Overview and Applications of the ‘Sharrow’

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Through most of the over 100 year history of bicycles and automobiles coexisting in surface transportation, the problem of how to control their interactions on the streets was not a prominent consideration. Popular sentiment in the post-World War II era was that the automobile was the most appealing and logical mode of transportation, and that road designs needed to maximize automotive mobility.

This approach has been slowly changing, and was first codified with the Intermodal Surface Transportation Efficiency Act (ISTEA), passed in 1991. Since that time, transportation planners and engineers have struggled with creating networks of infrastructure that could provide safe, direct, and appealing facilities for bicyclists, while preserving mobility for automobile traffic.

These bicycle facilities have evolved in their form and applications, with jurisdictions designing and implementing (or not implementing) their own set of solutions to safely accommodate their bicycling populations. Paved shoulders, mixed use trails, bicycle lanes, bicycle routes, and other facilities have evolved and become increasingly standardized, through design guidance from the American Association of State Highway Traffic Officials (AASHTO) and the Federal Highway Administration’s (FHWA) Manual on Uniform Traffic Control Devices (MUTCD).

The focus of this paper is a more recent and slightly unconventional approach to accommodating bicycles on the road. The shared lane marking is intended to encourage sharing of general purpose travel lanes by automobiles and bicycles. This new marking is colloquially referred to as the “sharrow”, due to its purpose to encourage ‘sharing,’ and the ‘arrows’ that indicate direction of travel and suggested lane position for bicyclists.
On December 16th, 2009, FHWA published a new final rule, implementing comprehensive revisions to the MUTCD. Its inclusion of the sharrow has not only brought new attention to this device, but the official MUTCD approval makes implementation much easier for jurisdictions. This paper will provide an overview of its evolving design, examine the many purposes and benefits of the sharrow, describe some deployment approaches, discuss the criticisms of sharrows, and recommend how localities should incorporate sharrows in their jurisdiction’s bicycle policies and plans.

Background -- Bicycle pavement markings that resemble the design and purpose of contemporary American sharrows first appeared in Europe and Australia. Denver, Colorado is widely acknowledged as the first domestic design and implementation of a shared lane marking, including a “bicycle stencil arrow” in the 1993 Denver Bicycle Master Plan (Picture 1). This design evolved into what is now known as a “bike-in-house” (Picture 2). The plan specifies the use of the device on signed bicycle routes where installation of a bicycle lane is not possible, with the intent of communicating the direction of travel, and alerting automobile drivers to the presence of bicycles. It does not address the issues of relative lane positions of automobiles and bicycles.¹

An evaluation of the “shared use arrow” then took place in Gainesville, Florida, in 1997. Gainesville produced a variation of the “bike-in-house,” (Picture 3) and tested this device by placing it 2.5 feet from the curb in a 15 foot travel lane, without adjacent parking. The purpose, like Denver, was to communicate the direction of travel and to alert drivers to the presence of bicycles. However, the Gainesville experiment also tracked the number of bicyclists who switched from sidewalk to road riding, and the relative lane positions of automobiles and bicycles. Bicycles showed a small but
significant shift outward, away from the curb, demonstrating the intended effect. There was also a significant change in bicycles in the street instead of the sidewalk.²

The shared lane marking was first dubbed the “sharrow” by San Francisco bicycle planner Oliver Gajda.³ San Francisco began experimenting with sharrows in 1998, and produced comprehensive findings on sharrows that demonstrated their efficacy in producing safer distances between automobiles and bicycles, and reducing improper bicycle riding behavior. Survey data also indicated greater driver awareness of bicycles, and created greater perceptions of safety for bicyclists.⁴ On the basis of these findings, the State of California Department of Transportation (CalTrans) approved, in September 2005, a ‘shared roadway bicycle marking’ that closely resembles today’s sharrow for optional use.⁵ With the CalTrans approval, sharrows were widely implemented in San Francisco, and other California cities, such as Santa Barbara.

The San Francisco experiment was also relied upon⁶ by the FHWA in approving the inclusion of the sharrow in the final 2009 MUTCD. Inclusion in the MUTCD made the sharrow an approved traffic control device, and removed the need for jurisdictions to conduct experimental studies along with implementations, or to obtain the FHWA’s approval on those experiments. Sharrows are now in use in at least 80 jurisdictions in 27 states as of 2009⁷ (listed in Appendix 1).

