An Evaluation of Illuminated Pedestrian Push Buttons in Windsor, Ontario

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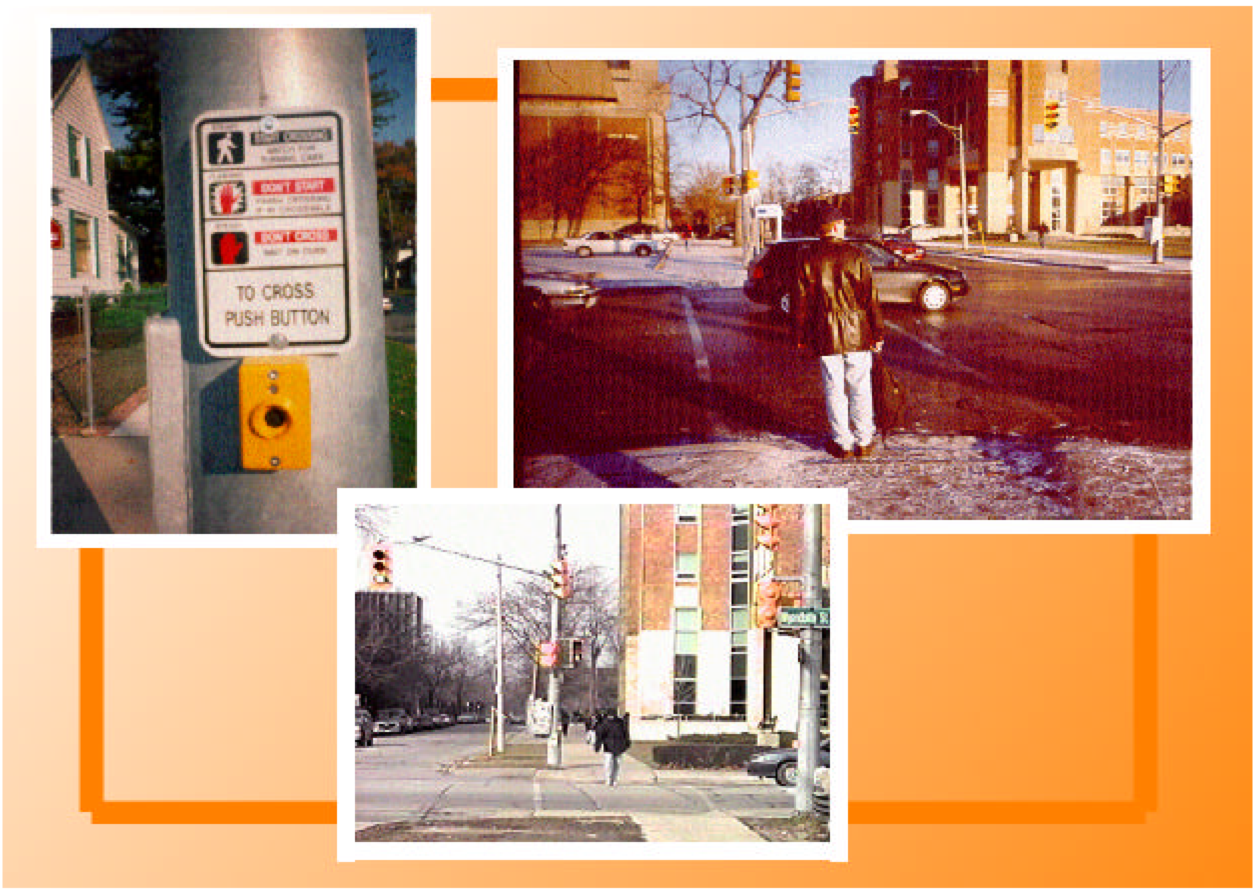

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Federal Highway Administration
Research, Development, and Technology
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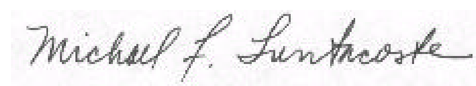
Pedestrian & Bicycle Safety

FOREWORD

The FHWA's Pedestrian and Bicycle Safety Research Program's overall goal is to increase pedestrian and bicycle safety and mobility. From better crosswalks, sidewalks and pedestrian technologies to growing educational and safety programs, the FHWA's Pedestrian and Bicycle Safety Research Program strives to pave the way for a more walkable future.

