IMPACT OF PEDESTRIAN COUNTDOWN SIGNALS ON VEHICLE APPROACH SPEED FOR DRIVERS OF DIFFERENT AGE AT SIGNALIZED INTERSECTIONS

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Purpose of the Study

Problem Statement

Pedestrian countdown signals (PCSs) give cues to drivers about the length of the remaining green phase, where:

- ❑ Some drivers speed up to clear the intersection
- ❑ Others slow down to avoid running a red light

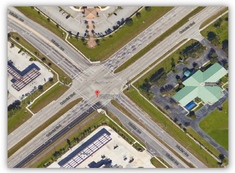
Objective

To evaluate the influence of PCSs on vehicle approach speed at signalized intersections as a function of driver age

FIGURE 1 Pedestrian countdown signal.

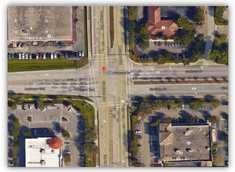
Study Area: Fort Myers, Florida

(a) Jamaica Bay Boulevard and S Tamiami Trail



(b) Colonial Boulevard and Winkler Road

(c) Gladiolus Drive and Winkler Road



(d) Gladiolus Drive and McGregor Boulevard

FIGURE 2 Study Sitemaps (Source: Google maps).

Field Data Collection Setup

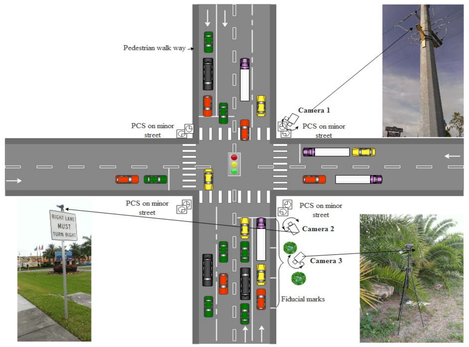


FIGURE 3 Field data collection setup.

Site Characteristics

TABLE 1 Lane configuration, posted speed limit, ADT, and PCSs cycle length at study sites

Site	Lane configuration	Posted speed limit on major street (mph)	ADT	PCS cycle length (seconds)
Jamaica Bay Boulevard and S Tamiami Trail	(1R + 3T + 1L); (1(R + T) +1L)	45	57,500	25
Colonial Boulevard and Winkler Road	(1R + 3T+1L); (1(R + T) + 1T+1L)	45	76,000;13,400	30
Gladiolus Drive and Winkler Road	(1R + 3T + 2L); (1(R + T) + 1T + 1L)	45	19,900; 12,700	25
Gladiolus Drive and McGregor Boulevard	(1R + 2T + 1L); 1(R + T) + 1T+ 2L)	45	25,500; 24,639	25

NOTE: R=Right, T=Through, and L= Left, ADT=Average Daily Traffic

Analysis Method

Welch-Satterthwaite 2-Sample t-Test (unequal variance)

It was used to compare the two speeds and determine whether they are statistically different at the 95% confidence interval.

Consider:

μ_{npcs}= population mean speed of vehicles when PCS timer is not operating

n_{npcs}= total number of vehicles crossing the intersection when PCS timer is not operating

1st presumption: Mean speed of vehicles when PCS timer is operating is higher than when PCS timer is off

$$H_o: \mu_{pcs} - \mu_{npcs} = 0$$
$$H_a: \mu_{pcs} - \mu_{npcs} > 0$$

2nd presumption: Older drivers generally exercise lower mean speed than young drivers

$$H_o: \mu_{older\ drivers} - \mu_{young\ drivers} = 0$$
$$H_a: \mu_{older\ drivers} - \mu_{young\ drivers} < 0$$

Results & Discussion

TABLE 2 Vehicle Mean Speed: Pedestrian Countdown Timer On Versus Off

Location	Mean speed (mph) PCSs	NPCSs	Difference in mean speed	P-value	Null Hypothesis
Vehicle crossing the intersection during 20 seconds after onset of green phase					
Jamaica Bay and S Tamiami trail (NB)	24.61(526)	22.30(237)	2.31	<0.0001	Reject
Jamaica Bay and S Tamiami trail (SB)	22.73 (768)	20.28(202)	2.45	<0.0001	Reject
Colonial Boulevard and Winkler (EB)	32.72(406)	31.35(86)	1.37	0.103	Do not reject
Colonial Boulevard and Winkler (WB)	21.26(481)	19.60(50)	1.66	0.012	Reject
Gladiolus Drive and Winkler avenue(WB)	26.11(752)	24.00(324)	2.11	0.001	Reject
Gladiolus Drive and McGregor Boulevard (EB)	26.29(218)	25.20(163)	1.09	0.026	Reject
Vehicle crossing the intersection during the last 10 seconds of green phase					
Jamaica Bay and S Tamiami Trail (SB)	32.42(24)	30.48(66)	1.94	0.082	Do not reject
Colonial boulevard and Winkler (EB)	43.60(15)	37.81(497)	5.79	0.002	Reject
Colonial boulevard and Winkler (WB)	45.80(10)	42.51(260)	3.29	0.008	Reject
Gladiolus drive and Winkler avenue(WB)	36.40(15)	35.12(137)	1.28	0.657	Do not reject
Gladiolus Drive and McGregor Boulevard (WB)	30.38(68)	27.45(11)	2.93	0.025	Reject

NOTE: Values in parentheses are number of vehicles, PCSs= Pedestrian countdown signal is operating at pedestrian clearance interval, NPCSs= pedestrian countdown signal is off, *P*-Value= Significant probability, NB= Northbound, SB= southbound, EB= eastbound, WB= Westbound.

