Bicycle-Specific Traffic Control – Is it "Bicycle-Friendly"?

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In the United States, the Uniform Vehicle Code and most state laws treat bicyclists as having much the same rights and responsibilities as operators of slower-moving vehicles, with some minor exceptions. Bicyclists operating on roadways are typically served by many of the same traffic control devices as other road users, and operate in many cases in a manner not unlike other vehicular traffic.

In recent years, a number of new traffic control devices have been proposed in the US for use on roadways with bicycle facilities, or where bicycle facilities intersect or interact with other transportation facilities. These devices are often proposed in order to remedy an operational problem caused by a specific facility, or to address the real or perceived needs or desires of bicyclists.

There are traffic engineering concerns raised when such bicycle-specific devices treat bicyclists differently than other road users at certain locations, or suggest or mandate actions by bicyclists that violate normal rules of the road. Also, there are concerns as to how other road users interact with bicycle traffic at these locations.

In general, traffic engineering is by its nature a conservative profession. Traffic engineers prefer to rely in most cases on proven, familiar solutions to traffic control. Experience has shown that road users easily understand these familiar applications, and that these are generally self-enforcing when properly applied.

This also can help minimize the possibility that traffic control devices "make promises they can't keep"; e.g. give the illusion that they improve operations or overall safety, but in practice fail to have a significant effect on road user behavior or crash rates.

Another fundamental principle of traffic engineering is uniformity. Road users, including bicyclists, should always be encouraged to behave in a similar manner in similar situations. For example, regardless of whether a signal is present, drivers are encouraged by signing and marking to turn left from the far left lane.

The Manual on Uniform Traffic Control Devices (MUTCD) reinforces this conservative and uniform approach, by requiring that all public highways conform with what is contained within the Manual, with authority granted for experimentation under limited and controlled circumstances.

Innovation is certainly not prohibited; but new concepts need to be critically evaluated to see if there are unintended consequences that have the potential to harm road users. Objective evaluation is vitally important to clearly determine that the intended results are achieved without unforeseen complications.

There can be a problem, however, with respect to accommodating bicyclists in this conservative approach. For decades, traffic engineers focused almost exclusively on the accommodation of motor vehicles on roadways, and most roadways were designed with the needs of motor traffic foremost in mind. This has resulted in many highways, streets, and roadways being difficult or undesirable for travel by most bicyclists.

In recent years, transportation professionals have recognized that bicyclists are legitimate, if often overlooked, users of our streets and roads. The MUTCD recognizes this change, and Part 9 of the MUTCD is focused specifically on bicycle facilities.

Yet, many bicycling advocates have posed the question to transportation professionals: Is there more that traffic engineers can do to accommodate bicycling, beyond the standard treatments of wide lanes, shoulders, and bike lanes?"

This paper will discuss two traffic control devices that have been hailed as being potentially beneficial for bicyclists, yet may have the very real potential of causing significant unintended problems for bicycle travel as well.

Bicycle Traffic Signals

Signals have been used to control vehicular traffic for many years. They are readily understandable by road users, have a high rate of compliance, and when placed appropriately based on warrant analyses, can create significant safety and operational improvements.

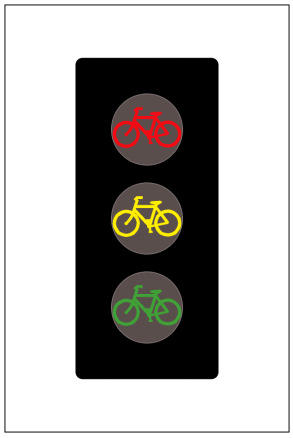

Figure 1 - Bicycle Traffic Signal

Bicycle traffic signals resemble standard traffic signal heads, with the distinguishing feature being that the bicycle signal displays the outline of a bicycle (see Figure 1) instead of the standard ball or arrow indication.

In Europe, there are a number of intersections that contain legs with separated parallel bicycle pathways or mandatory bike lanes. Because the presence of parallel paths complicate traffic flow patterns at intersections, bicycle traffic signals were developed to regulate bicycle movements at these intersections. A few cities in the United States, such as Davis, California, have installed bicycle traffic signals in locations with similar circumstances[(1)].

Bicycling advocates have seen bicycle traffic signals operating in these locations. They see that bicycles have their very own set of signals, and perceive that therefore, the use of these signals must be an improvement for bicyclists, or at least a recognition of bicycle accommodation. They may then ask their local agency, "How can we get a bicycle traffic signal in our town as well?"