At many signalized intersections, pedestrian detection is accomplished by the pedestrians pushing buttons to activate the Walk phase. Often, pedestrians do not whether the button already has been pressed or if it is even working. To address this problem, illuminated push buttons are used to indicate when the Walk phase has been activated. This study evaluated the effects of illuminated push buttons on pedestrian behavior. This study was part of a larger Federal Highway Administration research study investigating the effectiveness of innovative engineering treatments on pedestrian safety. It is hoped that readers also will review the reports documenting the results of the related pedestrian safety studies.

The results of this research will be useful to transportation engineers, planners, and safety professionals who are involved in improving pedestrian safety and mobility.



Michael F. Trentacoste
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and Development

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16. Abstract

At many intersections, pedestrians must push buttons to activate the Walk phase. However, they often do not know whether the button has been pressed and whether it is functional. If the Walk phase does not appear soon after the button has been pressed, they may believe that the button does not work and start crossing early, while the steady Don't Walk is still being displayed. When a pedestrian presses an illuminated push button, a light near the button turns on, indicating that the Walk phase has been activated and will appear. The objective of this study is to evaluate the effects of illuminated push buttons on pedestrian behavior.

In general, illuminated push buttons did not have a statistically significant effect on how often the pedestrian phases were activated, how many people pushed the button, how many people complied with the Walk phase, or such pedestrian behaviors as running, aborted crossings, and hesitation before crossing. Only 17 and 13 percent of pedestrians pushed the button in the "before" and "after" periods, respectively. In both the before and after periods, someone pushed the button in 32 percent of signal cycles with pedestrians. The majority of pedestrians (67.8 percent with, and 72.3 percent without illuminated push buttons) who arrived when parallel traffic had the red and who pushed the button complied with the Walk phase.

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INTRODUCTION

Many signalized intersections in the United States have buttons that pedestrians must push to activate the Walk signal; however, only about half of all pedestrians push those buttons (Zegeer et al., 1985). Pedestrians may not be aware that pressing the button is necessary to obtain the Walk signal. Even when pedestrians are aware of the requirement, they have no way of knowing whether the buttons are functioning properly. If the Walk signal does not appear in short order after the button has been pressed, pedestrians may conclude that the button is out of order and then start crossing before the Walk signal appears. Moreover, they may be less likely to push the button in the future if they believe that the button is not functional.

Pedestrians who do not push the button and do not get the Walk signal will often start crossing when parallel traffic gets the green. Persons who arrive when parallel traffic has the green will usually cross right away, even if the steady Don't Walk is showing. Traffic signals are timed for motor vehicle speeds, whereas pedestrian signals are timed for pedestrian speeds, typically 1.1 to 1.2 m/sec (3.5 to 4 ft/sec). Thus, the green traffic signal is not a reliable indication of whether a pedestrian will have enough time to cross the street. At most activated signals, pedestrians generally will not have sufficient time to cross during the parallel green signal unless the Walk signal is displayed. Hence, it is important for the Walk signal to be activated during periods when pedestrians intend to cross the street.

Pedestrians need positive feedback that the push button is functioning properly and that a Walk signal will soon occur. One way to provide feedback is through an internally illuminated push button. When an illuminated push button is pressed, a light on or near the button is illuminated. The light acknowledges that the Walk signal has been called and is intended to assure the pedestrian that the Walk signal will soon appear. The intent is that some pedestrians who would otherwise cross on a steady Don't Walk may wait for the Walk signal if they know that it will soon appear.

Illuminated push buttons are used extensively in Windsor, Ontario, and Toronto, Ontario. Both cities are systematically replacing conventional push buttons with illuminated push buttons. The illuminated push buttons consist of a button and an orange light that lights up (like many elevator buttons) once the button is pressed (Figure 1). The illuminated push buttons are being installed in response to citizen complaints that the conventional push buttons were not working. In fact, the conventional buttons *were* operational, but because the Walk signal did not come on quickly after the buttons were pressed, many citizens incorrectly thought that the conventional buttons were not working.

