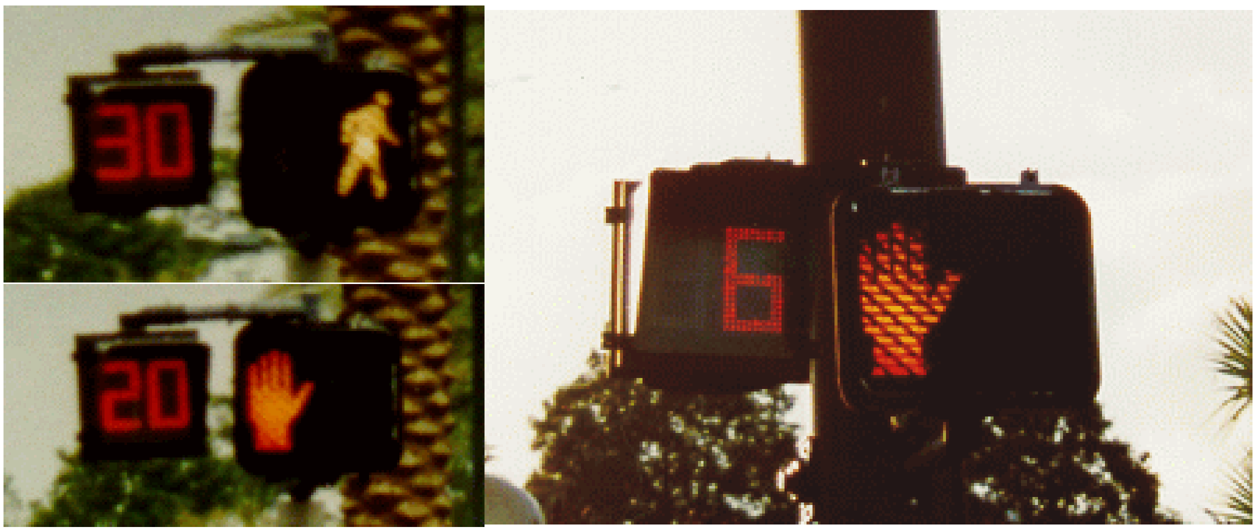
The Effects of Pedestrian Countdown Signals in Lake Buena Vista



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ABSTRACT

A countdown signal displays the number of seconds left until the steady Don't Walk phase appears and opposing traffic receives a green light. A pedestrian who has just arrived in the queuing area can use this information to decide whether to start crossing. A person who is in the crosswalk when the flashing Don't Walk interval appears can see the number of seconds remaining before the cross traffic gets a green light. This may reduce the likelihood that a person is still in the intersection when the light changes.

The objective of this study was to evaluate the effects of countdown signals at intersections in Lake Buena Vista, Florida. A "treatment" and "control" study design was used: countdown signals at two intersections were matched with three control intersections that were similar but did not have countdown signals. The countdown signals were evaluated according to three measures of effectiveness:

1. Pedestrian compliance with the Walk signal
2. Pedestrians who ran out of time
3. Pedestrians who started running when the flashing Don't Walk signal appeared

The countdown signals had the positive effect (compared to sites without countdown signals) of reducing the number of pedestrians who started running when the flashing Don't Walk signal appeared. They had the undesired effect of reducing compliance with the Walk signal. There was no effect on the number of persons who ran out of time while crossing.

It is recommended that countdown signals be tested at other locations. The use of countdown signals should be accompanied by public educational campaigns that explain what these devices are and how pedestrians can benefit from them.

Key words: Pedestrian, signal, countdown, crossing, compliance.

INTRODUCTION

Pedestrian signals display the messages Walk (or a walking person), flashing Don't Walk (or a flashing hand), and steady Don't Walk (or a steady hand) in conjunction with vehicle signals. The Walk signal indicates that pedestrians may cross the street in the direction of the signal. The flashing Don't Walk signal means that pedestrians should not start crossing, but pedestrians already in the street should have enough time to finish crossing. The steady Don't Walk phase means that pedestrians should not be in the street.

It is well-documented that many pedestrians do not understand the meaning of the pedestrian signal indications, particularly the flashing Don't Walk. In fact, Robertson *et al.* (1984) found that only about half of pedestrians understand the meaning of the flashing Don't Walk display. Many pedestrians expect to see the Walk signal for their entire crossing. Upon seeing the flashing Don't Walk, some pedestrians believe that they will not have enough time to reach the opposite side of the street. Others may return to the starting side, and a few may even stop in the middle of the street. (Zegeer, 1986)