What is often overlooked is that these signals may have significant drawbacks to bicycle travel that may not be evident to the casual observer.

The typical phasing for these signals is to hold all bicycle traffic on all approach legs for most of the signal cycle, and then to release the bicycle traffic during a "bike-only" phase, when all motor traffic is stopped. The perceived advantage to this phasing is that it reduces the potential for bicycle-motor vehicle conflicts at the intersection.

In order to establish a green phase solely for bicycle traffic, however, you must reduce green time for all other phases in the cycle. This by itself reduces the capacity of the intersection for all users.

Now, add into this the implicit assumption that bicycle traffic must be stopped on all other phases except the bicycle-specific phase. This can greatly increase intersection delay to bicyclists, who, if the bicycle traffic signal was not installed, could otherwise proceed at the same time as other traffic in the same direction.

This phasing pattern also assumes that bicyclists would consistently obey the signal. In the United States, given the current state of traffic law enforcement towards bicyclists and bicyclist compliance with traffic control devices, this may not always be a safe assumption.

Finally, this application of signalization can promote non-uniformity of traffic control for bicyclists. They will be expected to operate in a significantly different manner at the intersections controlled by these signals.

For example, at most intersections, bicyclists turn left from either the left hand side of the roadway or as a pedestrian in the crosswalk. At these bicycle traffic signals, though, these same bicyclists in many cases are encouraged to turn left from the right side bike lane or from the right side of the roadway. Some see this as an advantage of the bicycle signal, since it makes these turns "easier" to make.

If the bicyclist behaves in the same manner at any other intersection, though, and attempts the same left turn from the right side, they will be in very real danger of collision and injury from conflicting traffic.

One modification that has been suggested to reduce restrictions on bicycle travel at these signals is to make the bicycle traffic signal indications optional for bicyclists, freeing them to operate either in the bicycle-specific manner, or as part of the regular traffic flow.

Yet, everything about the design of a bicycle signal is intended to give the clear indication to road users (both motor vehicle drivers and bicyclists) that bicyclists are controlled by the bicycle signal indication. Most bicyclists, motorists, and the police will behave in a manner consistent with the devices installed, and a bicyclist who chooses to disobey the bicycle signal may be harassed or cited, regardless of the law.

It should be pointed out that there have been certain specific applications of bicycle traffic signals in the United States that may have benefits for bicyclists, without many of the problems noted above.

Tucson, Arizona has installed a bicycle signal on 3rd St., a residential street and bike route, at its intersection with Country Club Rd, a major arterial. As a "traffic calming" measure to discourage through motor travel on 3rd St. while encouraging bicycle travel, the city requires all motor vehicle traffic on 3rd St. to turn right at Country Club, while permitting bicycle traffic to continue straight across the intersection. This is done by installing markings and channelizing islands to require motorists to turn, along with bicycle channelization combined with a bicycle traffic signal to give a clear indication that only bicyclists (and pedestrians, served by a separate pedestrian indicator) may proceed across Country Club.

This application of a bicycle signal does not seem to confuse drivers or bicyclists, and sets up no inherent conflicts between bicycle and motor vehicle travel.

However, it could also be argued that the same installation could have used standard traffic signal heads to control the bicycle traffic, since the motor vehicle traffic on the legs in question were fully controlled by islands, bollards, and other channelization.

The adoption of bicycle traffic signals nationwide could create other potential problems for bicyclists. A very real potential exists for these signals to be used to restrict bicycle travel at many locations for perceived "safety" reasons, regardless of actual crash history. Bicycle traffic signals may be proposed to "solve" the problem of bicycle clearance time in single-point-urban interchanges and other large intersections, or to encourage bicyclists to turn left from the right side of the roadway. It is clear then that bicycle signals have the potential to negatively affect safe and convenient bicycling.

If bicycle traffic signals enter the MUTCD as an intersection treatment option, then strong warrants must be developed to prohibit inappropriate uses of these signals. Where they show benefit without creating serious problems, such as in the Tucson example, their use may be permitted. In the absence of definitive warrants and strong guidance language, though, there will be a very real potential for abuse or misuse of these signals.

Advance Stop Lines (Bike Boxes)

Advance stop lines are defined as stop lines that are placed on the approach to signalized intersections, typically in the rightmost lane, at a location upstream from the standard stop line location. These are placed in order to create a dedicated space for bicyclists to occupy while waiting for a green indication (see Figure 2).