This paper evaluates illuminated push buttons at four intersections in Windsor, Ontario. The research reported here is part of a larger national effort to evaluate the operational and safety effects of various pedestrian treatments: illuminated push buttons, automated pedestrian detectors, traffic calming measures, crosswalks, and sidewalks.

Figure 1. An illuminated push button in Windsor. The orange light is below the button.

STUDY DESIGN

A before-and-after study design was used. During the "before" period, operational and behavior data were collected at four intersections (seven crosswalks) where conventional pedestrian push buttons were present in the before period. These intersections were later upgraded to illuminated pedestrian push buttons. In the "after" period, operational and behavior data were collected at the same four intersections (Table 1).

Table 1. Intersections where before and after data were collected.

INTERSECTION	CROSSING(S)	DATA COLLECTION	
		BEFORE	AFTER
Wyandotte at Patricia	East	April 1997	November 1997
Wyandotte at Sunset	East, West	April 1997	November 1997
Tecumseh at Annie	East, West	October 1996	April 1997
Tecumseh at Howard	East, West	October 1996	April 1998

A video camera was used to record pedestrian and motorist behavior at all locations. The video camera was 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 traffic on the side street and pedestrian phases for pedestrians crossing the main road (Figure 2).

Figure 2. A view from the video camera, Wyandotte at Sunset, east crossing.

The illuminated push buttons were evaluated using four measures of effectiveness (MOEs).

1. The number of pedestrians who pushed the button
2. Signal cycles during which the button was pushed
3. Pedestrian compliance
4. Normal pedestrian crossing behavior

Each MOE is described later in more detail.

SITE DESCRIPTIONS

In the before period, conventional pedestrian push buttons controlled the crosswalks of interest. The conventional buttons were later replaced by illuminated push buttons. At three of these crosswalks, the Walk signal does not appear unless the button is pushed. If the button for either the east or west crossing is pushed, then the pedestrian signals for both crossings are activated. Pushing the button does not shorten the wait time for pedestrians or give pedestrians extra crossing time. The traffic signals remain on a constant cycle regardless of whether the button is pushed. Pedestrians who arrive when parallel traffic has a red signal (and the Don't Walk signal is displayed) and who do not push the button will still have sufficient time to cross if they start crossing as soon as the green signal appears for parallel traffic.

The pedestrian signals for the east crossing at Wyandotte and Patricia were observed to be on recall, meaning that the Walk signal appears in every cycle; the buttons there are redundant. It is not known whether (or how many) pedestrians are aware that pushing the button is not necessary to get the Walk signal at that location.

As the City of Windsor upgrades intersections, it is replacing the traditional push buttons with illuminated push buttons and is adding informational signs explaining the meanings of the Walk, flashing Don't Walk, and steady Don't Walk symbols (Figure 1). The City is doing so because local residents were calling about push buttons that did not appear to be working when in fact they were working. Intersections at school locations have priority in the upgrades.

Tecumseh at Annie

Tecumseh Road is an east-west arterial with an average daily traffic (ADT) of 28,900 and a speed limit of 60 km/h (37 mi/h). There are assorted shops and restaurants along the south side of Tecumseh. Annie Street is a residential street on the south leg and aligns with the entrance/exit to the parking lot of an enclosed shopping mall on the north side of Tecumseh. Pedestrians walk between the mall (to the north of Tecumseh), the transit bus stops along Tecumseh, and shopping and residential areas (to the south of Tecumseh). At the intersection, Tecumseh has five lanes, including the left-turn-only lane.

Tecumseh at Howard

This is an intersection of two arterials (Figure 3). Tecumseh Road has five lanes, including the left-turn-only lane. The ADT is 26,000 and the speed limit is 50 km/h (31 mi/h). Both the east and west legs of Tecumseh have refuge islands. A high school is located near the southwest corner of Tecumseh Road and Howard Avenue. In addition, another school is three city blocks west of Howard, so many students who go to that school pass through the intersection of Tecusmeh and Howard. Not surprisingly, most pedestrians at this intersection were students.

