Blue Light Special: Improving Bicycle Infrastructure with Active Feedback Devices

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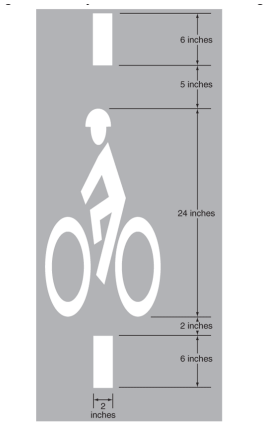
With such a growing bicycle community in North America, the demand for improved bicycle facilities has become imperative. Over the years, Portland, Oregon has developed a reputation of being one of the most bike-friendly cities in the U.S., as well as an innovator of bicycle technologies and infrastructure. Using inspiration from The Netherlands, the Portland Bureau of Transportation (PBOT) has recently been testing various detection technologies and new types of active feedback devices at traffic signals, which indicate to cyclists that they are being detected. This study summarizes what has been done and whether these active feedback devices impact cyclist behavior, and the extent to which these devices can be installed to improve bicycle facilities.

Currently, the City of Portland uses the Manual on Uniform Traffic Control Devices (MUTCD) 9C-7 bicycle stencil located over an inductive loop to indicate to cyclists where they should wait to be detected and place a call for a green light. The MUTCD R10-22 sign is also used and explains the purpose of the 9C-7 pavement parking. However, this pavement marking and sign are not always utilized consistently at intersections with bicycle detection, which creates confusion among the cycling community. Many cyclists are unaware of, or unclear on, the proper location they should position themselves in order to receive a green indication. This forces cyclists to either wait for an approaching vehicle to call a green light, or run a red light. The inability to be detected is a frustrating experience for any roadway user whether it is a vehicle, cyclist, or pedestrian. This inefficiency in our bicycle facilities, which sometimes leads to dangerous and unsafe behavior, demonstrates the importance of determining whether an active feedback device would be beneficial.



9C-7 Bicycle Detector Pavement Marking

R10-22 Bike Actuation Sign

Figure 1: MUTCD 9C-7 Bicycle Stencil and R10-22 Sign

The City of Portland completed a research study last year. This study involved a traffic signal detector feedback device which was installed at the intersection of SW Moody Avenue and SW Sheridan Street in

Portland, Oregon. At this location, there was an existing bicycle-only signal with its own bicycle phase for northbound cyclists, an inductive loop and 9C-7 bicycle stencil, and a bicycle push button. The MUTCD R10-22 sign was not installed at this location. The feedback device was mounted next to the red signal face on the bicycle signal. The device emits a small, blue light when a cyclist is positioned over the loop detector (on a 9C-7 stencil) and indicates to cyclists that their call for a green light has been made successfully. The study included three different instances where video data was collected: 1) before the blue light feedback device was installed, 2) after the blue light feedback device was installed, and 3) after an informational sandwich board sign depicting the purpose of the blue light was installed. The video data was collected from 7:30 A.M. to 6:00 P.M. on all days of data collection.

Figure 2: Blue Light Feedback Device at SW Moody Avenue and SW Sheridan Street in Portland, Oregon

Placement of front of Sign in Field. Looking Northeast.

Information on Back of Blue Light Informational Sign.

More information on the
BLUE LIGHT

1) There are detectors embedded in the road to detect metal objects at intersections. The bike stencil indicates the ideal location of the metal detector.
2) When metal is detected, a message is sent to the traffic signal to give the detected object a green light.
3) Also, the BLUE LIGHT turns on confirming when an object is detected.
4) As long as you see the blue light, a message is sent to the traffic signal to give you a green light as soon as possible.

If there are any issues with this traffic signal, please call 503-823-CYCL (2925)

Figure 3: Blue Light Informational Sandwich Board Sign

The video data was analyzed by observing and recording the behaviors of the northbound cyclists, specifically the first cyclists' behaviors. The behavior of the following cyclists were omitted since their decisions may not be independent, but instead influenced by the first cyclists' decisions. However, red light running, which is an independent decision, was noted for all cyclists. Analysts observed whether the first northbound cyclist chose to call for a green light by pushing the bicycle push button, waiting on the 9C-7 bicycle stencil, or by doing a combination of actions.

Figure 4: Screenshot of Video Data at SW Moody Avenue and SW Sheridan Street in Portland, Oregon

The results of this study revealed that after the installation of the blue light feedback device, there was an increase of cyclists using the 9C-7 stencil marking rather than the existing bicycle push button. Before

the blue light installation, 68% of cyclists pushed the bicycle push button and waited next to the button, while only 15% of cyclists used the stencil marking. After the blue light installation, 60% of cyclists pushed the bicycle push button and waited, while 20% of cyclists used the stencil marking, a statistically significant change. This change was even greater after the sandwich board sign was installed. After the instructional sign was installed, only 41% of cyclists used the push button and waited, while 49% of cyclists used the stencil marking. The results of this study indicated that blue light feedback devices, installed in conjunction with bicycle detection and the standard 9C-7 stencil marking, can be an effective substitute for bicycle push buttons. The blue light feedback devices are a cheaper alternative to bicycle push buttons and also provide more flexibility in intersection design.

Table 1: Bicyclist Behavior Observations at SW Moody Avenue and SW Sheridan Street in Portland, Oregon from 7:30 A.M. to 6:00 P.M.