- ❑ The mean speeds for the first 20 seconds after the onset of green phase were observed to be lower than the speed limit for each intersection- start-up lost time delays, table 2
- ❑ The mean speeds for the last 10 seconds of the green phase prior to its termination were observed to be higher than the mean speeds of the first 20 seconds of green, table 2
- ❑ The mean speeds when the PCS timer is counting down were higher compared to mean speeds when the PCS timer was off

TABLE 3 Vehicle Mean Speed: Older Drivers (65+) versus Young Drivers

Location	Mean speed (mph) Older drivers	Younger drivers	Difference in mean speed	P-value	Null Hypothesis
Vehicle crossing the intersection during 20 seconds after to onset of green phase -PCSs					
Jamaica Bay and S Tamiami Trail(SB)	20.23(31)	23.19(272)	-2.96	0.024	Reject
Colonial boulevard and Winkler Road(WB)	23.00(49)	25.27(246)	-2.27	0.047	Reject
Colonial Boulevard and Winkler Road(EB)	31.32(17)	32.48(348)	-1.36	0.286	Do not reject
Gladiolus Drive and Winkler(WB)	23.20(95)	25.06(747)	-1.84	0.047	Reject
Vehicle crossing the intersection during 20 seconds after to onset of green phase -NPCSs					
Jamaica Bay and S Tamiami Trail(SB)	21.21(14)	23.24(78)	-2.03	0.186	Do not reject
Gladiolus drive and Winkler Road(WB)	23.00(34)	26.90(221)	-3.83	0.030	Reject
Gladiolus Drive and McGregor Boulevard(WB)	23.2(10)	28.21(110)	-2.61	0.048	Reject
Vehicle crossing the intersection during the last 10 seconds of green phase -NPCSs					
Jamaica Bay and S Tamiami Trail(SB)	32.50(18)	36.59(59)	-4.09	0.039	Reject
Colonial boulevard and Winkler Road(EB)	32.72(25)	35.72(139)	-3.00	0.029	Reject
Gladiolus drive and Winkler Road(WB)	36.00(15)	37.52(128)	-1.52	0.318	Do not reject

NOTE: PCSs= Pedestrian countdown signal is operating at pedestrian clearance interval, NPCSs= pedestrian countdown signal is off.

- ❑ Older drivers have lower intersection approach speeds both when the PCSs are operating and when they are off
- ❑ Fewer number of older drivers were observed to cross the intersections during the last 10 seconds of the green phase as the pedestrian clearance interval approached zero
- ❑ The difference in mean speed between older and younger drivers when the PCS timer is off was observed to be much higher than the difference when PCS timer is counting down

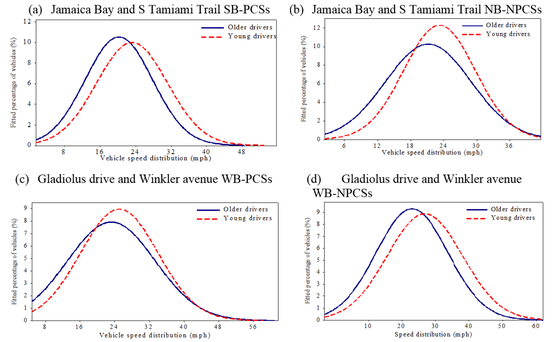


FIGURE 3 Speed distributions for older drivers compared with younger drivers during the first 20 seconds of green phase.

Conclusions & Recommendations

Conclusions

This study presents the evaluation of the impact of PCS on vehicle approach speeds Vehicle speeds were observed as they cross the stop bar, where the driver's age was identified as old or young

- ❑ The mean vehicle speed was higher when PCS timer was operating than when the PCS timer was off
- ❑ The mean speed during the last 10 seconds of green phase was higher than the mean speed during the first 20 seconds of green phase
- ❑ The number of older drivers who cleared the intersection when the PCS timer was approaching zero were lower compared to the number of older drivers who crossed the intersection when the PCS timer was off
- ❑ Information offered by PCSs improve the decision making of drivers on whether to speed up to clear the intersection, or to slow down and decelerate safely
- ❑ They also improve the intersection operation capacity

Recommendations

- ❑ Plans are underway to evaluate the effect of different categories of PCSs on drivers approach speed at intersection i.e. rest in walk PCS versus the ones that end before termination of the green phase, push buttons PCS versus automatic call PCS
- ❑ Future research could include investigating the influence of PCSs on dilemma zone