R0043

# An Evaluation of Flashing Crosswalks in Gainesville and Lakeland


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**for**

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## INTRODUCTION

Crossing streets at uncontrolled midblock locations can pose a serious risk to pedestrians, accounting for as many as 26 percent of all crashes according to a review of crash data from six states (Hunter *et al.*, 1996). An older study performed for the National Highway Traffic Safety Administration found that 39 percent of pedestrian-motor vehicle crashes in urban areas were midblock (Knoblauch, 1975).

When vehicle volumes and speeds are high, few adequate gaps may exist for pedestrians to cross the street safely. Driver expectancy for pedestrians crossing at mid block sites may be low. In addition, the driver may physically not see the pedestrian because the pedestrian is obscured by parked vehicles along the curb or by a vehicle in the curb lane that has stopped to allow the pedestrian to cross.

Local agencies may paint crosswalks at midblock locations based on average daily traffic, pedestrian volumes, and other warrants. However, even if a crosswalk has been painted across the roadway, the driver may not notice the crosswalk, particularly if the markings are faded or if no pedestrian warning signs are in place. Furthermore, crosswalks and pedestrians can be extremely difficult to see at night.

To enhance visibility at midblock crosswalks, cities may use high-visibility (continental) crosswalk markings, or they may install supplementary signs and devices. For example, Clearwater, Florida, uses an internally-illuminated overhead sign (Figure 1). Portland, Oregon, and several cities in New York State are experimenting with a ÅYIELD TO PEDESTRIANS@ sign that is mounted on a traffic cone placed at the crosswalk, on the centerline of the roadway (Figure 2).

Tucson, Arizona, has several pedestrian-activated overhead LED signs (STOP FOR PEDESTRIANS IN CROSSWALK) (Figure 3). Some of these are being replaced by pedestrian-activated Afire truck@ signals that first display a flashing amber signal that warns drivers to be prepared to stop. This is followed immediately by an alternating red signal requiring that drivers stop. Toronto, Ontario, Canada has hundreds of internally-illuminated overhead signs and beacons that flash when activated, as illustrated in Figure 4.

In Florida, the cities of Gainesville, Lakeland, and Orlando are using flashing crosswalks at one or more locations. These consist of lights embedded in the roadway on both sides of the crosswalk. Upon activation by a pedestrian, the lights flash at oncoming motorists, thereby alerting them to one or more pedestrians in the crosswalk. Two companies that manufacture flashing crosswalks are Flight Light, Inc. (based in Sacramento, California) and LightGuardJ

Systems, Inc. (based in Santa Rosa, California).

It should be pointed out that pedestrian-activated flashers conceptually have a clear advantage over continuous flashers in that the information conveyed by pedestrian-activated

flashers to motorists is in Areal time.@ That is, the flashing lights are associated with the presence of pedestrians waiting to cross, as opposed to simply flashing all the time. A continuously flashing device can become part of the background visual clutter that confronts motorists and may lose its effectiveness as motorists tune it out.

Overhead flashers have been used by some highway agencies in conjunction with pedestrian warning signs, and their effects are not clearly known. In-pavement flashing lights need to also be better understood in terms of the effects on motorist and pedestrian behavior.

This report describes evaluations of flashing crosswalks in Gainesville and Lakeland. These evaluations were part of a larger Florida Department of Transportation Safety Office research effort focusing on improving pedestrian and bicyclist safety.

## EXPERIENCES WITH THE LIGHTGUARDJ FLASHING CROSSWALK SYSTEM

From 1994 through 1998, the LightGuardJ flashing crosswalk system was installed in six California cities and two sites in Kirkland, Washington. Based on before-and-after evaluations, drivers were more aware of the flashing crosswalks than they were of conventional crosswalks (Whitlock & Weinberger, 1995 and 1998). Drivers were observed to apply their brakes earlier with the flashing crosswalks than with the conventional painted crosswalks. The flashing crosswalk resulted in higher percentages of drivers yielding to pedestrians than in the conventional crosswalk situation in the tests in California and Washington. The effects of the flashing crosswalks were more pronounced at night and during inclement weather than during the day and under clear weather conditions. In terms of implementation, pedestrians reported being less confused by the use of an automated detection system than the use of push buttons to activate the flashers. The effectiveness of the flashing crosswalk was also found to depend upon the amount of parking activity in the area, the amount of pedestrian activity on the sidewalks near the crosswalk, traffic volume, and the length of time that the lights flash (Whitlock & Weinberger, 1995 and 1998).

