Pedestrian Countdown Signals: Experience with an Extensive Pilot Installation

SAN FRANCISCO, CA, USA'S PILOT PEDESTRIAN COUNTDOWN SIGNALS WERE ASSOCIATED WITH A DECREASE IN PEDESTRIAN INJURIES AND FEWER PEDESTRIANS FINISHING CROSSING ON RED. THIS FEATURE DISCUSSES THE IMPACTS OF THE POPULAR DEVICES ON COLLISIONS, PEDESTRIAN BEHAVIOR AND ATTITUDES, MOTORIST BEHAVIOR AND SIGNAL MAINTENANCE NEEDS.

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INTRODUCTION

At a street corner in San Francisco, CA, USA, one senior citizen said to another, "I'm a '15.' What are you?" They were discussing how long it takes them to cross the street, no longer a mystery with pedestrian countdown signals installed at about 700 of San Francisco's 1,100 signalized intersections.

More than a conversation piece, however, San Francisco's countdown signals have been associated with a 52-percent reduction in pedestrian injury collisions at pilot locations. Figure 1 shows the numeric display. Pedestrian countdown signals attempt to improve safety by displaying the time left to cross. The San Francisco Department of Parking and Traffic equipped 14 intersections in a pilot program beginning in March 2001.

Pedestrian noncompliance with signs and signals is a significant factor in pedestrian injury collisions nationally and in San Francisco, partly reflecting the frequent misunderstanding of conventional pedestrian signals. Countdown signals attempt to improve this situation by providing information on how much time is left to cross safely.

These devices have been used nationwide with generally favorable results.[1] Evaluations in Minneapolis–St. Paul, MN, USA and Montgomery County, MD, USA, each assessed five pilot locations. The Minnesota study found a reduction in pedestrians finishing crossing after conflicting traffic received the green indication and 79 percent of interviewees preferring the countdown to the conventional signal. The Montgomery County study found a reduction in pedestrian/vehicle conflicts.

In San Jose, CA, the percentage of pedestrians finishing crossing on red also was lower with countdown signals, although the study authors noted that pedestrians more often interpreted the countdown signal as allowing the start of crossing during the pedestrian clearance interval. This early experience led to the adoption of countdown signals in 2002 as a standard device in the *Manual on Uniform Traffic Control Devices* (MUTCD) *Millennium Edition*, Revision 2.

Figure 1. Pedestrian countdown signal.

Beginning in March 2001, San Francisco equipped 14 intersections in one of the early pilot testing programs in California. The period covered was sufficient that any "novelty" impacts ("the Hawthorne effect") were minimized.

(The Hawthorne effect refers to the phenomenon identified by researchers at the Western Electric Hawthorne plant, who found that virtually any reasonable change in the workplace environment had a positive impact on productivity, which they hypothesized was due to improved morale attributable to the attention paid to workers by researchers, rather than the changes themselves.)[2]

The pilot intersections were selected based on a range of factors, including pedestrian injury collision record; pedestrian volumes; crossing distance; public complaints about perceived safety; and diversity of physical and social environments. Although a press conference was held with San Francisco's mayor to introduce the new signals and the California State Automobile Association developed a flyer, the basic meaning of the countdown was intuitive to virtually all pedestrians.

Because the countdown starts (per MUTCD) at the beginning of the flashing red hand (the pedestrian clearance interval)—when pedestrians are not to start crossing—the flyer suggested that the countdown should not be used to determine when to start crossing. As discussed later, for many pedestrians who walk faster than the average rate, however, starting at the beginning of the countdown actually is quite safe.

Provided with the opportunity to replace conventional pedestrian signals with light-emitting diode (LED) signals and encouraged by the preliminary results described in this feature, San Francisco decided to convert virtually all pedestrian signals citywide to the countdown version. San Francisco has installed countdown signals at about 700 intersections and intends to install them at all 1,100 signalized intersections in the city.

STUDY PURPOSE AND OBJECTIVES

The first stage of the evaluation (the preliminary evaluation) assessed behavioral impacts and attitudes toward the new devices. The second stage included crash analysis and maintenance history. The evaluation attempted to answer the following questions:

- Do countdown signals reduce pedestrian injuries?
- How do they change pedestrian behavior, especially when pedestrians start and finish crossing?
- How do countdown signals change driver behavior, especially red-light running?
- Do pedestrians like countdown signals and, if so, why?
- Do countdown signals imply to pedestrians that it is acceptable to leave on the flashing red hand?
- Are there any serious maintenance or installation problems?
- How effective is starting the countdown on the flashing red hand, as directed by MUTCD?