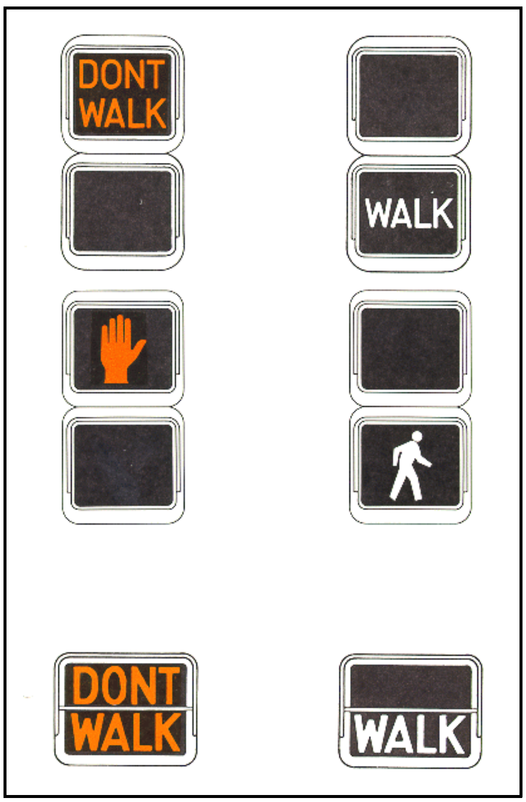

Figure 1. Standard pedestrian signal indications.

A pedestrian countdown signal contains a timer display that counts down and shows the number of seconds left to finish crossing the street. This device is intended to aid pedestrians in getting out of the street before they would be exposed to the danger of oncoming motor vehicles. A countdown signal can reassure a pedestrian who is in the crosswalk when the flashing Don't Walk phase appears that he or she still has time to finish crossing and does not need to panic, run to the opposite side, return to the starting side, or stop in the middle of the street. A countdown pedestrian signal is shown in Figure 2.

The use of a countdown pedestrian signal has several potential outcomes. The possible <u>positive</u> outcomes of the countdown signal (in terms of perhaps reducing crash risk) include:

- A pedestrian already in the street during the flashing Don't Walk (clearance interval) will see the countdown timer and take action such as walking faster if necessary to reach the other side of the street safely, before the timer counts down to zero (and cross traffic gets the green light).

- A pedestrian who arrives at the curb during the flashing Don't Walk and observes that the countdown shows only a few seconds may decide that there is not enough time to cross to the other side of the street and thus may wait until the beginning of the next Walk interval. The time available to cross a street is even more important when crossing wide streets, especially those with high traffic speed and volumes.

In the broader perspective, some traffic engineers may decide to use the countdown signal in the hope that it would not only improve pedestrian safety (*i.e.*, by reducing the number of pedestrians stranded in the street when cross traffic gets a green light), but also improve traffic flow on the cross street as a result.

The possible <u>negative</u> outcomes of the countdown signal (*i.e.*, increasing the risk of a pedestrian crash) include:

- A pedestrian arrives at the curb while the flashing Don't Walk is displayed along with the number of seconds remaining. The pedestrian mistakenly assumes that the time displayed on the countdown device is sufficient to cross the street. He or she begins crossing the street and is in the middle of the street when crossing traffic gets a green light. The pedestrian is at risk of being struck.

- A motorist stopped at an intersection on a red signal phase is waiting for the green light. The driver can clearly see the device counting down and uses it as a "starting gun" to step on the accelerator as soon as the countdown displays zero seconds, even before he or she gets the green light. A pedestrian who is still in the process of crossing the street may be struck by this motorist.

Figure 2. Countdown signal in Sacramento County, California.

(Top)	No time display appears during the Walk interval.
(Middle)	The timer counts down through the flashing Don't Walk interval.
(Bottom)	After the timer reaches zero, the time display disappears.

Countdown signals were installed at several intersections in Sacramento County, California, in 1997 and 1998. Huang and Zegeer (1999) found that those countdown signals reduced pedestrian compliance with the Walk phase. Another adverse effect was that the countdowns increased the number of people who finished crossing after the steady Don't Walk display appeared. The countdowns did not affect whether pedestrians ran or hesitated while crossing.

This report evaluates countdown signals at two intersections in Lake Buena Vista, Florida. This study focused on determining the positive and negative effects of these devices on pedestrian behavior.

DATA COLLECTION

A treatment-and-control study design was used. Data were collected at two signalized intersections (one crosswalk at each) with countdown pedestrian signals (the "treatment" sites). Each intersection was matched with one or two nearby "control" intersections which had conventional pedestrian signals (Table 1). Data collection took place on various days between May and November 1999, during daylight hours and under dry conditions.

Table 1. Intersections where data were collected.