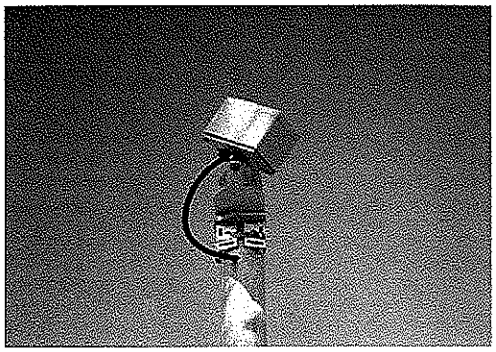
In Orlando, Florida, a flashing crosswalk connects a hotel with a theater and walkways leading to a sports arena (Figure 5). Pedestrians activate the flashers by stepping between two bollards. Huang *et al.* (1999) found that more motorists stopped or slowed down for a pedestrian after the flashing crosswalk was installed (13 percent Abefore@ vs. 34 percent Aafter@). Conflicts between motor vehicles and pedestrians were less likely when pedestrians crossed in the flashing crosswalk than when they crossed somewhere else. About 60 percent of the pedestrians who crossed in the crosswalk when vehicles were approaching experienced conflicts, compared to 87 percent of the pedestrians who crossed somewhere else. The flashing crosswalk was not very effective in channelizing pedestrians to cross there instead of somewhere else, because of their scattered origins and destinations. The flashing crosswalk never failed to activate when it was supposed to. Interviews with pedestrians suggested that most of them did not understand how the flashing crosswalk works (Huang *et al.*, 1999).

## SITE DESCRIPTIONS

Lakeland B Cresap Street, 2 block west of Lakeside Avenue

Cresap Street is a two-lane road that approaches Lake Hunter (one of many lakes in the city) from the east. Westbound drivers are on a slight downgrade as they approach the crosswalk and prepare to turn left to go around the lake. The speed limit is 25 mi/h (40 km/h) and the ADT is 2,000 to 2,500 vehicles per day.

The crosswalk connects single-family houses to the north with Florida Presbyterian Homes (a senior citizens= home) to the south (Figure 6). Many senior citizens live in the houses and go to the seniors= home for meals and social activities. In-pavement flashers were added to the existing crosswalk at this location in July 1999 (Figure 7). Pedestrians activate the flashers by stepping in between bollards on the north side and by entering the microwave detection zone on the south side (Figures 8 and 9). Pedestrian activity is very light except when meals and social events are scheduled in the seniors= home.



Gainesville **B** Museum Road, just west of SW 13th Street

Museum Road is an east-west road with two through lanes, a painted median, and bike lanes on both sides. It is one of the main thoroughfares on the University of Florida campus. The speed limit is 20 mi/h (32 km/h) and the ADT is 14,500 vehicles per day. The in-pavement flashers were added to the existing crosswalk in August 1999. Pedestrians activate the flashers by walking in between bollards. There are also speed humps about 40 feet (12 m) upstream of the crosswalk in each direction. Pedestrian activity is steady and sometimes heavy during weekdays, when classes are in session.

## DATA COLLECTION PROCEDURES

A before-and-after study design was used. The crosswalks were videotaped prior to, and following the installation of in-pavement flashers. A 35 mm video camera was set up on a tripod, approximately 100 feet (31 m) upstream from the crosswalk. The video camera was positioned so that it recorded the actions of pedestrians as they crossed the street and also the actions of motorists as they passed over the crosswalk.

ABefore@ data were collected in May 1999 (Lakeland only) and July 1999 (both Gainesville and Lakeland). AAfter@ data were collected in October 1999 (both Gainesville and Lakeland) and November 1999 (Lakeland only).

