Driver-Yielding Results for Three Rectangular Rapid-Flash Patterns

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Flashing traffic control devices can help draw drivers' attention to the traffic control device and to the area around the device. When interim approval for the use of the rectangular rapid-flashing beacon (RRFB) was issued by FHWA in July 2008, the only flash pattern that had been tested was a flash pattern that had two pulses on one side of a light bar followed by five pulses on the other side (commonly called the 2-5 pattern); Table 1 shows an illustration of this pattern. Because the 2-5 pattern appears to the human eye to be a 2-3 flash pattern, several devices were installed with the 2-3 pattern rather than the 2-5 pattern. The inability to accurately determine the number of pulses within a pattern was later confirmed in a closed-course study. The same closed-course study found that certain flash patterns—those that could be characterized as having limited or no dark periods within the flash pattern—negatively influenced the amount of time participants needed to identify the direction a pedestrian was walking. Prior to developing the proposed provisions for incorporating a rapid-flashing beacon traffic control device into the *Manual on Uniform Traffic Control Devices*, it is important to determine which flash patterns are acceptable from the perspectives of effectiveness and simplicity. This study seeks to determine if less complicated flash patterns and flash patterns with different proportions of dark and light periods can be as or more effective than the 2-5 pattern.

An open-road study was conducted to examine different flash patterns used with yellow, rapid-flashing beacons. The objective of the study was to determine if drivers yielded differently to the selected flash patterns. The measure of effectiveness was the number of drivers who did and did not yield to or stop for a staged pedestrian who activated the rapid-flashing beacon and was attempting to cross the roadway. The study included eight sites, located in either College Station or Garland, Texas. Seven of the sites had four lanes with a 40- or 45-mph posted speed limit. The remaining site had two lanes and a 30-mph posted speed limit. Figure 1 is a photo of one of the sites.

A temporary light bar and controller were developed to permit the research team to have control over several of the beacon's characteristics, such as flash pattern and brightness. The light bar was designed so that it was not obvious that the beacons being observed during the staged pedestrian crossings were any different from the permanent RRFB light bar to which they were mounted. A remote control was used to activate the temporary light bar.

Table 1 illustrates the three patterns selected for testing in the field using the temporary light bars. The patterns examined in this study included the following:

- Pattern using a combination of long and short flashes (called Blocks).
- Pattern using a combination of wig-wag and simultaneous flashes (called WW+S).
- The 2-5 pattern (called 2-5).

Table 1. Flash patterns studied.

Pattern	Blocks		WW+S		2-5	
Cumulative Time (ms)	Left—Time Beacon Is On (ms)	Right—Time Beacon Is On (ms)	Left—Time Beacon Is On (ms)	Right—Time Beacon Is On (ms)	Left—Time Beacon Is On (ms)	Right—Time Beacon Is On (ms)
25	25		25		25	
50	25		25		25	
75	25				25	
100	25	25			25	
125	25	25		25	25	
150	25	25		25		
175	25					
200	25					
225	25		25		25	
250			25		25	
275					25	
300					25	
325		25		25	25	
350		25		25		
375		25				
400	25	25				
425	25	25	25	25		25
450	25	25	25	25		
475		25				25
500		25				
525		25	25	25		25
550			25	25		
575						25
600						
625						25
650						25
675						25
700						25
725						25
750						25
775						25
800						25
On time (ms)	**300**	**300**	**200**	**200**	**250**	**300**
Percent of cycle for a given beacon with the beacon on	**38%**	**38%**	**25%**	**25%**	**31%**	**38%**
On ratio = percent of cycle where at least one of the beacons is on	**56%**		**37%**		**69%**	
Off ratio = percent of cycle where both beacons are dark	**44%**		**63%**		**31%**	