**Purposes** -- The first of the primary reasons for implementing sharrows is to encourage bicyclists to travel away from the right-hand edge of the travel lane, especially in two circumstances. The first circumstance is when there is an adjacent parking lane, to prevent dooring. Dooring is a particularly common crash scenario, where an automobile door is opened directly in the path of a bicycle travelling in close proximity to the parked
automobile. The sharrow coaxes bicyclists away from the perceived safety of the right side of the travel lane by suggesting a place on the road for the bicycle to travel, out of range of an open door. The other circumstance is when the lane width is too narrow for a bicycle and automobile to safely share a lane side-by-side, and the bicyclist is encouraged to travel in the lane to discourage drivers from attempting to squeeze by.

The second purpose of the sharrow is to alert drivers to the likely presence of bicycles in the general purpose travel lane. In this regard, it serves a similar role to bicycle advisory signs, such as the “Share the Road with Bicycles” sign. In addition to the positive safety implications of increasing automobile driver awareness while driving, that same driver may be more likely to look behind before opening the door of a parked automobile into the bicycle travel space.

The third purpose of the sharrow is to promote bicycling in areas where installation of bike lanes or other more exclusive bicycle facilities are not possible. Class I (physically separated bicycle facilities) and Class II (bike lanes) have a demonstrated positive impact on bicycle ridership rates\(^8\). While no observational research was found on sharrows relative to these other facilities, stated preference surveys indicate that sharrows are a less attractive facility for bicyclists. However, sharrows are significantly more attractive to potential users than a signed bicycle route alone.\(^9\) (Appendix 2).

A fourth theoretical benefit to placing bicyclists further into the general purpose travel lane is to achieve traffic calming effects. The only study found that measured automobile speed before and after sharrow implementation showed no change.\(^10\) However, this only measured one site with a 25 mph speed limit, and a comprehensive
evaluation of automobile speeds at varying types of sharrow placements could provide more definitive evidence for or against this theory.

A final benefit of the sharrow is to encourage proper bicyclist behavior. The San Francisco study found that the sharrow design reduced riding on the sidewalk by 35%, and reduced wrong-way riding by 80%. However, these before/after observations do not provide any insight into how sharrows compare to other bicycle facilities.

**Design and Implementation Details** -- The MUTCD approved sharrow is over 9 feet by 3 feet (Picture 5). The dual chevron arrows provide optional guidance the bicyclist to ride in the centerline of the marking. Automobile drivers are free to drive anywhere within the travel lane, and thus sharrows are a potential solution for accommodating bicycles where there is insufficient lane width to insert a bike lane. The MUTCD states that the centerline of the sharrow should be located 11 feet from the curb when parking is present. This 11 foot clearance is based on a presumed 7 foot parking lane, and four feet of clearance for automobile doors (Picture 6). There is no guidance for clearance where the parking lane exceeds 7 feet.

Cost estimates for sharrows vary. San Francisco, a large scale implementer of sharrows, estimates approximately $150 per marker. Following the MUTCD guidance of a sharrow every 250 feet, sharrows would cost about $3,300 per lane mile (though Fauquier County, VA, estimates $10,560). Compare to an estimated cost range of $5000 to $50,000 for a bike lane (Fauquier County estimates $50,160 for bike lanes). Sharrows are recommended to be installed with a thermoplastic material, rather than paint. Placement within the street is an important maintenance consideration, and
repainting may be required every two to five years, with longer replacement intervals when the sharrow is placed out of automobile tire tracks.

**Applications** – In ascending order of specificity, this section will discuss the street conditions under which a jurisdiction might consider using in identifying sites for implementing sharrows, or determining where another facility may be more appropriate.

1. *Speed Limit 35 MPH or Less* – Guidance in the MUTCD indicates that sharrows are appropriate for streets with speed limits that do not exceed 35 mph. This differs from the 2005 CalTrans approval, which provided guidance that sharrows are appropriate for streets with speed limits that do not exceed 40 mph. The reason for the change is unclear.

