crossing phases with 672 pedestrians were captured and considered in Colombo. Next, probability curves were obtained separately for early and delayed start-up times in the two cities and standard deviations were found for each as shown in Table 1.

Table 1: Mean and Standard Deviation

	Total start-up time (s)		**Early start-up time (s)**		**Delayed start-up time (s)**	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Total	0.05 (0.69)	1.43 (1.36)	-1.23 (-0.95)	1.21 (0.74)	0.93 (1.39)	0.69 (0.82)
Male	-0.08 (0.74)	1.45 (1.36)	-1.27 (-1.00)	1.17 (0.76)	0.92 (1.41)	0.67 (0.83)
Female	0.20 (0.61)	1.40 (1.32)	-1.16 (-0.87)	1.28 (0.70)	0.94 (1.36)	0.70 (0.67)
Alone	0.02 (0.67)	1.44 (1.39)	-1.24 (-0.99)	1.22 (0.76)	0.92 (1.40)	0.68 (0.85)
Group	0.33 (0.84)	1.37 (1.12)	-1.06 (-0.70)	1.16 (0.59)	1.02 (1.35)	0.75 (0.68)
10-30	-0.02 (0.51)	1.43 (1.27)	-1.23 (-0.90)	1.27 (0.81)	0.89 (1.21)	0.61 (0.76)
30-60	0.12 (0.77)	1.38 (1.39)	-1.17 (-0.99)	1.13 (0.71)	0.94 (1.49)	0.71 (0.84)
Above60	-0.23 (1.06)	1.66 (1.28)	-1.52 (-0.93)	1.43 (0.55)	0.97 (1.58)	0.68 (0.68)

Legend

1.0 - Kandy
(1.0) - Colombo

Using those curves, the cumulative probability curves were plotted separately as shown in Figures 1 to 3. Z statistic showed that the start-up times in two cities are significantly different. The probability matrix created separately for the two cities can be used to find the probability of an individual to different start-up time ranges when the age, gender & group size of that pedestrian is known.

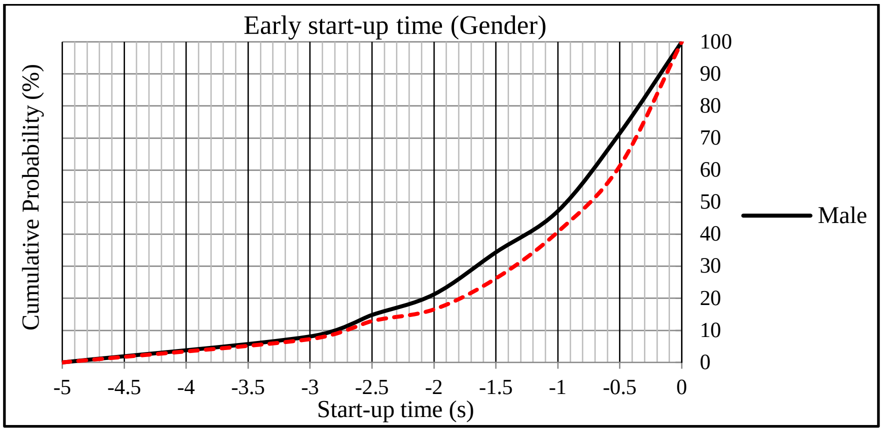

Figure 1: Cumulative probability variation for early start-up times of male & female pedestrians in Kandy

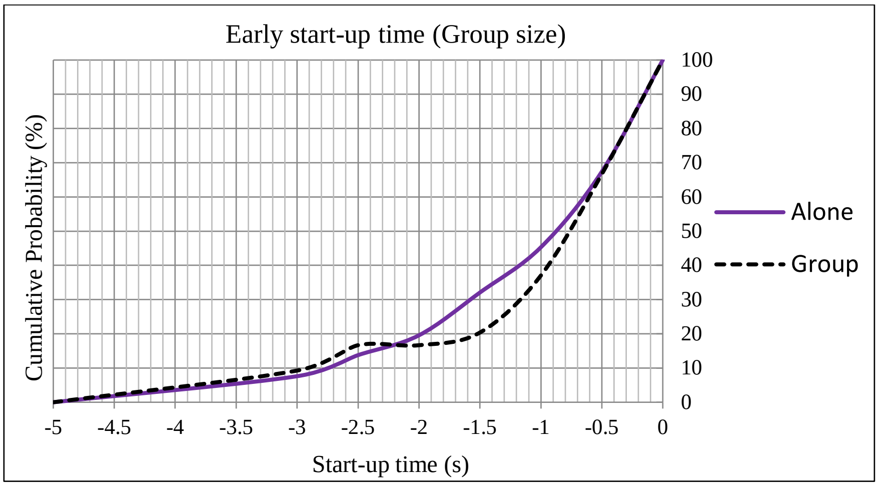

Figure 2: Cumulative probability variation for early start-up times according to group size in Kandy