Observation Type	Before Blue Light Installation	Percentage of Behavior Observations	After Blue Light Installation	Percentage of Behavior Observations	After Blue Light Informational Sign Installation	Percentage of Behavior Observations
Total Count of NB People on Bikes	694	-	658	-	454	-
Total Number of Behavior Observations	369	-	332	-	260	-
User Pushes Button Only and Wait Next to Button	251	68%	200	60%	107	41%
User Pushes Button and Moves to Stencil	13	4%	17	5%	13	5%
User Waits on Stencil Only	54	15%	68	20%	127	49%
Number of People who Did Not Comply with Bike Signal (Ran Red Light)	51	13.8%	47	14.2%	37	14.2%
Number of People who Did Not Comply with Bike Signal (Ran Red Light), out of total NB cyclists	51	7.3%	47	7.1%	37	8.1%

While the study was successful in determining that at this particular location blue light feedback devices combined with the 9C-7 stencil marking could serve as a replacement for bicycle push buttons, the study also revealed that there was no statistically significant change in the number of cyclists running red lights. Before the blue light installation 7.3% of cyclists ran red lights. After the blue light installation 7.1% of cyclists ran red lights. And after the sandwich board installation, 8.1% of cyclists ran red lights. The blue light active feedback device did not seem to have any impact on cyclists' red light running, but further research on this is necessary.

Something to note is the intersection design at SW Moody Avenue and SW Sheridan Street (depicted previously in Figure 2 and below in Figure 4). The design is such that the bicycle stencil and loop are right next to the bicycle push button. While cyclists here may decide whether to use either the stencil or the push button, it is quite easy for them to do both at this particular location. This may not always be the case at other intersections.

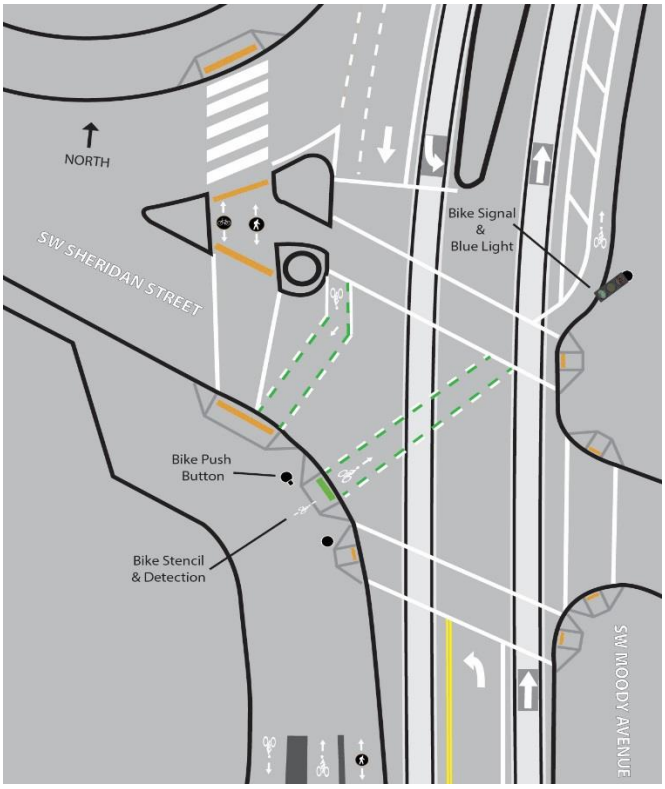


Figure 4: Aerial View of SW Moody Avenue and SW Sheridan Street in Portland, Oregon

The City of Portland is currently in the midst of furthering testing and conducting two additional studies. In the second study, the same kind of blue light as at SW Moody Avenue and SW Sheridan Street has been installed at two locations: 1) SE Division Street and SE 21st Avenue and 2) NE Martin Luther King Jr. Boulevard and NE Tillamook Street. At these locations, cyclists share a travel lane with vehicles and use the existing vehicle signal heads. The blue light devices were again installed next to the red signal face. This study will include two different instances where video data will be collected: 1) before conditions, where just the blue light and stencil were installed and 2) after a bicyclist intercept survey has been administered to cyclists. Video data will be collected from 7:30 A.M. to 6:00 P.M. on all days for video collection. This study will provide insight on user understanding of the device.

In the third study, a "WAIT" signal, similar to the Dutch "WACHT" signal, will be installed at an approach of a signalized intersection. This device displays the word "wait" surrounded by a ring of illuminated tick marks when a cyclist is detected. This device provides two pieces of active feedback: 1) a cyclist's call for a green light is made successfully, and 2) temporal feedback; the cyclist is notified of how much time (not in seconds, but in number of illuminated ticks) they have until a green light. The results of this study will help to determine whether the installation of the "wait" device affects cyclists' queuing position and whether cyclists were more inclined to wait for a green light rather than run a red light.

As more research is done on these active feedback devices and bicyclist behavior, intersections with bicycle facilities can be designed more appropriately to increase efficiency of travel as well as general safety for all roadway users.

References

Boudart, J., Liu, R., Koonce, P., & Okimoto, L. (2015). An Assessment of Bicyclist Behavior at Traffic Signals with a Detector Confirmation Feedback Device. *Transportation Research Board*, 13.

Portland Bureau of Transportation. (n.d.). *Vehicle Detection Or, Getting a Green Light on a Bicycle at an Intersection.* Retrieved June 24, 2015, from City of Portland Bureau of Transportation: http://www.portlandoregon.gov/transportation/article/145110