INTERSECTION	T/C	HOURS OF DATA COLLECTION	NUMBER OF PEDESTRIANS
State Route 535 at Hotel Plaza Blvd., north crossing	T	6 h 00 min	232
County Route 535 at Vinings Way Blvd., north crossing	C	6 h 00 min	32
State Route 535 at Palm Parkway, north crossing	C	16 h 00 min	250
Buena Vista Drive at entrance to Team Disney, east crossing	T	4 h 00 min	136
Buena Vista Drive at entrance to Disney Casting Center, east crossing	C	3 h 45 min	26

T = Treatment site, with a countdown signal
C = Control site

A video camera was used to record data at all locations. The video camera was placed on a tripod and set up on the sidewalk along the side street, approximately 23 m (75 ft) upstream from the intersecting main road. The camera faced in the same direction as traffic on that half of the side street. This position enabled the camera to record, on videotape, pedestrians in the crosswalk as they were crossing the main road, and those waiting in the queuing areas on either side of the main road. The camera also recorded signal phases for parallel traffic on the side street and pedestrian phases for pedestrians crossing the main road.

The countdown signals were evaluated according to three measures of effectiveness (MOE’s):

1. Pedestrian compliance with the Walk signal
2. Pedestrians who ran out of time when crossing the street
3. Pedestrians who started running when the flashing Don’t Walk signal appeared

It should be noted that the sample sizes vary for each MOE, because: (1) some MOE’s pertain to only a subset of the total number of pedestrians; and (2) some pedestrians were not clearly videotaped.

SITE DESCRIPTIONS

At all of the intersections used in this study, pedestrian signals with conventional push buttons control the crosswalks of interest. The Walk signal will not appear unless the button is pushed. Descriptions of the two treatment and three control sites are given below.

State Route 535 at Hotel Plaza Boulevard (existing countdown pedestrian signal)

State Route 535 is a bustling north-south commercial strip with many hotels, restaurants, and souvenir shops (Figures 3 and 4). The east leg of Hotel Plaza Boulevard is the entrance to a shopping plaza. The west leg of Hotel Plaza Boulevard is one of the entrances to Walt Disney World™. State Route 535 has three lanes of through traffic and a right-turn lane in each direction. There is one left-turn lane for southbound traffic and two left-turn lanes for northbound traffic. Northbound and southbound traffic are separated by a raised grass median. The ADT is 68,300 vehicles per day and the speed limit is 64 km / h (40 mi / h).

The northside crosswalk is equipped with a countdown signal. It starts at 37 seconds, when the Walk first appears. At 25 seconds, the flashing Don’t Walk appears. At 0 seconds, the steady Don’t Walk appears and the timer display disappears.

There was steady pedestrian activity during the data collection periods. Most pedestrians crossed in groups. Because of heavy traffic along State Route 535, someone in most groups pushed the button, and people usually waited for the Walk phase.

Figure 3. State Route 535 at Hotel Plaza Boulevard (countdown signal site).

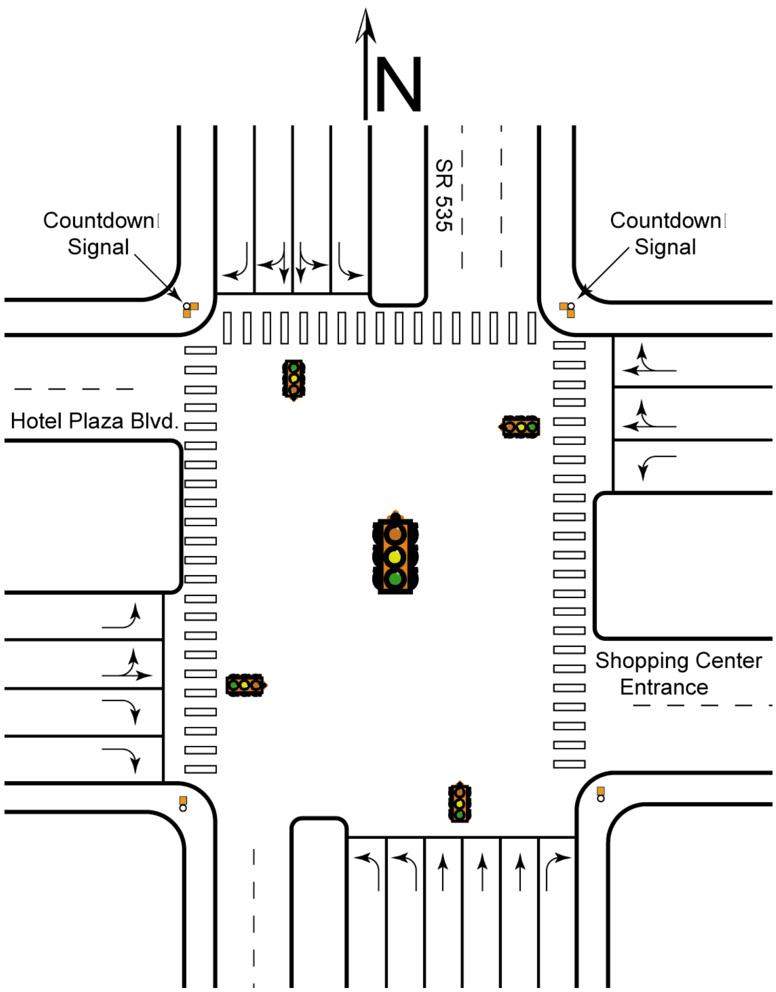

Figure 4. SR 535 at Hotel Plaza Boulevard.