DATA COLLECTION AND ANALYSIS METHODS

Crash Analysis

The San Francisco Department of Public Health geo-coded and mapped state-collected data for every pedestrian injury event that occurred within 50 feet (15.2 meters) before and after the installation of countdown signals at the nine pilot intersections that were equipped first (March to May 2001). There has been insufficient time since the citywide installation to allow for an evaluation of the citywide impacts, but such an evaluation is planned for the near future.

The 21-month "after" treatment period began on April 2, 2001 and ended on December 31, 2002. The "before" treatment period included an equivalent amount of time (July 2, 1999 to April 1, 2001) before the pilot installation was completed.

Changes in injury counts over time may be due to overall changes in pedestrian or motor vehicle travel frequency or behavior throughout San Francisco. Also, because intersections chosen for special improvement typically are selected at least partly because they have high numbers of collisions, statistically, they would be likely to improve even if nothing were done. This is termed "regression to the mean."

To determine if there was a temporal effect, two other types of intersections were included in the analysis. The authors mapped a list of intersections that were scheduled or considered for countdown signals (that had traffic signals and, in most cases, conventional pedestrian signals) and that had at least one injury during the observation period; these were "Planned CD" intersections. The remaining intersections that had at least one injury in the observation period were "No Signals Planned" intersections. For a statistical test of the differences in injury trends, a Poisson model with the SAS statistical package was used.[3]

Because the pilot countdown locations were selected based partly on higher-than-average pedestrian injuries, the pilot countdown intersections were compared to a sub-group of signalized intersections that had a minimum of two pedestrian injury crashes in the 21-month pre-installation period. The mean number of pedestrian injury crashes in the pilot group was 3.00; the mean number in the comparison sub-group was 2.74. They were closely matched.

Pedestrian and Driver Behavior

Two sets of behavioral assessments were performed. The first involved observations of pedestrians shortly before and after the devices were installed in 2001 for:

- Signal phase when a pedestrian started and finished crossing;
- Whether a pedestrian ran or aborted crossing; and
- Whether there was a pedestrian-vehicle conflict (near miss).

In addition, a sample of vehicles was observed for:

- Signal phase when a vehicle entered intersection;
- Signal phase when a vehicle cleared intersection; and
- Whether there was a pedestrian-vehicle conflict (near miss).

This initial evaluation included observations of nearly 600 pedestrian crossings before installation and over 900 post installation.

In some cases, yellow intervals were extended and/or all-red phases were added when the countdowns were installed. Positive impacts may be due partly to this signal timing change rather than the countdown devices themselves, although the changes were made gradually to the planned countdown signals control group as well. It is not possible to separate the two effects.

The second set of pedestrian/vehicle observations was carried out in spring-summer 2003 at eight intersections. A total of 1,342 pedestrians were observed for this post-installation phase. Differences in proportions before installation versus post installation were assessed with a Z-test.

Pedestrian Attitudes and Knowledge

During the pre-installation and first post-installation phases, pedestrians at each study intersection were approached and questioned briefly about their attitudes and knowledge. Questions covered:

- Whether respondents noticed the countdowns;
- How helpful respondents found the countdowns;
- How the countdowns compared to conventional pedestrian signals;

- Whether respondents thought they were crossing differently due to the countdowns; and
- Whether respondents knew that to start crossing on the flashing red hand (flashing DON'T WALK) is a violation of the vehicle code.

Installation and Maintenance Experience

The Department of Parking and Traffic's Signal Shop maintains records of maintenance calls. These were available for assessing the reliability of countdown signals.

STUDY RESULTS

Crash Analysis

The number of pedestrian injury crashes declined by 52 percent after the introduction of the countdown signals (see Table 1 and Figure 2), a statistically significant reduction (confidence interval = 24.8 percent, 93.3 percent, p-value <= 0.03). There was a slight decline for the primary comparison intersection types during the time periods in question. These comparison intersection declines were not statistically significant, although the number of intersections and the injury counts were large.

The reduction in injury crashes in a higher injury non-countdown comparison sub-group was almost as great as the decline in the countdown treatment group, and the difference was not statistically significant. This suggests that regression to the mean may have played a major role in the decline.