= Beacon is on for 25 ms

= Beacon is off

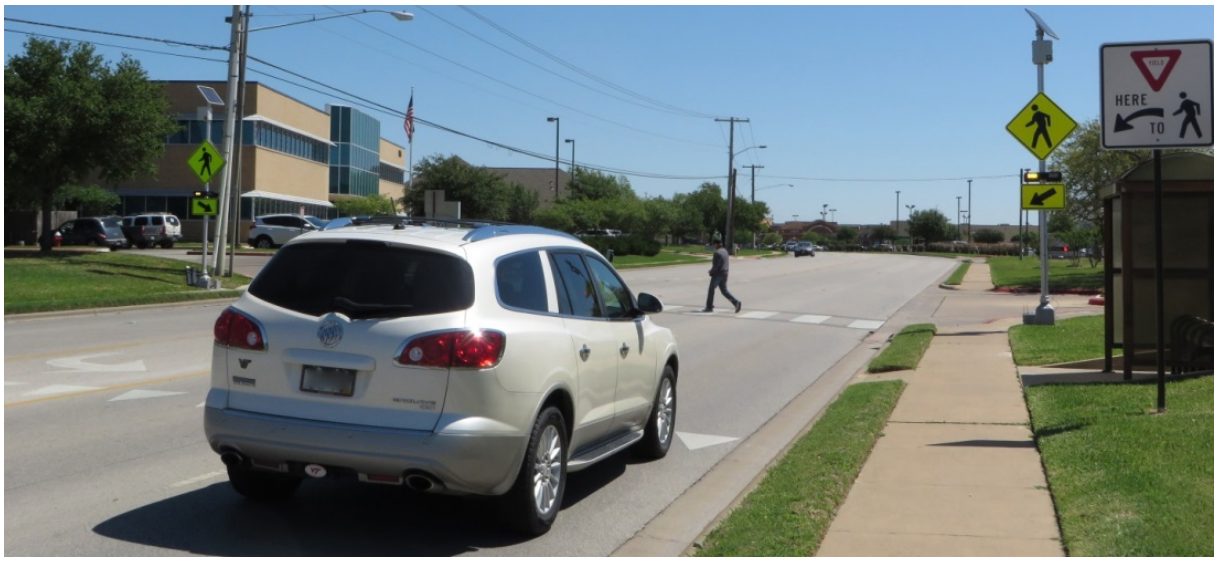

Figure 1. Study site with installed temporary light bars and staged pedestrian crossing.

The research team used a staged pedestrian approach to evaluate driver yielding for the different patterns. Under this protocol, a member of the research team acted as a pedestrian using the crosswalk to stage the conditions under which driver yielding could be observed. Each staged pedestrian wore similar clothing (a gray t-shirt, blue jeans, and gray tennis shoes) and followed specific instructions in crossing the roadway. The staged pedestrian was accompanied by a second researcher, who observed and recorded the yielding data on pre-printed datasheets. Data were collected for a minimum of 40 crossings for each pattern at each site during February and March 2014. Table 2 shows the average yielding rates per site and pattern. The overall average driver yielding for the WW+S pattern at the eight sites was 80 percent, for the Blocks pattern 80 percent, and for the 2-5 pattern 78 percent.

Logistic regression was used to model the yielding and not-yielding data for each crossing. The results from the generalized linear mixed model indicate that there is no significant difference between the 2-5 flash pattern and the WW+S flash pattern (P=0.321) or between the 2-5 flash pattern and the Blocks flash pattern (P=0.176). The WW+S and Block patterns developed as part of this research study were as effective as the 2-5 pattern.

Table 2. Driver yielding rate by site and pattern.

Site	WW+S Pattern	Blocks Pattern	2-5 Pattern
CS-02	63%	50%	61%
CS-03	84%	94%	87%
GA-02	76%	75%	67%
GA-06	96%	81%	85%
GA-07	78%	92%	84%
GA-10	90%	94%	89%
GA-11	87%	90%	82%
GA-13	80%	84%	84%
All	**80%**	**80%**	**78%**