<u>County Route 535 at Vinings Way Drive</u> (control site #1 for State Route 535 at Hotel Plaza Boulevard)

This T-intersection is two traffic lights, about 0.8 km (0.5 mile) north of its matching treatment site (State Route 535 at Hotel Plaza Boulevard) (Figure 5). The east leg is the entrance to a shopping plaza. County Route 535 has two lanes of through traffic and a left-turn lane in each direction, and a raised grass median. The ADT is 47,200 vehicles per day and the speed limit is 64 km / h (40 mi / h). Compared to State Route 535 at Hotel Plaza Blvd., pedestrian activity was more sporadic here. The area north of this intersection is largely undeveloped.

Figure 5. County Route 535 at Vinings Way (control site #1).

Figure 6. State Route 535 at Palm Parkway (control site #2).

<u>State Route 535 at Palm Parkway</u> (control site #2 for State Route 535 at Hotel Plaza Boulevard)

Because of low pedestrian activity at Vinings Way Drive, a second control site for Hotel Plaza Boulevard was added to the study. This site is about halfway in-between Hotel Plaza Boulevard and Vinings Way Drive. State Route 535 approaches this intersection from the south and turns to the west. It has two lanes of through traffic and a left-turn lane in each direction, and a raised grass median (Figure 6). The ADT is 47,200 vehicles per day and the speed limit is 64 km / h (40 mi / h). To the north of the intersection, the road is known as County Route 535 and has a similar cross-section as State Route 535 to the south. Palm Parkway approaches from the east. It has two lanes of through traffic in each direction, left- and right-turn lanes for westbound traffic, and a raised median. There are hotels, restaurants, and souvenir shops here. More pedestrian activity was observed here than at County Route 535 and Vinings Way Drive.

Buena Vista Drive at entrance to Team Disney, east leg (existing countdown pedestrian signal)

Buena Vista Drive is an east-west roadway with a raised grass median (Figures 7 and 8). There are three through lanes and a left-turn lane in each direction. The ADT is 30,500 vehicles per day and the speed limit is 56 km / h (35 mi / h). The north side of Buena Vista Drive is occupied by Downtown Disney, which is a shopping, restaurant, and entertainment complex. Team Disney, which houses Walt Disney Company offices, is on the south side.

Figure 7. Buena Vista Drive at Team Disney (countdown signal site).

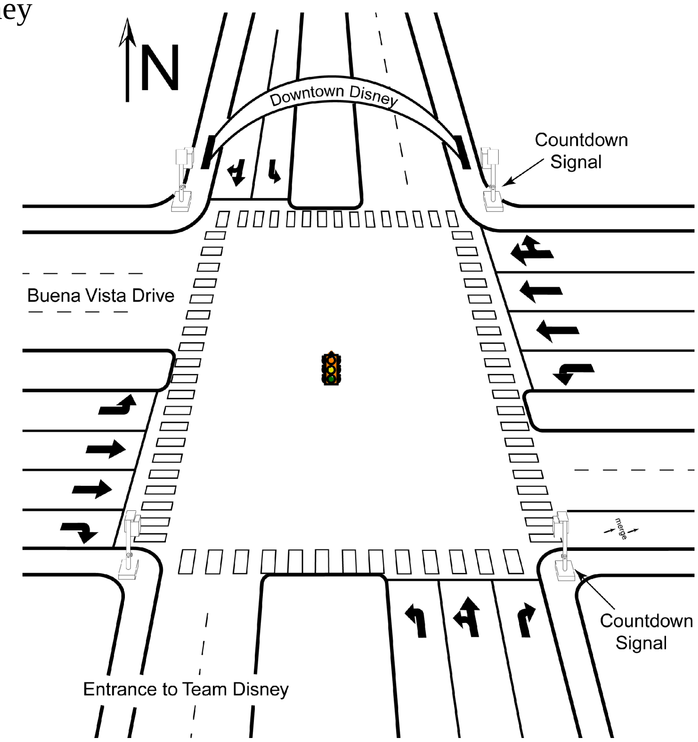

Figure 8. Buena Vista Drive at entrance to Team Disney.

<u>Buena Vista Drive at entrance to Disney Casting Center, east leg</u> (control site for Buena Vista Drive / Team Disney)

This location is one traffic light (about 1/4 mile) east of its corresponding treatment site (Buena Vista Drive at entrance to Team Disney). Buena Vista Drive is an east-west roadway with a raised grass median (Figure 9). There are three through lanes and a left-turn lane in each direction. The ADT is 30,500 vehicles per day and the speed limit is 56 km / h (35 mi / h). Downtown Disney is on the north side of Buena Vista Drive. The Disney Casting Center serves as the Walt Disney World™ employment office, and is on the south side.