Many students take the shortest walking paths between residential neighborhoods or transit bus stops and the school, and cross Tecumseh at points 30 m (100 ft) or so west of Howard. Thus, the actual number of students crossing Tecumseh is considerably higher than what was recorded on videotape.

Figure 3. Tecumseh at Howard, west leg.

Wyandotte at Sunset

Wyandotte Street is an east-west arterial that runs through the University of Windsor campus. Sunset Avenue is a north-south collector street. At the intersection, Wyandotte has two through lanes and a left-turn-only lane. The ADT is 12,100 and the speed limit is 50 km/h (31 mi/h). The University of Windsor campus is to the north of Wyandotte. A mix of University buildings and single-family residences is to the south of Wyandotte. Pedestrian activity was steady during the periods of data collection.

Wyandotte at Patricia

Patricia Road is a north-south collector street two blocks to the west of Sunset. This is a T-intersection, and Patricia forms the south leg of the “T.” (Figure 4) At the intersection, Wyandotte has four lanes. The ADT on Wyandotte is 12,100 and the speed limit is 50 km/h (31 mi/h). The east leg of Wyandotte (but not the west leg) has a marked crosswalk and a pedestrian signal. The southside crosswalk is extra long, as pedestrians cross both Patricia and a bridge on-ramp, which is separated from Patricia by a raised median. The University of Windsor campus is to the north of Wyandotte. A mix of University buildings and single-family residences is to the south of Wyandotte. Pedestrian activity was steady during the periods of data collection.

HOW MANY PEDESTRIANS PUSHED THE BUTTON?

With a conventional push button, pedestrians who arrive in the queuing area have no way of knowing whether the button has already been pushed, unless they observe someone pushing the button. Because an illuminated button lights up when it is pushed, arriving pedestrians can see whether the button has already been pushed. The evaluation process included determining whether subsequent arrivals would be less likely to push the button if they see that it has already been pushed (i.e., see the light illuminated).

Figure 4. Wyandotte at Patricia, east leg.

The chi-square statistic was used to evaluate whether the illuminated push buttons in fact caused fewer pedestrians to push the button. This happened at only one location (Table 2). At the other six locations, the illuminated push buttons did not have a significant effect on the number of people who pushed the button. Table 2 also shows that fewer than one-third of all pedestrians pushed the button. Although the pedestrian signal at Wyandotte at Patricia was observed to be on recall, pedestrians may not have realized this, and some of them pushed the button. For all sites combined, the percentage of pedestrians pushing the button was less (12.7 percent) in the after period than in the before period (16.9 percent).

SIGNAL CYCLES DURING WHICH THE BUTTON WAS PUSHED

A signal cycle is a progression from when parallel traffic has the red to the green to the amber. When the red interval reappears, a new cycle begins. At intersections with pedestrian-activated signals, the Walk signal does not appear in every signal cycle, but only when the push button has been pressed. If one or more persons arrive when parallel traffic has the red (and the steady Don't Walk signal is being displayed) and anyone pushes the button, then everyone who waits will benefit from the information conveyed by the Walk signal when it appears. If the button is pushed during more cycles, then the Walk signal will appear during more cycles, and more pedestrians will potentially benefit from having the pedestrian signal displays.

The previous section considered the percentage of all pedestrians who pushed the button. This section considers the percentage of signal cycles during which the button is pushed. A hypothetical example may clarify this distinction. Assume that data are collected over two signal cycles. Suppose that nine pedestrians arrive during the first cycle and one pedestrian arrives during the second cycle. If only one person in the first cycle pushes the button, then 10 percent of all pedestrians (one out of 10 total) pushed the button, and the button was pushed in 50 percent of the cycles (one out of two). If all nine people in the first cycle push the button, but the person in the second cycle does not, then 90 percent of all pedestrians (nine out of ten total) pushed the button, and the button was pushed in 50 percent of the cycles (one out of two).

Table 2. How many pedestrians pushed the button?