However, the countdown injury decline was consistently greater than the non-countdown decline, in several different comparisons matching countdown and non-countdown intersections with similar pre-installation injury levels. Therefore, although the 52-percent reduction in collisions overstates the impact of the countdown, a real reduction did occur.

Table 1. Pedestrian injury events before and after countdown signals were installed.

Treatment group	Number of intersections	Number of injury events	Percentage of injuries after/before
Group A: Countdown signals installed			
After	9	13	48.1[a]
Before		27	
Group B: Planned countdown intersections			
After	629	740	97.0
Before		764	
Group C: No signals planned			
After	628	423	90.0
Before		469	
Group D: Countdown signals installed with 2+ crashes pre-installation			
After	7	11	42.3[a,b]
Before		26	
Group E: Planned countdown signals with 2+ crashes for the same period			
After	185	282	55.6[a,b]
Before		507	

* Note:
[a] = Sample group crash reduction statistically significant, p-value < .05
[b] = Difference between groups D and E not statistically significant
Before = prior period (July 2, 1999 to April 1, 2001)
After = treatment period (April 2, 2001 to December 31, 2002)

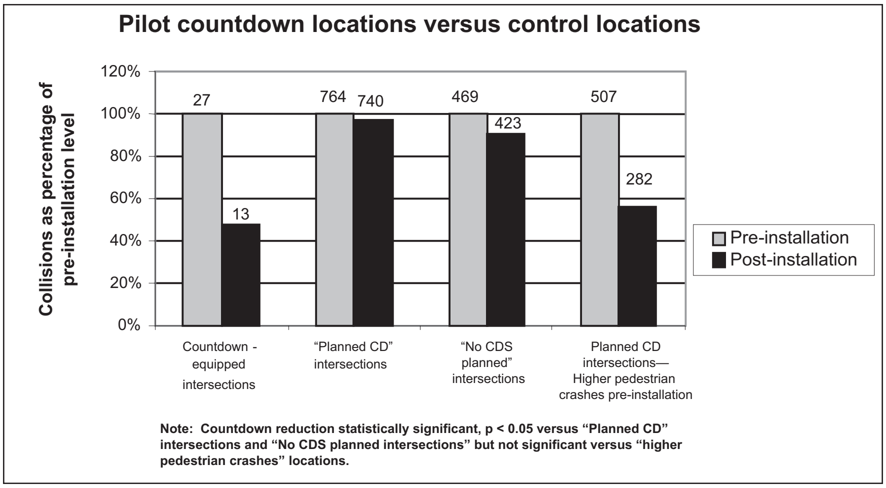

Figure 2. Pedestrian injury collision impacts of countdown signals.

Pedestrian Behavior

The most important findings of the preliminary behavioral observations (as illustrated in Figure 3) were as follows:

- The percentage of pedestrians still in the crosswalk when the signal turned red showed a statistically significant decrease after the installation of countdown signals.
- The percentage of pedestrians leaving during the flashing red hand or solid red hand increased slightly (but not to a statistically significant degree).
- The percentage of pedestrians running or aborting their crossings showed a statistically significant decrease.
- The percentage of observed vehicle/pedestrian conflicts decreased (but not to a statistically significant degree).

Pedestrians who finished crossing on red dropped from 14 to 9 percent at eight intersections that were observed (during one pre-installation data collection period and two post-installation sets). This decrease is statistically significant (probability less than 1 percent of a difference due to random sample variation, pre-installation N = 591, post-installa-