All videotaping was done during daylight hours, under dry conditions. In Gainesville, videotaping was done on weekdays, when university classes were in session, and students were expected to be present. In Lakeland, videotaping was done on Sundays, Wednesdays, and Fridays, at times when social activities were scheduled in the senior citizens= home, and therefore, pedestrians were expected to be present. Videotaping was not done at night, because little pedestrian activity was expected at night at the treated sites.

**Table 1. Study Locations, Number of Pedestrians, and Hours of Data Collection**

| CITY | TOTAL NUMBER OF PEDESTRIANS | | HOURS OF DATA COLLECTION | |
|---|---|---|---|---|
| | BEFORE | AFTER | BEFORE | AFTER |
| GAINESVILLE | 682 | 503 | 3 h | 1 h 30 m |
| LAKELAND | 168 | 169 | 9 h 45 m | 13 h 55 m |

## RESULTS

The flashing crosswalks were evaluated according to four measures of effectiveness (MOE=s):

1. Motorists yielding to pedestrians
2. Pedestrians who had the benefit of motorists yielding to them
3. Pedestrians who crossed at a normal walking speed
4. Pedestrians who crossed in the crosswalk

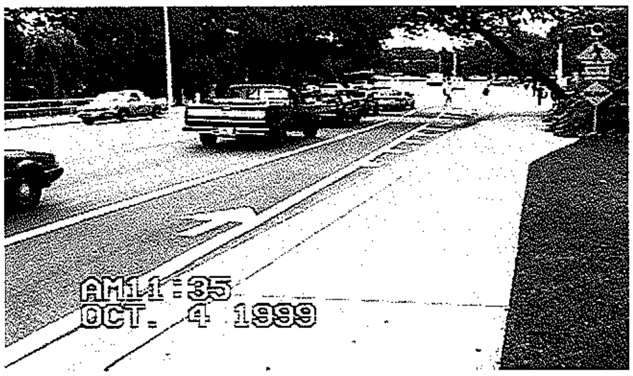
The videotapes were watched and information pertaining to the MOE=s was recorded.

The results for the MOE=s are described in more detail in the following sections.

**Motorists Yielding to Pedestrians**

The chi-square statistic was used to compare the percentages of motorists who yielded to pedestrians in the crosswalk before and after the flashing crosswalk was installed. It was hypothesized that the flashing crosswalk would result in increased motorist yielding.

This analysis included only motorists who drove across the crosswalk when pedestrians were crossing or waiting to cross. In both Gainesville and Lakeland, many motorists drove across the crosswalk when no pedestrians were present; these motorists were not included in the analysis.




In Gainesville, most motorists yielded to pedestrians in the crosswalk (Figure 12 and Table A-1). However, the percentage was unexpectedly higher before the flashing crosswalk was installed than after (80.6 percent “before” vs. 74.6 percent “after”). Although this decline was statistically significant (chi-square statistic = 3.61, p-value = 0.057). It is not clear whether it is of *practical* significance. It is likely that the percentage of motorists who yield varies somewhat from one day to another. More important, the flashing crosswalk was installed immediately before the start of a new academic year. Therefore, the “after” data were collected soon after a new academic year had started, at a time when many newcomers were present. As motorists, these newcomers may not have been familiar with driving in a university setting and how to react when they saw pedestrians in the flashing crosswalk. As pedestrians, these newcomers may not have been familiar with the location of the flashing crosswalk and when it was appropriate to cross the street.

Only a minority of motorists yielded to pedestrians in the crosswalk in Lakeland (Figure 12 and Table A-2). Although the percentage of motorists yielding to pedestrians was higher after the flashing crosswalk had been installed (18.2 percent "before" vs. 29.7 percent "after"), this increase was not statistically significant (chi-square statistic = 1.51, p-value = 0.220). The lack of statistical significance is most likely the result of smaller sample sizes in Lakeland, compared to Gainesville. As sample sizes increase, the chi-square statistic becomes more sensitive to relatively small percentage differences.