Figure 9. Buena Vista Drive at Disney Casting Center (control site).

RESULTS

For analysis purposes, the two countdown signal sites were combined and the three control sites were combined.

Pedestrian Compliance with the Walk Signal

A pedestrian complied with the Walk signal if he or she started crossing during the Walk interval. Pedestrians who crossed during the flashing or steady Don't Walk for any reason (such as impatience, arriving late, or not pushing the button and not getting a Walk) were not in compliance with the Walk signal.

With countdown pedestrian signals, pedestrians who arrive at the curb just as the flashing

Don't Walk appears will see that they still have as much as 20-25 seconds left to cross. Some may decide to "go for it" instead of pushing the button and waiting for the next Walk interval. Thus, it was hypothesized that countdown signals might have the *undesirable* effect of reducing compliance with the Walk signal.

The chi-square statistic was used to compare the levels of compliance at the countdown signal locations and the control sites. Figure 10 and Table 2 show that pedestrians were less

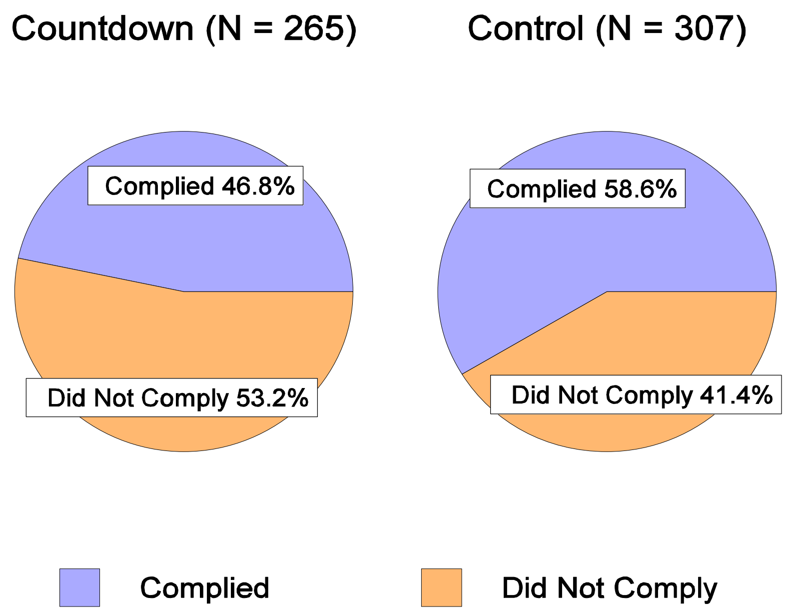

Figure 10. Pedestrians who complied with the Walk signal.

likely to comply at the countdown signal locations than at the control sites. This difference was significant at the 0.005 level. The findings support the hypothesis.

Table 2. Pedestrians Who Complied with the Walk Phase

	Countdown	Control
Complied	124 (46.8%)	180 (58.6%)
Did Not Comply	141 (53.2%)	127 (41.4%)

chi-square statistic = 8.006302
p-value, with one degree of freedom = 0.004662 SIGNIFICANT

Pedestrians Who Ran Out of Time

Pedestrians who start crossing on a Walk or flashing Don't Walk signal and who are still in the crosswalk when the steady Don't Walk signal is displayed and parallel traffic has the red signal have one to two seconds of an all-red interval before cross traffic gets the green signal. For the purposes of this analysis, such pedestrians were considered to have run out of time. It was hypothesized that countdown signals might have the *desirable* result of fewer pedestrians remaining in the intersection after the steady Don't Walk appears, since they will know how much time they have and will presumably attempt to finish crossing before "time runs out."

Some people started and finished on a steady Don't Walk either because: (1) no one pushed the button and the Walk signal never came on, or (2) they started and finished while opposing traffic had the green. These people were not included in this analysis.

The chi-square statistic was used to compare the number of pedestrians who finished crossing after time ran out at the countdown signal locations and the corresponding control locations. Figure 11 and Table 3 show the number of pedestrians (total of all three study locations) who ran out of time (*i.e.*, started crossing on a Walk or flashing Don't Walk and finished crossing during the steady Don't Walk). A slightly smaller percentage of people ran out of time at the control sites than at the countdown sites, but the difference was not statistically significant.