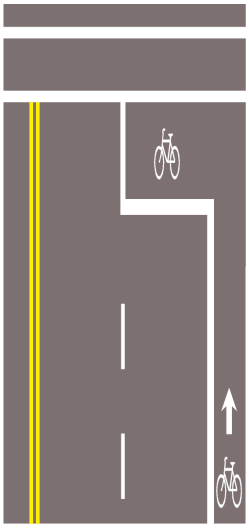

Figure 2 - Advance Stop Line

Advance stop lines require the existence of a bike lane or other similar facility to permit bicyclists to pass other queued traffic on the intersection approach leg.

The stated advantages to the advance stop line are:

- To permit bicyclists to wait for a traffic signal at the front of the queue, giving bicyclists preferential treatment in proceeding through the intersection, and reducing exposure to pollutants emitted by automobiles in the queue[(2)].
- To permit bicyclists to clear the intersection before motor vehicle traffic, sometimes in conjunction with bicycle traffic signals.
- To encourage bicyclists proceeding along a one-way street to move from one side of the street to the other at a specific location[(3)]. In this case, the advance stop line spans the entire width of all regular travel lanes.

Drivers of motor vehicles, after many years of habituation, tend to behave in a uniform manner at intersections. They generally operate in a manner consistent with where they expect things to be at intersections; e.g. stop near the curb return behind the crosswalk, etc. This usually works to enhance smooth and consistent traffic flow.

The advance stop line works on the presumption that the vehicles will obey the markings and other traffic control devices, and stop prior to crossing the advance stop line and entering the area for bicycle queueing.

However, this conflicts with ingrained driver behavior. When the stop line is moved a significant distance back from the "typical" place, such as in this case, then drivers may not react appropriately, unless enhanced signing in pavement marking is used. Advocates of advance stop lines are optimistic in their belief that driver behavior can be modified through the use of signs and markings. Even under these circumstances, though, there have been reports from the countries where advance stop lines have been installed that violation rates by drivers entering the area of the advance stop line are high[(4)].

This treatment also promotes non-uniformity of traffic control at intersections. At these locations, bicyclists are encouraged to pass stopped traffic and occupy positions in the front of the right lane queue. If the bicyclist behaves in the same manner at other

intersections, and attempts the same maneuver, there is the potential of collision with right-turning and through vehicles occupying the front of the queue, who are not expecting a bicyclist to appear from an unseen location.

Advance stop lines will also only function in the manner intended if right turns on red are prohibited at these locations. Since most jurisdictions in the United States permit right turns on red unless specifically prohibited, this can create a conflict between driver behavior and the signs and markings at these locations. This may also significantly affect the traffic flow and capacity of the intersection, depending on right turn volume.

Summary

Traffic control devices serve a very useful purpose in guiding and regulating traffic, both of the motorized and non-motorized kind.

As noted above, however, not everything that is bicycle-specific will also be consistently "bicycle-friendly", and this can create unforeseen disadvantages for bicyclists.

Citizens and advocates frequently request that transportation professionals "do something" to improve conditions for bicyclists and other road users. This must be tempered by the fact that decades of experience have shown that poor traffic control designs can have a worse effect than if no action had been taken. Furthermore, it is frequently more difficult to get a poor design removed than to adopt a more beneficial design in the first place. New designs and concepts that are unfamiliar to road users must be carefully evaluated before they are recommended for widespread adoption.

Except under extraordinary circumstances, the advantages of bicycle traffic signals and advance stop lines do not seem to outweigh the significant disadvantages inherent to these devices. Therefore, the adoption of these treatments as standard traffic control devices in the United States should be strongly discouraged except under narrowly defined and warranted circumstances, or unless further compelling evidence of safety and operational advantages can be demonstrated.

Traffic engineers and planners are familiar and comfortable with implementing facility-based and device-based solutions to safety and operational problems. Yet one potential solution that is frequently overlooked, but can have very beneficial effects, is education of bicyclists and other road users. A comprehensive education program for bicyclists can effect a reduction of up to 80% in crash rates[5], without the need for special traffic control devices or facilities. Education of motorists on how to properly interact with bicyclists on roadways could also deliver significant benefits at modest cost. Despite its great potential, however, this will only be successful with a multidisciplinary approach involving professionals from both inside and outside the field of transportation.

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Endnotes

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4. *Design Hazards in Camden for Cyclists*, Camden Cycling Campaign, London, England, 1999.

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