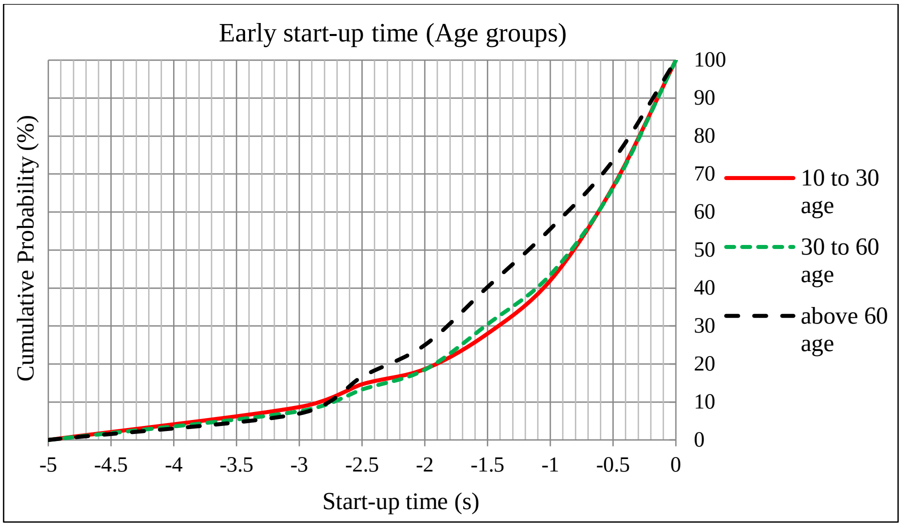

Figure 3: Cumulative probability variation for early start-up times according to age groups in Kandy

Table 2: Probability Matrix

Start-up time	Total	Male	Female	Alone	Group	10 to 30	30 to 60	Above 60
-4.1 to -5	1.58	1.10	0.48	1.3	0.27	0.69	0.75	0.14
-3.1 to -4	1.58 (0.15)	0.89 (0.15)	0.69 (0)	1.51 (0.15)	0.07 (0)	0.21 (0.15)	1.17 (0)	0.21 (0)
-2.1 to -3	4.8 (2.98)	3.16 (1.93)	1.65 (1.04)	4.46 (2.83)	0.34 (0.15)	1.1 (1.34)	2.81 (1.64)	0.89 (0)
-1.1 to -2	9.47 (7.89)	6.04 (5.36)	3.43 (2.53)	8.92 (6.99)	0.55 (0.89)	2.06 (2.98)	6.18 (4.17)	1.24 (0.74)
0 to -1	24.37 (19.64)	13.52 (11.9)	10.84 (7.74)	21.83 (16.67)	2.54 (2.98)	6.31 (8.33)	15.58 (10.42)	2.47 (0.89)
0.1 to 1	35.35 (25.45)	17.30 (17.11)	18.05 (8.33)	31.64 (21.73)	3.71 (3.72)	8.37 (10.57)	23.75 (13.10)	3.23 (1.79)
1.1 to 2	18.74 (28.87)	9.20 (20.24)	9.54 (8.63)	16.27 (23.51)	2.47 (5.36)	4.32 (9.85)	12.70 (16.07)	1.72 (2.98)
2.1 to 3	4.05 (11.90)	1.99 (8.48)	2.06 (3.42)	3.43 (9.67)	0.62 (2.23)	0.55 (3.72)	3.02 (6.99)	0.48 (1.19)
3.1 to 4	0.27 (3.12)	0.14 (2.08)	0.14 (10.40)	0.21 (3.12)	0.07 (0)	0 (0.45)	0.27 (2.38)	0 (0.03)

Legend
2.0 - Pedestrians are not familiar with the signal phase
(2.0) - Pedestrians are familiar with the signal phase

5. Conclusion

Pedestrians in Kandy have an early start-up when compared with pedestrians in Colombo. Therefore, pedestrians' familiarity to signal phases affect start-up times. Male pedestrians have early start-up times than female pedestrians. Pedestrians who are alone have early start-up times than pedestrians who cross in groups. Start-up times show different variations within different age groups. Therefore, consideration of start-up times of pedestrians is important to improve the safety of pedestrians.

6. References

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Keywords*: start-up time, early start-up, delayed start-up*