2. *Bicycle Lane Preference* – Because of the preference of many riders for bike lanes, jurisdiction may consider adopting a policy that sharrows will not be implemented on a street that already has another bicycle facility, such as a bike lane, or will only implement sharrows on streets that are incompatible with bicycle lanes, such as those without sufficient lane width to give 4-5 feet for AASHTO standard bicycle lanes.

3. *Adjacent Parking* – Sharrows are most often cited as a solution to the problem of dooring, and thus, may be considered primarily for streets with adjacent parking (both parallel and diagonal). The MUTCD guidance states that the centerline of the sharrow should be located 11 feet from the curb when parking is present. However, jurisdictions are left to their own discretion in deciding between bicycle lanes and sharrows when sufficient space exists for a bicycle lane.

4. *Existing Bicycle Route* – Where a jurisdiction has already installed “bicycle route” signage, or bicycle riders are already making heavy use of a street, a sharrow may be an appropriate installation.
5. Create Network Connections – Where several nearby bicycle facilities that provide greater segregation for bicycle riders exist, sharrows can be a low cost and easy method to facilitate connections between these facilities, thus enhancing the network.

6. Roundabouts – Roundabouts pose significant difficulties in accommodating bicycles, and sharrows may prove easier to implement on a roundabout than attempting to design another facility, since bike lanes are prohibited in roundabouts by the MUTCD.16

7. Single Roadside Complement to Other Facilities – In the Washington DC metro area, two sharrow implementations were on one side of the road, in order to complement other facilities on the opposite side. On the one-way 15th St NW, Washington DC, a sharrow was placed in the right-hand travel lane, in order to dissuade bicyclists travelling with automobile traffic from using the contra-flow bicycle lane on the opposite side of the road. On Braddock Road in Alexandria, VA, a sharrow on the downhill side of the road complements a climbing lane on the uphill side. David Amiton, a Transportation Analyst with University of Washington, criticizes this particular application, stating that:

This fosters situations where people on bicycles are essentially forced to travel 20-25+ mph down extremely steep grades while mixed with heavy traffic, resulting in very uncomfortable—and some would say unsafe—riding conditions.17

8. Presence of Unsignalized Crosswalks – Where a crosswalk exists without a traffic signal, guiding the bicycle further into the travel lane may assist both the pedestrian and bicycle rider, by enhancing visibility around adjacent parked automobiles, and providing greater spacing between them if they simultaneously enter the crosswalk.

9. Bike Lane Terminations – Where bicycle lanes end, a sharrow may provide a strong indication to both automobile drivers and bicycle riders that general purpose travel lanes
must be shared, if only for a brief period. Such an application could supplement “bicycle lane ending” signs, and may be especially appropriate for complex intersections.

10. Community Input – Street users may provide insight into particular streets where sharrow placement may enhance safety, but may not be apparent to planners. An example provided to the City of Cincinnati during its outreach to identify experiment sites was a block where turnover of street parking was especially high. 

Implementations in Plans -- Because the MUTCD approval of sharrows occurred relatively recently, few jurisdictions have adopted policies or plans as to where (or if) sharrows should be implemented. The few examples identified can be categorized in three groups. The first group are those that are planning for relatively widespread implementation. The City of Fort Wayne, IN, appears to meet that definition. According to Senior Planner Paul E. Spoelhof:

Our "rules of thumb" [for installing sharrows] include using sharrow pavement marking on roadways that have posted speed limit at or below 35MPH, volumes at or below 10,000 AADT for 11’ -12’ travel lanes, and below 15,000 for 13’ - 14’ travel lanes. We felt that sharrows are more appropriate than bike lanes where there is on-street parking, but we deviated from this guideline a few times.

San Francisco is another example. Since sharrows have been adopted in California for nearly five years, and San Francisco led the way on experimentation, it is not surprising that San Francisco has installed approximately 1300 sharrows, with more than 4000 additional sharrows planned. At one sharrow every 250 feet, that equates to over 250 lane miles of sharrows. With hills requiring climbing lanes and “wiggle” routing, and constrained street space, sharrows may be appropriate for wide-scale implementation.