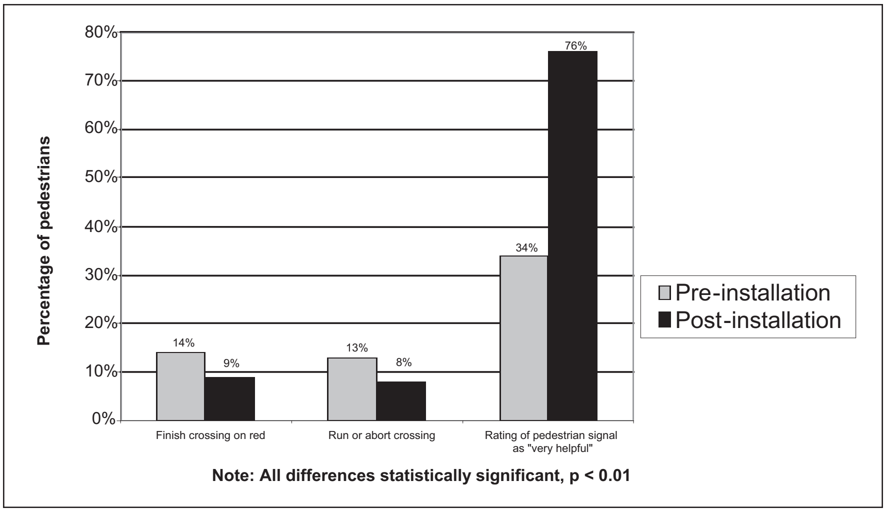

Figure 3. Pedestrian behavior impacts of countdown signals.

tion N = 916, on a two-tailed Z-test of the difference of proportions).

This result was due mostly to walkers hurrying across (more often finishing on the yellow) rather than being more compliant with pedestrian signals. The proportion of pedestrians starting crossing on the flashing or solid red hand (DON'T WALK) increased by 1 percentage point—not significant, although the impacts varied widely by location.

The proportion of pedestrians who ran or aborted their crossing dropped from 13 to 8 percent, a statistically significant result ($p < 0.01$). There was a small change in observed vehicle/pedestrian conflicts, dropping from 6 to 4 percent of pedestrians (not statistically significant).

In the second (2003) set of observations, the proportion finishing crossing on red also was 9 percent (down from 14 percent in the pre-installation observations, significant, $p < 0.01$). The proportion observed running or aborting their crossing dropped even further (from 13 to 4 percent, $p < 0.01$). Vehicle/pedestrian conflicts dropped below 1 percent (from the 6 percent initially observed, $p < 0.01$).

Driver Behavior

There was a small decrease in the reported incidence of red-light running (drivers entering the intersection on red), from 2 percent on pre-installation to 1 percent during both post-installation periods (not statistically significant).

A more rigorous study of driver behavior and human factors in Monterey, CA, found that unsafe driver behavior was not a problem, although concerns had been raised that drivers will use the countdown to decide whether to speed up on a "stale" green.[4] However, observers generally agree that most drivers seem to use the information to make sure they do not run the red light; some drivers may speed up. At many locations during peak periods, congestion makes speeding difficult or impossible.

Pedestrian Attitudes and Knowledge

In the 2001 data collection effort, interviewees finding pedestrian signals "very helpful" increased substantially with the countdown signals—only 34 percent with conventional signals but 76 percent with countdown signals. About 92 percent of post-installation interviewees explicitly said the countdown signals were "more helpful" than conventional pedestrian signals, primarily because they showed the time remaining to cross.

This is consistent with recent Federal Highway Administration (FHWA) research, which showed that a pedestrian sample strongly preferred countdown signals to actual and theoretical versions of pedestrian signals, and that the countdown version was "most easily understood."[5]

Only 6 percent said the conventional pedestrian signals were more helpful. In these few cases, the apparent reason was the clarity of the walking person/red hand symbol. In the pilot program, the countdown symbols used only the outline of the red hand/walking man, but current San Francisco specifications call for a solid density of LED pixels.

Few (17 percent) understood that it is a violation of the vehicle code to start crossing during the countdown (flashing red hand). This compares to 40 percent in the pre-installation study. This suggests that pedestrians are using the countdown signals to decide when to start to cross, which is not the official purpose in San Francisco. A substantial proportion of pedestrians do not strictly follow the "letter of the law" (the Uniform Vehicle Code/MUTCD sections on pedestrian signal compliance).

MUTCD calls for pedestrian clearance to be based on a walking speed of 4.0 feet per second or slower. In San Francisco, 77 percent of pedestrians walk faster than this rate; therefore, a large share know they can "beat the countdown" if they start walking early enough in the pedestrian clearance phase. The MUTCD prohibition on starting to cross during the flashing red hand (the pedestrian clearance) is called into question when pedestrians can judge for themselves whether they can cross safely before conflicting traffic starts.

The authors recommend that the wording "pedestrians shall not" begin crossing should be changed to "pedestrians should not" begin crossing. Pedestrians are capable of judging time and distance, as demonstrated when they cross at uncontrolled crossings with heavy traffic volumes, determining whether a gap in traffic is adequate.