**Pedestrians Who Had the Benefit of Motorists Yielding to Them**

The chi-square statistic was used to compare the percentages of pedestrians who had the benefit of motorists yielding to them (Figure 13). It was hypothesized that the flashing crosswalk would result in more pedestrians who had the benefit of motorists yielding to them, as it was expected that more motorists would be induced to yield.

This analysis included only pedestrians who crossed when motorists were approaching. The pedestrian was the unit of analysis. The distinction between this and the previous MOE (motorists yielding to pedestrians) can be illustrated by an example. If a total of 100 pedestrians crossed when vehicles were approaching, and motorists yielded to 51 of the pedestrians, then 51 percent of the pedestrians had the benefit of motorists yielding to them and 49 percent did not. It


does not matter whether the pedestrians crossed as one large group, several smaller groups, or one-by-one. If the 51 pedestrians crossed as one large group, and one vehicle yielded to them, while the remaining 49 pedestrians crossed individually, and 49 vehicles did not yield to them, then the motorist yield rate would be one out of 50, or 2 percent.

In Gainesville, fewer pedestrians had the benefit of motorists yielding to them after the flashing crosswalk was installed (85.1 percent Abefore@ vs. 55.4 percent Aafter@) (Figure 14 and Table A-3). This decrease was significant (p-value = 0.000).

The flashing crosswalk in Lakeland resulted in more pedestrians who benefitted from motorists yielding to them (15.8 percent Abefore@ vs. 41.0 percent Aafter@) (Figure 14 and Table A-4). This increase was significant (chi-square statistic = 6.01, p-value = 0.014).

**Pedestrians Who Exhibited Normal Crossing Behavior**

For the purposes of this study, it was presumed that pedestrians exhibited Anormal@ crossing behavior if they walked across the roadway at a steady pace. Pedestrians did not exhibit normal crossing behavior if they ran at any time while crossing, if they aborted the crossing, or if they hesitated while crossing. An aborted crossing occurred if a pedestrian stepped into the roadway and then retreated back onto the curb because of oncoming traffic. A pedestrian hesitated while crossing if he/she stepped into the roadway and then waited for a gap in oncoming traffic before starting to cross, or if he / she started crossing and then waited for a gap before finishing. The more that motorists yield, the less likely it is that pedestrians will feel a need to run, abort, or hesitate while crossing the street. Because it was thought that flashing crosswalks would increase motorist yielding, it was therefore hypothesized that more pedestrians would cross normally after flashing crosswalks were installed.

More than 98 percent of pedestrians at both locations exhibited normal crossing behavior (Figure 15 and Tables A-5 and A-6). With such a high incidence of normal crossing behavior, there was not much room for improvement. According to the chi-square statistic (0.372, p-value = 0.542), there was no change in normal crossing behavior in Gainesville. The chi-square statistic was not used on the Lakeland data because of small sample sizes B only two pedestrians did not exhibit normal behavior in both the Abefore@ and Aafter@ periods.

**Pedestrians Who Crossed in the Crosswalk**

It was hypothesized that the installation of in-pavement flashers would result in more

pedestrians using the crosswalk, so that they would benefit from motorists yielding to them (Figure 16).

The chi-square statistic was used to compare the percentages of pedestrians who crossed in the crosswalk. The vast majority of pedestrians at both locations crossed within the crosswalk (Figure 17 and Tables A-7 and A-8). The slight decrease in Gainesville was statistically significant (chi-square statistic = 3.23, p-value = 0.072) but is probably not of *practical* significance for two reasons. First, even with the decline, 95.0 percent of pedestrians still used the crosswalk. At such high levels of crosswalk usage, there is not much room for improvement. Second, the chi-square statistic becomes more sensitive to small percentage differences when the sample sizes increase. The improvement in Lakeland was also significant (chi-square statistic = 11.050, p-value < 0.001).

**Activation of the In-Pavement Flashers**

Figure 18 shows that 98.2 percent of the pedestrians at the Gainesville location started crossing when the flashers were Aon.@ This number is comparable to the 95.0 percent who crossed in the crosswalk in the Aafter@ period. People who did not enter the street between the bollards would not have activated the flashers. Some of them may have started crossing while the flashers were Aon@ because they followed someone who stepped between the bollards and activated the flashers.