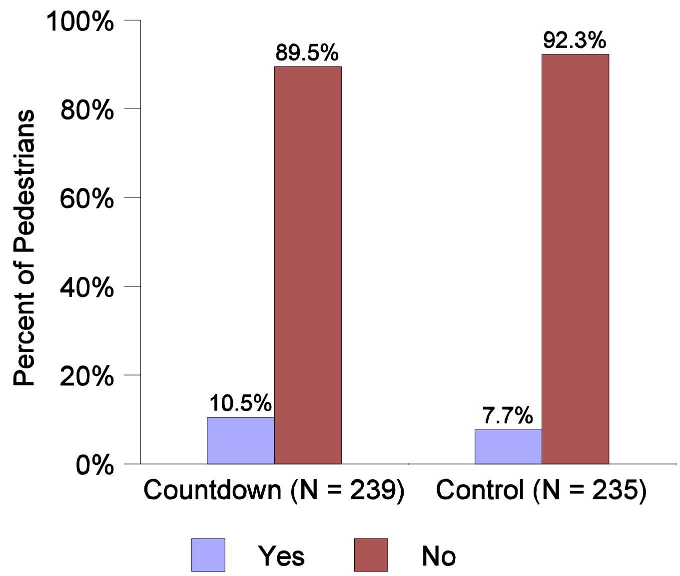

Figure 11. Pedestrians who ran out of time.

Table 3. Pedestrians Who Were Crossing When the Steady Don't Walk Was Displayed

	Countdown	Control
Yes	25 (10.5%)	18 (7.7%)
No	214 (89.5%)	217 (92.3%)

chi-square statistic = 1.126717
p-value, with one degree of freedom = 0.288477 NOT SIGNIFICANT

Pedestrians Who Started Running When the Flashing Don't Walk Display Appeared

It was thought that the effects of countdown signals on pedestrian crossing behavior are likely to be mixed. On the one hand, the timer display may reassure crossing pedestrians that they still have time to finish crossing, even when the flashing Don't Walk is being displayed. On the other hand, more pedestrians may decide to "run for it" when they arrive on flashing Don't Walk if they see how many seconds are left. In this study, it was hypothesized that countdown signals would have the *desirable* effect of *less* running when the flashing Don't Walk display first appears.

About three percent of those crossing at the treatment sites and ten percent of those crossing at the control sites started running when the flashing Don't Walk signal appeared (Figure 12 and Table 4). This difference was significant, with a p-value of 0.011. This finding suggests that pedestrians are paying attention to the countdown timer display and are not being confused as to the meaning of the countdown signal.

Table 4. Pedestrians Who Started Running When the Flashing Don't Walk Appeared

	Treatment	Control
Yes	10 (3.4%)	25 (10.4%)
No	203 (96.6%)	221 (89.6%)

chi-square statistic = 6.405311
p-value, with one degree of freedom = 0.011378 SIGNIFICANT

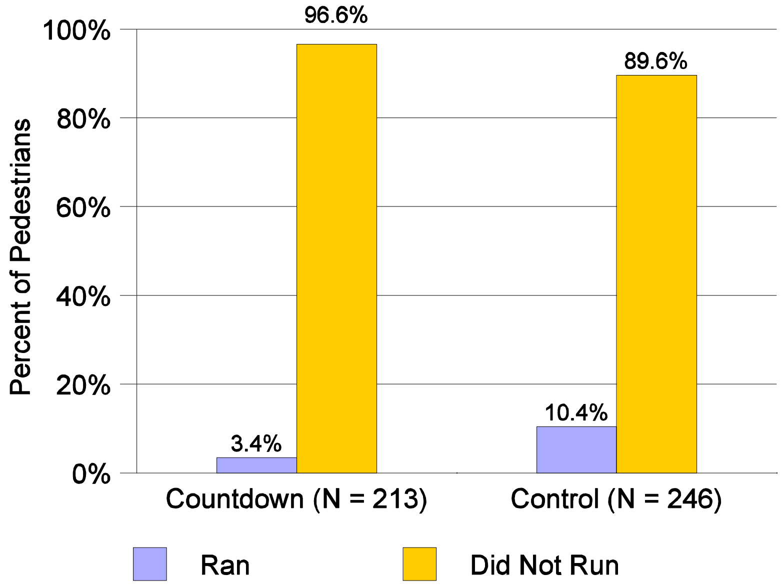

Figure 12. Pedestrians who started running when the flashing Don't Walk display appeared.

CONCLUSIONS AND RECOMMENDATIONS

This study involved the before-and-after evaluation of countdown signals on pedestrian behavior. Two crosswalks at two intersections in Lake Buena Vista, Florida, were used for test purposes. Three nearby crosswalks without countdown signals (*i.e.*, the control sites) were used for comparison purposes. The key findings and authors' discussion are given below.

1. The countdown signals had both positive and negative effects on pedestrian behavior at the treatment sites, compared to the matched control sites.