CROSSWALK LOCATION	BEFORE	AFTER	SIGNIFICANCE (0.10 level)
Tecumseh at Annie, east leg	28.7% (167)*	24.9% (221)	N
Tecumseh at Annie, west leg	23.4% (64)	22.4% (58)	N
Tecumseh at Howard, east leg	23.5% (98)	13.6% (162)	✓ (0.041034)
Tecumseh at Howard, west leg	14.9% (101)	9.8% (153)	N
Wyandotte at Patricia	22.6% (279)	18.0% (466)	N
Wyandotte at Sunset, east leg	11.5% (234)	8.7% (618)	N
Wyandotte at Sunset, west leg	10.0% (459)	8.1% (630)	N
TOTAL	16.9% (1,402)	12.7% (2,308)	✓ (0.000443)

ABBREVIATIONS

* Sample sizes in parentheses.
✓ Significant at the 0.10 level or better (significance level in parentheses).
N Not significant.

Table 3 shows the percentage of cycles during which the button was pushed. This analysis includes signal cycles only if pedestrians arrived during that cycle. For example, in the before period at Tecumseh and Annie (east crosswalk), pedestrians arrived at the curb during 70 cycles. Someone pushed the button and activated the Walk signal during 61.4 percent of those 70 cycles. In the remaining 38.6 percent of those 70 cycles, no one pushed the button.

It was expected that the button would be pushed in more cycles in the after period because the light on the illuminated push button is an indication that the button is working. Thus, individuals who cross the intersection may realize that the button works and may be more inclined to push it than they would be if no indication were given.

Table 3. Percentage of cycles during which someone pushed the button.

CROSSWALK LOCATION	BEFORE	AFTER	SIGNIFICANCE
Tecumseh at Annie, east leg	61.4% (70)*	56.0% (89)	N
Tecumseh at Annie, west leg	46.7% (30)	30.3% (33)	N
Tecumseh at Howard, east leg	34.5% (55)	27.6% (76)	N
Tecumseh at Howard, west leg	30.4% (46)	16.1% (87)	X
Wyandotte at Patricia	39.2% (148)	49.0% (143)	✓ (0.093505)
Wyandotte at Sunset, east leg	22.1% (122)	24.6% (203)	N
Wyandotte at Sunset, west leg	21.0% (195)	26.6% (173)	N
TOTAL	32.4% (666)	32.0% (804)	N

ABBREVIATIONS
* Sample sizes in parentheses.
✓ Significant at the 0.10 level or better (significance level in parentheses).
X Significant but in the undesired direction.
N Not significant.

The chi-square statistic was used to compare the number of cycles that the button was pushed in the before and after periods. The effect of illuminated push buttons on the number of cycles that the button was pushed was significant at one location. At another location, the effect was significant but in the wrong direction (i.e., the button was pushed in fewer cycles in the after period). The effect was not significant at the remaining five locations. Overall, the percentage of signal cycles during which the button was pushed was nearly identical in the before period (32.4 percent) and the after period (32.0 percent).

DID PEDESTRIANS COMPLY WITH THE WALK SIGNAL?

For this analysis, observations were made of pedestrians who arrived when parallel traffic had the red signal and when someone had pushed the button. Pedestrians complied with the Walk signal if they waited until the Walk indication appeared before starting to cross (Figure 5). Pedestrians may start crossing early, before the Walk signal appears, if they see a gap in traffic or if they believe that the button does not work and the Walk signal will not appear. Table 4 shows the number and percentage of pedestrians who arrived when parallel traffic had the red signal and who waited for the Walk signal to cross.

Illuminated push buttons are intended to reassure pedestrians that the buttons are working and encourage them to wait for the Walk signal. Hence, it was expected that pedestrian compliance would be higher in the after period, compared with the before period.

The chi-square statistic was used to compare the number of pedestrians who complied in the before and after periods. Most of the illuminated push buttons did not result in a statistically significant effect on pedestrian compliance. At one location, the effect was in the undesired direction (i.e., compliance was *lower* in the after period). However, that location had a small sample size in the before period and the results are not conclusive. Overall, there was a lower percentage of pedestrians complying with the Walk signal in the after period, when illuminated push buttons were in place. The overall effect was not statistically significant.