In Lakeland, the flashers were activated by bollards on the north side and by a microwave detector on the south side. About three-fourths of the pedestrians in Lakeland started crossing when the flashers were Aon@ (Figure 19). The lower percentage in Lakeland compared to Gainesville is partly the result of somewhat fewer pedestrians (89.3 percent) crossing in the crosswalk in Lakeland. Moreover, the microwave detector missed persons who were not standing in the detection zone. The City of Lakeland plans to replace the microwave detector with bollard detection, due to false activations by trucks and rain.

## SUMMARY AND CONCLUSIONS

This report evaluated flashing crosswalks in Gainesville and Lakeland to determine their effects on pedestrian and motorist behavior.

- The flashing crosswalk in Lakeland had positive effects in the Aafter@ period compared to the Abefore@ period: (1) more motorists yielded to pedestrians; (2) more pedestrians benefitted from having motorists yield to them; and (3) pedestrians were more likely to cross within the crosswalk. The Lakeland site had a speed limit of 25 mi/h (40 km/h) and the ADT was 2,000 to 2,500. It is not clear what effect these factors played in the positive effect of the flashing crosswalk in Lakeland. However, the overall yielding rate was only about 30 percent in the Aafter@ period. It is thought that the low overall yielding rate resulted from these site-specific conditions:
  1. The crosswalk had low pedestrian volumes. Therefore, drivers were not expecting to see pedestrians.
  2. Vehicle speeds may have been higher at this site than at the Gainesville site, because westbound drivers may be accelerating as they go downhill and there were no speed humps on the approaches to the flashing crosswalk.

- Even though the levels of motorist yielding and pedestrians for whom motorists yielded declined at the Gainesville site (see below), the levels of motorist yielding and pedestrians for whom motorists yielded at the Gainesville site were higher in the Aafter@ period than at the Lakeland site. It is thought that the high overall yielding rate at the Gainesville location is the result of these site-specific conditions:
  1. The flashing crosswalk is located on a university campus and has high pedestrian volumes during the day, so drivers expect pedestrians.
  2. Speed humps are present on both approaches to the flashing crosswalk. These humps likely reduced the speeds of approaching motorists and made it easier for them to yield to pedestrians.

- The flashing crosswalk in Gainesville did not have the positive effect in the Aafter@ period of more motorists yielding to pedestrians. One possible reason for this outcome is that the Abefore@ data were collected in July, while summer classes were in session, whereas the Aafter@ data were collected in October, soon after the start of a new academic year. The new students may not have been familiar with driving and walking on campus. A second possible reason is that a high percentage of drivers was already yielding to pedestrians in the Abefore@ period, so there may not been much room for improvement.

- The number of persons who crossed within the crosswalk at the Gainesville site fell by 2.1 percent in the Aafter@ period, compared to the Abefore@ period. It is worth emphasizing that this decline is probably not of *practical* significance, despite its statistical significance.

- Over 98 percent of all pedestrians at both locations exhibited normal crossing behavior, both before and after the flashing crosswalks were installed.

- Most people started crossing while the in-pavement lights were flashing. In Lakeland, some people were outside the detection zone of the microwave detector and started crossing without the lights flashing.

Although a limited number of test sites was available, this evaluation does allow for some initial information concerning the desirability of flashing crosswalks at sites such as those in Lakeland and Gainesville. Pedestrian and motorist behavior fluctuate somewhat from day to day depending on many factors. Testing of the flashing crosswalks is needed at additional sites and also at night (at sites that have enough pedestrian activity at night to allow for adequate nighttime samples). Flashing crosswalks would be expected to be more effective in improving pedestrian safety at night than during the day because of their added nighttime visibility.