Seattle defines a second class of sharrow implementer. They have been aggressively deploying, and includes 220 lane miles of sharrows in its bicycle master
However, they express a preference for bicycle lanes, and hold open the possibility of installing sharrows as an interim measure, while the more complex implementation measures necessary for bicycle lanes are resolved.\textsuperscript{22}

Finally, Portland typifies a conservative approach to sharrows, stemming from its aggressive mode-shift goals and stated preference for segregated bicycle facilities among beginning bicycle riders. According to Jessica Roberts, a Programs Manager with Alta Planning + Design:

\begin{quote}
The City of Portland views sharrows as a treatment that should only be used where a bike lane should be (by policy/planning) but where there is insufficient right-of-way to provide one. So, to date we have just a few marked gaps in bike lane streets that are filled by sharrows.\textsuperscript{23}
\end{quote}

Portland’s Bicycle Plan states that its facility choices will, “Emphasize low-stress bicycle routes,” and accordingly, only plans that 5\% (or 45 lane miles) of its finished bicycle network will be composed of sharrow lanes.\textsuperscript{24}

**Discussion** – There are a number of criticisms and concerns regarding sharrows, especially relative to bicycle lanes:

**The MUTCD does not specify where to locate sharrows in the road as standards, leading to poor placements, such as the example shown in Appendix 3.**

**The MUTCD does not specify a required distance between parked cars and sharrows.**

**Drivers could perceive that a street without a sharrow does not have to be shared.**

**Widespread implementation of sharrows could diminish the behavioral impact that has been observed with drivers to date.**

**Sharrows do not provide sufficient perception of safety to encourage bicycling.**

Because sharrows are cheaper and easier to implement than other more segregated facilities, the fear is that jurisdictions will opt for sharrows for the sake of expediency.
Planners have been too conservative in implementing sharrows. Few sharrows have been implemented at the center or left half of narrower travel lane, despite potential benefits in certain situations to locating the bicycle rider near the street centerline. Wider implementation of sharrows in narrow-lane, centerline, traffic calming scenarios may be coming, with Portland choosing to mark its new bike boulevards with sharrows.25

However, bicycle advocates who dislike segregated facilities have largely accepted the sharrow as a preferable alternative to the bicycle lane. Bicycle lanes adjacent to parked automobiles generally do not provide any guidance to the bicyclist on avoiding the four-foot dooring zone, unlike the sharrow. In fact, one criticism of the standard bicycle lane is that the vast majority of reserved space is within the dooring zone.26 A fatality in Cambridge Massachusetts in an AASHTO compliant bike lane demonstrated the dooring danger.27

In summary, sharrows are a novel solution for some applications, such as where inadequate right-of-way exists, or other road geometry problems require bicycles to travel in the lane. However, the comparative safety of sharrows and bike lanes has yet to be determined. And with many localities adopting goals to increase bicycle mode share, the perceived safety of the bicycle lane must be considered. Until comparative safety is proven, or the sharrow proves to attract beginning cyclists into the general purpose travel lane, the correct approach for the locality interested in increasing bicycle mode share would be to adopt a policy on sharrow implementation that defines the appropriate applications, is aggressive in deploying sharrows to provide maximum safety and encouragement to bicycle riders, but establishes a firm preference for segregated bicycle facilities, and does not settle for the most inexpensive and expedient solution.
PICTURE 1 – Denver, CO, 1993

PICTURE 2 – Denver, CO and Ithaca, NY, 1997

PICTURE 3 – Gainesville, FL, 1997

PICTURE 4 – San Francisco/ CalTrans, 2005
Figure 9C-9. Shared Lane Marking

PICTURE 5 -- 2009 MUTCD Final approved design
PICTURE 6 – Diagram of Curb Distance (from “San Francisco’s Shared Lane Pavement Markings – Improving Bicycle Safety,” Feb 2004)
Appendix 1 – List of Jurisdictions and States Experimenting With and/or Implementing Sharrows

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26 States and the District of Columbia
Appendix 2

City of Pittsburgh Shared Lane Pavement Markings survey Question #17: “Do you prefer to ride on:” n=86
Appendix 3

Photo of S. Walter Reed, Arlington VA, by Michael Neubert

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