Table 5 summarizes the effects of countdown signals by each MOE. For example, the countdown signals had a desirable effect on pedestrian running (*i.e.*, less running) when the flashing Don't Walk signal appeared. Because relatively few people arrived at the curb during the flashing Don't Walk interval, no conclusions can be drawn as to whether they were more or less likely to push the button and wait for the next Walk signal.

Table 5. The effects of countdown signals by MOE.

MOE	EFFECT
COMPLIANCE WITH WALK SIGNAL	U
RAN OUT OF TIME	N
STARTED RUNNING WHEN FLASHING DON'T WALK SIGNAL APPEARED	**T**

T Had desirable effect, significant at the 0.10 level.
U Had undesirable effect, significant at the 0.10 level.
N No effect.

A potential drawback of a countdown signal is that some pedestrians who would otherwise wait for the next Walk signal may be encouraged to start crossing on the flashing Don't Walk, with insufficient crossing time. This, of course, can result in more persons being stranded in the street when cross-traffic gets the green light. Although the countdown signals were found to reduce compliance with the Walk signal (an undesirable effect), the countdowns did not appear to have had an effect on the number of pedestrians who ran out of time. This clearly may be the result of some pedestrians leaving during the flashing Don't Walk but walking fast to complete their crossing before the steady Don't Walk is displayed.

2. Based on these results and those of other studies, countdown signals are *not* recommended for use at standard intersections in Florida.

Countdown signals may result in more pedestrian signal violations among some age groups. For example, teenage and young adult males (such as near high schools and universities) may try to "beat the light" after seeing that they still have several seconds to cross. Countdowns may be more promising at intersections that are frequented by an older adult population, by virtue of the added information about the time available for crossing.

3. The countdown pedestrian signals should be tested at other signalized intersections.

The present study was a behavioral evaluation of countdown pedestrian signals using two treatment sites and three control sites. Ideally, data would have been collected using a before-and-after approach, at a larger number of locations. Countdown signals should be tested in other cities, especially those with multiple countdown signal installations. With a before-and-after study, it is more likely that any effects on pedestrian and motorist behavior are in fact the result of the treatment alone, and not from differences between sites. However, a before-and-after study requires that the data collection be coordinated with local agencies' installation schedules. This was not possible within the time frame of this study, so a treatment-and-control study was conducted as the next best option. Of course, conducting a crash-based analysis of a countdown signal would require hundreds or thousands of test sites in order to have an adequate sample of pedestrian crashes.

4. Instead of pedestrian countdown signals, there may be more effective alternatives to improve pedestrian safety and service at signalized intersections.

A number of alternative devices and treatments are available to the traffic engineer to improve conditions for pedestrians at signalized intersections. These may be more effective alternatives than pedestrian countdown signals in achieving more desirable pedestrian and / or motorist behavior.

<u>Pedestrian signalization alternatives</u>

- **Longer Walk and clearance intervals:**
  At wide intersections, pedestrian crossing times often dictate green splits and cycle lengths. As a result, *minimum* Walk and flashing Don't Walk times are too often used. The *Manual on Uniform Traffic Control Devices* recommends a minimum Walk interval of 4 to 7 seconds (MUTCD, 1988). With such a short interval, pedestrians may only get one or two lanes across the street before the flashing Don't Walk appears and they may get confused or even panic (because they do not understand the meaning of the flashing Don't Walk). It is desirable to provide a longer Walk interval whenever practical. Also, the timing of clearance (*i.e.*, flashing Don't Walk) intervals to assume slower walking speeds (*e.g.*, 0.9 or 1.1 m / sec (3 or 3.5 ft / sec) instead of 1.2 m / sec (4 ft / sec)) may also be appropriate, particularly at locations with older pedestrians which cross the street regularly.

- **Exclusive pedestrian signal phasing at downtown intersections:**
  Most pedestrian signals use standard (or concurrent) timing, in which the Walk signal is displayed at the same time with the green light for parallel traffic. Under such a timing scheme, right- and left-turning motor vehicles may conflict with pedestrians crossing on the Walk signal (and many motorists will not yield to pedestrians when making turns at such intersections).

  Two alternatives are exclusive timing and scramble (or Barnes dance) timing. With exclusive timing, all vehicular traffic is stopped and pedestrians are allowed to cross in any crosswalk: the Walk interval is displayed for all crosswalks at the same time, while all motorists have a red traffic signal. Exclusive timing has been associated with approximately a fifty percent reduction in motor vehicle - pedestrian crashes as compared to standard timing (Zegeer *et al.*, 1985). With scramble timing, all vehicular traffic is stopped and pedestrians are allowed to cross in any crosswalk or diagonally across the intersection (Figure 13). These exclusive timing schemes are most appropriate in downtown signalized intersections with high pedestrian volumes (1,200 or more per day), and relatively low vehicle speeds and volumes. Such timing schemes will typically increase vehicle and pedestrian delay, since longer signal cycles are required, and it may

Figure 13. With scramble timing, pedestrians are allowed to cross in any direction, including diagonally.

be difficult to synchronize adjacent signals. Exclusive timing plans are generally impractical outside of downtown areas.