## RECOMMENDATIONS

Though expensive, flashing crosswalks are cheaper than full signalization. Thus, flashing crosswalks may be appropriate if they contribute to higher levels of motorist yielding behavior. Whitlock & Weinberger (1998) concluded that a flashing crosswalk system Ahas the potential to be an effective traffic control device since it fulfills a need, commands attention, conveys a clear meaning, commands respect of road users, and gives adequate time for proper response.@

Whitlock & Weinberger (1998) recommended that the following guidelines be met for installing flashing crosswalks:

- Flashing crosswalks should be used at uncontrolled crosswalks.
- Main street average vehicular approach speeds should be 45 mi/h (72 km/h) or less.
- Main street traffic volumes should be between 5,000 and 30,000 vehicles per day.
- At speeds less than 35 mi/h (56 km/h), approaching motorists should be able to see the flashers at least 400 feet (122 m) in advance of the flashing crosswalk. At speeds greater than 40 mi/h (64 km/h), at least 600 feet (183 m) of sight distance should be available.
- There should be no other crosswalks or traffic control devices within 250 feet (76 m) of the flashing crosswalk.
- A minimum of 100 pedestrians per day is suggested.

Caltrans (the California Department of Transportation) is developing standards and guidelines towards making flashing crosswalks standard traffic warning devices in California. At the national level, the U.S. Federal Highway Administration is authorizing flashing crosswalk test sites. The data from these test sites will be used to recommend national standards and warrants for inclusion in the Manual on Uniform Traffic Control Devices (Whitlock & Weinberger, 1998).

The author of the present report offers the following additional recommendations:

1. Additional evaluations of flashing crosswalks are needed to better quantify their effects on pedestrian and motorist behavior under various traffic and roadway conditions.

2. If a bollard detection system is used, the bollards should be placed along the same line as each row of flashers. In Orlando, the bollards were placed closer together than the rows of flashers (Huang *et al.*, 1999). Thus, it was possible for someone to enter in the crosswalk (*i.e.*, between the rows of flashers), but outside the bollards and therefore not activate the flashers.

3. In terms of automated pedestrian detection systems, Whitlock & Weinberger (1998) found that ultrasonic detection was not completely reliable. They also found that video imaging was superior to ultrasonic detection but still had false activations and missed activations. In Lakeland, the microwave detector missed persons who were outside the detection zone. The microwave detector also had false activations from trucks and rain. With additional experimentation, automated detection systems could be adjusted to improve their reliability.

4. A sign such as **A**YIELD TO PEDESTRIANS@ (preferably over the roadway) would remind drivers of their responsibilities. It is hoped that more motorists will become familiar with flashing crosswalks in Gainesville, Lakeland, and other such sites and will associate the flashing lights with the presence of pedestrians. This sign could be retrofitted with lights that flash only in conjunction with the in-pavement lights. Alternatively, a beacon that flashes only with the in-pavement lights could be mounted below a standard pedestrian crosswalk sign. Figure 20 shows a crosswalk sign that has been modified to include a row of flashing lights between the crosswalk lines. This sign is used at the flashing crosswalk in Lakeland.

5. To improve pedestrian understanding of how the flashing crosswalk works, custom-made signs directed at pedestrians could be placed on or near the bollards. The suggested wording might be: FLASHING CROSSWALK **B** WALK BETWEEN POSTS TO ACTIVATE **B** WATCH FOR CARS **B** CROSS ONLY WHEN IT IS SAFE TO DO SO. In time, more pedestrians will become familiar with how to use the flashing crosswalk.

6. Increased police enforcement of motorist yielding behavior is recommended to supplement flashing crosswalks and other pedestrian crossings.

7. The flashers should be examined periodically for signs of wear and tear. They can be situated on the roadway so that they are not in the direct path of vehicle tires. The flashers should be placed so that they do not impede bicyclists.

8. This study was an evaluation of flashing crosswalks at two locations. Evaluations of more flashing crosswalk installations in Florida and other states are needed to better understand their effects on driver and pedestrian behavior in different situations. A longer-term and more comprehensive study would include an analysis of the effects of flashing crosswalks on motor vehicle - pedestrian crashes after an adequate sample of such treatment sites exists.

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## REFERENCES

Huang, Herman, Ronald Hughes, Charles Zegeer, and Marsha Nitzburg. *An Evaluation of the LightGuard™ Pedestrian Crosswalk Warning System.* Prepared for the Florida Department of Transportation Safety Office, June 1999.