Figure 5. Pedestrians complying with the Walk signal, Tecumseh at Howard, west crossing.

Table 4. Number and percentage of pedestrians who complied with the Walk signal.

CROSSWALK LOCATION	BEFORE	AFTER	SIGNIFICANCE
Tecumseh at Annie, east leg	89.0% (73)*	94.3% (88)	N
Tecumseh at Annie, west leg	95.2% (21)	81.8% (11)	S
Tecumseh at Howard, east leg	60.0% (30)	68.8% (32)	N
Tecumseh at Howard, west leg	61.1% (18)	68.4% (19)	N
Wyandotte at Patricia	57.1% (77)	61.3% (150)	N
Wyandotte at Sunset, east leg	92.3% (26)	57.0% (100)	S
Wyandotte at Sunset, west leg	65.8% (76)	61.9% (84)	N
TOTAL	72.3% (321)	67.8% (484)	N

ABBREVIATIONS
* Sample sizes in parentheses.
N Not significant.
S Small sample size.

PEDESTRIAN CROSSING BEHAVIOR

Pedestrians were considered to have exhibited "normal" crossing behavior if they walked across the roadway without running or hesitating. Pedestrians did not exhibit normal behavior if they ran at any time during the crossing, if they aborted the crossing, or if they hesitated while crossing. Although some pedestrians will run because they are impatient to get to their destinations, pedestrians usually run, abort, or hesitate in response to oncoming and turning traffic. Pedestrians abort a crossing if they step into the roadway and then retreat back onto the curb because of opposing traffic. A pedestrian hesitation involves stepping into the roadway and then waiting for a gap before starting to cross. A hesitation could also involve crossing part of the way and then waiting for a gap before continuing to cross.

Most pedestrians crossed normally, i.e., without running, aborting the crossing, or hesitating while crossing (Table 5).

Table 5. Number and percentage of pedestrians who exhibited normal crossing behavior.

CROSSWALK LOCATION	BEFORE	AFTER	SIGNIFICANCE
Tecumseh at Annie, east leg	80.2% (167)*	86.9% (221)	✓ (0.077263)
Tecumseh at Annie, west leg	84.6% (65)	77.6% (58)	N
Tecumseh at Howard, east leg	85.7% (98)	62.3% (162)	N
Tecumseh at Howard, west leg	72.3% (101)	85.0% (153)	✓ (0.013483)
Wyandotte at Patricia	77.8% (279)	76.2% (466)	N
Wyandotte at Sunset, east leg	89.3% (234)	89.0% (618)	N
Wyandotte at Sunset, west leg	88.0% (459)	90.4% (633)	N
TOTAL	83.8% (1,403)	85.8% (2,311)	N

ABBREVIATIONS
* Sample sizes in parentheses.
✓ Significant at the 0.10 level or better (significance level in parentheses).
N Not significant.

Illuminated push buttons are intended to increase the probability that pedestrians will comply with the Walk signal and thereby be less exposed to oncoming traffic. Consequently, it was expected that the percentage of pedestrians who crossed normally would increase after installation of the illuminated pedestrian push button.

The chi-square statistic was used to evaluate the change in the percentage of pedestrians who crossed normally, from the before to the after period. As Table 5 shows, the effects were significant at two locations (i.e., higher percentage of normal behavior after installation of illuminated push buttons) and not significant at five locations.

DISCUSSION AND CONCLUSIONS

This study involved the before-and-after evaluation of illuminated pedestrian push button devices on pedestrian behavior. A total of seven crosswalks at four intersections in Windsor, Ontario, was used for test purposes. These intersections were located near schools, a large shopping center, and a strip commercial area. The key findings and authors' discussion are as follows:

1. The illuminated pedestrian push buttons had a minimal effect on pedestrian behavior at the test sites.

Table 6 summarizes the effects of illuminated push buttons on the selected MOEs. It shows, for example, that the effects on the number of pedestrians who pushed the button were significantly better at one location and were not significant at the remaining six locations.