Reducing pedestrian crashes involving through vehicles

C **Refuge Islands:**
Refuge islands are areas within an intersection or between lanes of traffic where pedestrians may safely wait if they are unable to cross the entire street within the allotted time. A refuge island at a signalized intersection can provide a place for slower pedestrians to safely stop and wait for the next cycle to finish crossing.

C **Medians:**
Streets with raised medians experienced lower pedestrian crash rates compared to streets with painted two-way left turn lanes or undivided streets (Bowman and Vecellio, 1994).

A refuge island or median island should be a minimum of 1.2 m (4 ft) (and preferably 1.8 m, or 6 ft) wide, and at least 3.7 m (12 ft) long or the width of the crosswalk, whichever is greater. Cut-through ramps at pavement level or curb ramps are needed to accommodate wheelchair users. More information about medians and refuge island design can be found in the Institute of Transportation Engineers' *Design and Safety of Pedestrian Facilities* (1998).

C **Automated pedestrian detection:**
Infrared, microwave, or video detection devices can be installed to automatically detect pedestrians waiting at the curb and activate the pedestrian phases (Figure 14). The devices can be set up so that if the pedestrian starts crossing before the WALK phase, the "call" for the pedestrian phase will be canceled, thereby reducing delay to cross traffic.

These devices can also detect persons in the crosswalk and extend the clearance interval if necessary so that pedestrians will have time to finish crossing.

Automated pedestrian detectors were evaluated in Los Angeles, CA (infrared and microwave), Phoenix, AZ (microwave), and Rochester, NY (microwave) (Hughes *et al.*, 1999). The results indicated that the use of automated detection devices in conjunction with the standard pedestrian push-button resulted in a significant reduction in vehicle-pedestrian conflicts as well as a reduction in the number of pedestrians beginning to cross during the steady Don't Walk phase. Detailed field testing of the microwave equipment

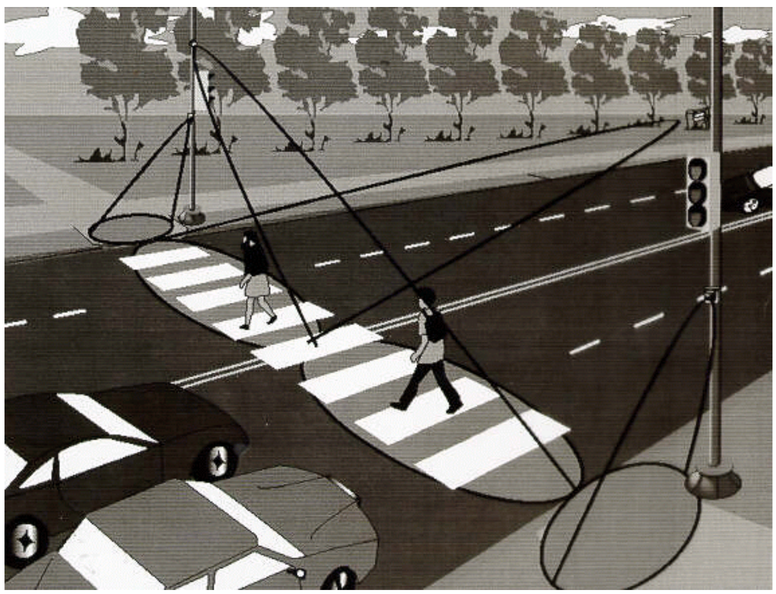

Figure 14. An automated pedestrian detection system.

in Phoenix revealed that fine tuning of the detection zone is still needed to reduce some false calls and missed calls (Hughes *et al.*, 1999).

Education and enforcement

Education and enforcement can help improve conditions for pedestrians. Table 2 and Figure 10 show that 47 percent of pedestrians at the countdown sites, and 58 percent of those at the control sites, complied with the Walk phase. In other words, 53 and 42 percent, respectively, did not comply. Some of those who started crossing on a flashing Don't Walk were still in the street when the countdown timer reached zero. This finding highlights the need to educate pedestrians as to what the signals mean and when it is appropriate to cross the street. For instance, an informational sign could explain what pedestrians should do during the Walk, flashing Don't Walk, and steady Don't Walk signal intervals (Figure 15).

Figure 15. A sign that explains the meaning of the pedestrian signal displays.

Driver education programs should deal effectively with driver responsibility to yield to pedestrians when turning at intersections and other situations where motorists should yield the right-of-way to pedestrians, driving slowly in pedestrian areas, etc. Better enforcement of driver compliance to traffic signals (perhaps using red light cameras) may also be effective in improving pedestrian safety at signalized intersections.

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