Installation and Maintenance Experience

The devices manufactured by GELcore™ (Valley View, OH, USA) and Dialight™ (Farmingdale, NJ, USA) had a generally positive record. The manager of the Department of Parking and Traffic's Signal Shop believed that the reliability of the countdown signals had been close to that of conventional (incandescent) pedestrian signals.

STUDY CONCLUSIONS AND RECOMMENDATIONS

Although additional long-term studies would be useful, the initial results from San Francisco's pilot locations provide a number of useful conclusions:

- Countdown signals appeared to reduce pedestrian injuries. Although the test group's reduction by roughly half likely was affected by regression to the mean, because the countdown reductions were consistently greater than those experienced at higher injury non-countdown locations, an improvement in safety is clearly indicated by the study. Although the trial involves a limited number of intersections, the trial period was long enough to reduce the novelty factor.
- The countdowns reduced the proportion of pedestrians finishing crossing on the red. There has not been a significant increase in the number of pedestrians starting to cross during the pedestrian clearance phase.
- The countdowns did not result in an increase in drivers running red lights.
- The devices are viewed very favorably by pedestrians for providing additional information. They are better understood than conventional pedestrian signals.
- The devices appear to imply to a substantial proportion of pedestrians that it is proper to start crossing on the flashing red hand (flashing DON'T WALK). However, the disadvantages of this effect are less important than the advantages listed above.
- The countdown signals are relatively easy to install for signal electricians. The maintenance record from two different manufacturers has been positive.
- Starting the countdown on the pedestrian clearance does not appear to reduce effectiveness substantially or trigger public complaints. Although there initially was concern among pedestrian advocates and some Department of Parking and Traffic staff that the shorter countdown would lead to complaints about allegedly insufficient time to cross and lack of usefulness, that has not been the case.
- The LED signals save energy compared to the incandescent version they replaced. The countdown uses roughly 9–10 watts and the hand/walking man uses 6–9 watts, versus about 67 watts for conventional incandescent pedestrian signals. The energy savings are a key component of San Francisco's conversion to countdown signals—the cost of installing the new countdowns was financed entirely through a loan with the state of California to be repaid out of reduced energy costs.

NEXT STEPS

Although the results are encouraging, additional analysis will be carried out when citywide results over an extended period are available. Also, within the next several years, national tests will be conducted with pedestrian countdown signals that add "animated eyes." The shifting eyes during the WALK phase remind pedestrians to check both ways. This would be funded by FHWA as part of an evaluation of several innovative technologies.

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ITE Coordinating Council Summary Report— Key Projects Completed in 2005

Council	Committee Title	Type	Committee Chair
Management & Operations/Intelligent Transportation Systems Council	Management and operations mega-issue	Informational report	Pat Noyes, 303-440-8171; pat@patnoyes.com
	Traffic signal self-assessment	Other	Les Jacobson, 206-382-5290; jacobsonl@pbworld.com
Parking Council	Rescission of Guidelines for Parking Design	Other	Randy McCourt, 503-243-3500; rsm@dksassociates.com
Pedestrian and Bicycle Council	*Site Design Review Guidelines for Promotion of Alternative Transportation Modes: Canadian Guide to Promoting Sustainable Transportation Through Site Design*	Informational report	Eugene Chartier, 905-985-7346 ext. 10; gchartier@township.scugog.on.ca
	Segway investigations	*ITE Journal* article	Luis Porrello; lporrello@hntb.com
Traffic Engineering Council	Update of *Guidelines for Prohibition of Turns on Red*	Recommended practice	Bill Savage, 517-339-3933; msusavage@aol.com
	Benefits of retiming traffic signals	Brochure	Srinivas Sunkari, 979-845-7472; s-sunkari@tamu.edu
	Preemption of Traffic Signals at or Near Railroad Grade Crossings with Active Warning Devices (Revision)	Recommended practice	Thomas Lancaster, 503-248-0313; tom@lancasterengineering.com
Transportation Consultants Council	2005 Young Professionals Scholarship Program	Other	Paul Eng-Wong, 212-695-5858; peng-wong@eng-wongtaub.com
Transportation Education Council	Knowledge expectation survey	Survey	Gary B. Thomas, 979- 458-3263; g-thomas@tamu.edu
	ASCE Policy 465	*ITE Journal* article	Martin Lipinski, 901-678-3279; mlipinski@memphis.edu