At most sites, no significant differences were found in pedestrian behavior. However, there was a reduction in "abnormal" crossing behavior (i.e., running, aborted crossings, and hesitations) at two of the sites after illuminated push buttons were installed. At one site, there was an improvement in terms of the number of signal cycles in which someone pushed the button. When all sites are taken together, there were more pedestrians who pushed the button after the illuminated push buttons had been installed.

Traffic officials in the City of Windsor indicated that they are receiving fewer service calls with the illuminated push buttons than with the conventional push buttons. They attributed the reduction to fewer "false" service calls, i.e., calls from residents who mistakenly believe that the push buttons are not working properly when in fact the buttons are working. Thus, the buttons may not have had much of an effect on pedestrian behavior, but the City is saving money by not having to respond to as many unnecessary requests for service.

2. A major reason for the lack of effectiveness of the illuminated push button device may be that it does not address several basic reasons for pedestrians not pushing the buttons.

The results of this study showed that only 16.9 percent of pedestrians pushed the button in the before period and 12.7 percent pushed the button in the after period (Table 3). Furthermore, the button was pushed during only 32 percent of the signal cycles in both the before and after periods (Table 2). Previous research in the United States has found that only about half of pedestrians will push a button to activate a Walk signal (Zegeer et al., 1985).

Table 6. The effects of illuminated push buttons by site.

CROSSWALK LOCATION	PEDESTRIANS WHO PUSHED THE BUTTON	CYCLES IN WHICH THE BUTTON WAS PUSHED	COMPLIANCE WITH WALK SIGNAL	NORMAL PEDESTRIAN BEHAVIOR
Tecumseh at Annie, east leg	N	N	N	Better (0.077263)
Tecumseh at Annie, west leg	N	N	S	N
Tecumseh at Howard, east leg	Better (0.041034)*	N	N	N
Tecumseh at Howard, west leg	N	Worse (0.053548)	N	Better (0.013483)
Wyandotte at Patricia	N	Better (0.093505)	N	N
Wyandotte at Sunset, east leg	N	N	S	N
Wyandotte at Sunset, west leg	N	N	N	N
TOTAL	Better (0.000443)	N	N	N

<u>ABBREVIATIONS</u>

* Significance levels in parentheses.
N No significant change.
S Small sample size.

One reason why pedestrians may not push the buttons to activate a Walk signal is their lack of confidence that pushing the button results in the desired effect. As in the case of an elevator button, the illuminated push button is intended to address this concern by giving immediate feedback to the pedestrian and hopefully encouragement to wait for the Walk signal. Following are some of the other possible reasons why pedestrians do not push a button:

1. They do not know that pushing the button is required to get the Walk signal.
2. They arrive when parallel traffic has the green.
3. They arrive when parallel traffic has the red, but there is a gap in opposing traffic, and they see no reason to wait for the Walk signal.
4. The button is mounted too far away or is hidden from view, or the pedestrian push button sign is not visible.

5. They do not know which of two buttons mounted on the same pole pertains to the desired crossing.
6. Many pedestrian signals are on recall (and do not have push buttons). These lead pedestrians to automatically expect a Walk interval at every pedestrian signal.

It seems unlikely that replacing conventional push buttons with illuminated push buttons will effectively address these issues.

Pedestrians may push buttons (including illuminated push buttons) more often if they get a bigger "reward," i.e., a shorter wait time or a longer crossing interval. This option may be possible at crossings with high pedestrian volume but that do not quite warrant a fixed-time signal with an automatic Walk signal on every cycle. The illuminated push buttons that were evaluated in this study did not provide a quicker or longer crossing opportunity.

3. Another reason for the lack of effectiveness may be that the light is difficult to see.

The illuminated push button device that was evaluated in this study is the accepted design being used at hundreds of intersections in Canada. It has only a small orange light that may be difficult for pedestrians to see, particularly in the sun's glare.

A more visible acknowledgment or an audible message may be more effective. For example, some push buttons in Germany display a lighted message, "SIGNAL KOMMT" (translates as "Signal is coming") when the button is pushed (Figure 6). Other push buttons emit a soft ticking sound that varies in speed according to how much longer before the WALK signal appears (FHWA Study Tour, 1994).