Hunter, William W., Jane C. Stutts, Wayne E. Pein, and Chante L. Cox. *Pedestrian and Bicycle Crash Types of the Early 1990's.* Report No. FHWA-RD-95-163. Federal Highway Administration, McLean, Virginia, June 1996.

Knoblauch, R.L. *Urban Pedestrian Accident Countermeasures Experimental Evaluation. Volume II: Accident Studies.* National Highway Traffic Safety Administration and Federal Highway Administration, February 1975.

Whitlock & Weinberger Transportation, Inc. *An Evaluation of a Crosswalk Warning System Utilizing In-Pavement Flashing Lights.* Whitlock & Weinberger Transportation, Inc., Santa Rosa, California, April 1998.

Whitlock & Weinberger Transportation, Inc., in conjunction with TJKM Transportation Consultants. *Analysis of an Experimental Pedestrian Crosswalk Device* **B** *Phase II.* Whitlock & Weinberger Transportation, Inc., Santa Rosa, California, October 1995.

# APPENDIX A
# GAINESVILLE AND LAKELAND DATA TABLES

**Table A-1. Motorists Who Yielded to Pedestrians, Gainesville**

| MOTORIST ACTION | Before the flashing crosswalk was installed NUMBER & PERCENT | After the flashing crosswalk was installed NUMBER & PERCENT |
|---|---|---|
| Yielded to pedestrian | 275 (80.6%) | 249 (74.6%) |
| Did not yield | 66 (19.4%) | 85 (25.4%) |
| TOTAL | 341 (100.0%) | 334 (100.0%) |
| No pedestrians around (Not included in Total) | 997 | 446 |

chi-square with 1 d.f. = 3.608628
p-value for chi-square = 0.0574806 SIGNIFICANT, IN UNDESIRED DIRECTION

**Table A-2. The Number of Motorists Who Yielded to Pedestrians, Lakeland**

| MOTORIST ACTION | Before the flashing crosswalk was installed NUMBER & PERCENT | After the flashing crosswalk was installed NUMBER & PERCENT |
|---|---|---|
| Yielded to pedestrian | 6 (18.2%) | 19 (29.7%) |
| Did not yield | 27 (81.8%) | 45 (70.3%) |
| TOTAL | 33 (100.0%) | 64 (100.0%) |
| No pedestrians around (Not included in Total) | 544 | 1,650 |

chi-square with 1 d.f. = 1.506491
p-value for chi-square = 0.219675 NOT SIGNIFICANT

**Table A-3. Pedestrians Who Had the Benefit of Motorists Yielding to Them, Gainesville**

| | Before the flashing crosswalk was installed NUMBER & PERCENT | After the flashing crosswalk was installed NUMBER & PERCENT |
|---|---|---|
| Pedestrian crossed and vehicle yielded | 291 (85.1%) | 150 (55.4%) |
| Pedestrian crossed, but the vehicle did not yield | 51 (14.9%) | 121 (44.6%) |
| TOTAL | 342 (100.0%) | 271 (100.0%) |
| Pedestrian crossed, no vehicles approaching (Not included in Total) | 337 | 232 |

chi-square with 1 d.f. = very large
p-value for chi-square = 0.000 SIGNIFICANT, IN UNDESIRED DIRECTION

**Table A-4. Pedestrians Who Had the Benefit of Motorists Yielding to Them, Lakeland**

| | Before the flashing crosswalk was installed NUMBER & PERCENT | After the flashing crosswalk was installed NUMBER & PERCENT |
|---|---|---|
| Pedestrian crossed and vehicle yielded | 6 (15.8%) | 16 (41.0%) |
| Pedestrian crossed, but the vehicle did not yield | 32 (84.2%) | 23 (59.0%) |
| TOTAL | 38 (100.0%) | 39 (100.0%) |
| Pedestrian crossed, no vehicles approaching (Not included in Total) | 130 | 130 |