Figure 6. A pedestrian push button displaying the message "SIGNAL KOMMT" (signal is coming). (FHWA Study Tour, 1994).

4. The potential for gaining further pedestrian compliance to the Walk signal may be limited at the study sites.

The majority of pedestrians (72.3 percent in the before period and 67.8 percent in the after period) who arrived when parallel traffic had the red and who pushed the button complied with the Walk signal (Table 4). Perhaps these percentages are at or near the maximum levels of compliance that these crossings will attain, given existing traffic and pedestrian characteristics. That is, there may be little or no additional compliance that can be realized without effective pedestrian enforcement or educational programs.

It appears that the effects of illuminated push buttons on changing pedestrian behavior may be limited. Perhaps the effects are stronger at locations other than those that were evaluated. It is also likely that illuminated push buttons may not be the best means to change behavior. As noted at the beginning of this paper, the City of Windsor is replacing conventional buttons with illuminated buttons in response to complaints that the conventional buttons were not working. Illuminated push buttons may be a worthwhile investment simply to cut down on the costs associated with field-checking buttons that the public erroneously report as being out of order.

5. The testing in this study was limited in duration and does not necessarily reflect long-term effects that may result after a longer acclimation period.

The days and times when data were collected in this study are a snapshot of pedestrian and motorist behavior, and may or may not accurately portray long-term behavior. Day-to-day variations in the MOEs may obscure significant changes and magnify insignificant changes. For example, if the reality is that 50 percent of pedestrians will comply with the Walk signal in the before period and 60 percent in the after period, the expected change would be an increase of 10 percent. The actual percentages will vary from one day to the next, with a mean of 50 percent in the before period and 60 percent in the after period. If a higher-than-average percentage of pedestrians complied when before data were collected, and a lower-than-average percentage complied when after data were collected, then the observed change will be less than 10 percent, and may turn out to be not significant. Improvements in pedestrian behavior may also result from pedestrian educational programs regarding such devices and proper crossing behavior.

Although the results of this study were disappointing, it would be worthwhile to evaluate illuminated pedestrian push buttons at other locations to determine if improved behavior or crossing conditions would result.

6. Other signal hardware is also being tested in the United States in an attempt to enhance pedestrian safety.

Countdown signals are being tested in a few places, including Sacramento County, California, and Lake Buena Vista, Florida. By displaying the number of seconds left before the steady Don't Walk signal appears, a countdown signal provides more information than conventional pedestrian signals.

A countdown signal may serve to reassure a pedestrian who is in the crosswalk when the flashing Don't Walk signal appears that he or she still has time to finish crossing and does not need to panic.

In addition to illuminated push buttons, other tools are available to the traffic engineer to increase the likelihood that pedestrian signals will be activated without pushing buttons. For example, the signals could be fixed-time, with pedestrian indications in every cycle. This option may not be practical at wide intersections, where pedestrian crossing times often dictate the allocation of green time among vehicle movements. A second option is to install infrared, microwave, or video detection devices to automatically detect pedestrians and activate the pedestrian intervals. Microwave detectors are being tested in cities such as Los Angeles and Phoenix.

Even if pedestrian signals are activated more consistently (through the use of illuminated push buttons, automated detection, or recall), there is no guarantee that pedestrians will comply and wait for the Walk signal (Figure 7). An immediate Walk signal (a "hot" button), or at least a shorter delay between activation and the appearance of the Walk signal is likely to improve compliance, but can disrupt intersection operations if the signal is frequently activated. Education can help improve compliance. For instance, an informational sign could explain what pedestrians should do during the Walk, flashing Don't Walk, and steady Don't Walk intervals (Figure 1). Stricter enforcement of pedestrian compliance would also result in fewer people crossing against the signal. Better enforcement of driver compliance to traffic signals (e.g., red light cameras) may also be effective in improving pedestrian safety at signalized intersections.

A Pedestrian User's Guide will soon be available from the Federal Highway Administration. This User's Guide will assist the traffic engineer in identifying and remedying problems in the pedestrian environment.

Figure 7. This pedestrian is waiting for the Walk display, but many pedestrians do not wait.

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