chi-square with 1 d.f. = 6.005867
p-value for chi-square = 0.014258 SIGNIFICANT

**Table A-5. Pedestrians Who Exhibited Normal Crossing Behavior, Gainesville**

| PEDESTRIAN CROSSING BEHAVIOR | Before the flashing crosswalk was installed NUMBER & PERCENT | After the flashing crosswalk was installed NUMBER & PERCENT |
|---|---|---|
| Normal | 668 (98.4%) | 497 (98.8%) |
| Not Normal | 11 (1.6%) | 6 (1.2%) |
| TOTAL | 679 (100.0%) | 503 (100.0%) |

chi-square with 1 d.f. = 0.371770
p-value for chi-square = 0.542040511 NOT SIGNIFICANT

**Table A-6. Pedestrians Who Exhibited Normal Crossing Behavior, Lakeland**

| PEDESTRIAN CROSSING BEHAVIOR | Before the flashing crosswalk was installed NUMBER & PERCENT | After the flashing crosswalk was installed NUMBER & PERCENT |
|---|---|---|
| Normal | 166 (98.8%) | 167 (98.8%) |
| Not Normal | 2 (1.2%) | 2 (1.2%) |
| TOTAL | 168 (100.0%) | 169 (100.0%) |

The chi-square statistic was not calculated because of small sample sizes of Anot normal@ behavior.

**Table A-7. Pedestrians Who Crossed Within the Crosswalk, Gainesville**

| CROSSED WITHIN THE CROSSWALK? | Before the flashing crosswalk was installed NUMBER & PERCENT | After the flashing crosswalk was installed NUMBER & PERCENT |
|---|---|---|
| Yes | 659 (97.1%) | 478 (95.0%) |
| No | 20 (2.9%) | 25 (5.0%) |
| TOTAL | 679 (100.0%) | 503 (100.0%) |

chi-square with 1 d.f. = 3.23409
p-value for chi-square = 0.072120 SIGNIFICANT, IN UNDESIRED DIRECTION

**Table A-8. Pedestrians Who Crossed Within the Crosswalk, Lakeland**

| CROSSED WITHIN THE CROSSWALK? | Before the flashing crosswalk was installed NUMBER & PERCENT | After the flashing crosswalk was installed NUMBER & PERCENT |
|---|---|---|
| Yes | 126 (75.5%) | 150 (89.3%) |
| No | 41 (24.5%) | 18 (10.7%) |
| TOTAL | 167 (100.0%) | 168 (100.0%) |

chi-square with 1 d.f. = 11.0497
p-value for chi-square = 0.000887 SIGNIFICANT

**APPENDIX B**
**LIGHTGUARD™ FLASHING CROSSWALK SPECIFICATIONS, ORLANDO**

Signal Head

| | |
|---|---|
| Model No. | LSG-IRSH Type V-A |
| Name | LightGuard J In-Roadway Signal Head |
| Housing | Aluminum |
| Coating | Powder Coat/White |

Base Plate

| | |
|---|---|
| Model No. | LSG-IRB V-A |
| Name | LightGuard J In-Roadway Base Plate |
| Material | Aluminum |
| Attachment to LGS-IRSH V-A: | (6) 1/4-20 x 2" Tamper Proof Bolts |
| Attachment to Roadway: | Industrial Standard Epoxy |

Bollard Detection System

| | |
|---|---|
| Model No. | LGS-B1A (Active Side) |
| Name | LightGuard J Bollard Activation Unit |
| Detection Method | Break beam modulated 650 nm LED |
| Distance | 25ft maximum betweeen sensor and reflector |
| Power | 0.04 A. 12 VDC Sensors<br>0.04 A. 12 VDC Lighting |
| Rating | 250 ma maximum |
| Response Time | 4 milliseconds |
| Adjustments | Light/dark operate and sensitivity |
| Model No. | LGS-B1R (Reflective Side) |
| Name | LightGuard™ Bollard Reflector Unit |
| Material | Steel (Body) Top (Aluminum) |
| Finish | Powder Coat/White |
| Dimensions | 8.5" d x 42" h x .12" |
| Mounting | (3) 2" bolts |
| Access | Two part center detachment |
| Sensors | LGS-SBM1 |