

Power of the Line

Shared-Use Path Conflict Reduction

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Painting a yellow center line at blind curves on a busy multiuser path (bicyclists, pedestrians, in-line skaters, runners) decreased the percentage of people who “went the wrong way” on the path, in a before-and-after study whose sample size was 2,147. A busy 3.6-m (12-ft) paved recreational and commuting path in Philadelphia circles the Schuylkill River for 13.5 km (8.4 mi). There are numerous blind curves caused by hedges, rock outcrops, and bridge piers. Many people were traveling on the wrong side around sharp blind curves. Counts were taken and videotapes made in order to determine the percentage of bicyclists, pedestrians, in-line skaters, and runners on the proper side, on the wrong side, and passing on the wrong side. Then a solid-yellow center line and directional arrows were neatly spray painted at the blind curves, and after counts were taken. The percentage of wrong-side travel fell from 35 percent to 15 percent, a 57 percent reduction. White lines and arrows were placed at driveways and road crossings. The white lines reduced wrong-way travel from 30 percent to 10 percent, a reduction of 66 percent. Painted center lines kept people on the proper side and reduced the likelihood of conflicts and crashes. Paint is easy, fast, and inexpensive, and creates no physical obstacle; it is hard to damage and it works without education of the public.

The problem to be studied was collisions and close calls caused by users who traveled on the wrong side of a nonmotorized multiuser park path. In an attempt to minimize conflicts and head-on crashes, what are the best ways to keep people on the correct (right) side of a heavily used multiuser path? People often occupy the wrong side of the path because of heavy use, inattention, lack of realization that they should be on the right side of the path, and sharp turns that make it “natural” to drift over the middle of the path and into the oncoming lane. Philadelphia’s River Drive path has sharp turns that are “blind” because of hedges, rock outcrops, bridge piers, and walls (Figure 1a). Fairmount Park officials were resistant to making changes at one particularly dangerous blind curve for aesthetic, bureaucratic, and jurisdictional reasons. The Philadelphia Parks Association, a private group more than 100 years old that maintains some park areas, saw the hedge as “historic” (vintage 1950s, twice modified).

HYPOTHESIS

The hypothesis was that if a center line and directional arrows were painted at intersections and on dangerous curves, more users would stay on the proper side of the path, and fewer conflicts and collisions would occur. Staying right is a rule of law on motor vehicle roads. On nonmotor vehicle path and trails, staying right is a custom, ethic, or

self-preservation instinct. Many users are on the wrong side and this leads to conflicts, near misses, and crashes. Many users feel uncomfortable because of close calls. No useable crash data exists for this path used by bicyclists, pedestrians, skaters, and runners. The *Manual on Uniform Traffic Control Devices* (MUTCD) and AASHTO guidelines have codified multiuser path markings, but whether these codes are the best way to mark paths is not entirely clear.

RESEARCH

Counts of which side of the path users were on were done before and after the painting of a center line. Before counts and videotaping were done in six locations. The number of bicyclists, pedestrians, in-line skaters, and runners who were on the right side, on the wrong side, or passing on the wrong side were counted. Then, lines and directional arrows were neatly spray painted on the trail using a professional striping machine. Then after counts were taken. Videotape was used for its reproducibility, reduction of subjectivity, ease of counting during heavy volume periods, and ability to provide a visual report. The percentages of Right, Wrong, and Pass for each mode were calculated for the before and after center line condition. Total number of observations was 2,147. Obviously there was some judgment involved in counting “wrong side” examples, especially in the before condition. However, a great percentage of the counts was clearly Right or Wrong. Only a small percentage of wrong side was close calls, and the researchers hoped that these evened out. Most counts were videotaped for reproducibility and for allowing of consensus of the researchers.

DESCRIPTION OF PATH

The East and West River Drive paths are along the Schuylkill River in Philadelphia. The 13.5-km (8.4-mi) asphalt loop is 2.5- to 3.6-m (8- to 12-ft) wide and extends from the Museum of Art in Center City upriver to the Falls Bridge and connects to many nearby and upriver neighborhoods. It is a natural bicycle commuter route and is part of the 40.2-km (25-mi) Freedom Valley bike route from the Liberty Bell in Independence National Historic Park to Valley Forge National Historic Park. There are many crew boathouses, picnic areas, sculpture gardens, parking lots, and fishing spots along the path. It is heavily used by runners, walkers, in-line skaters, bicyclists, baby strollers, lovers, and dog walkers.

The path has a number of blind curves. The three blind curves described below had a single 10-cm (4-in.) yellow center line and directional arrows painted on them for this research. The idea for the solid yellow line was “Do not cross the line—doing so is dangerous at this location.” No education, explanation, or signage was attempted.

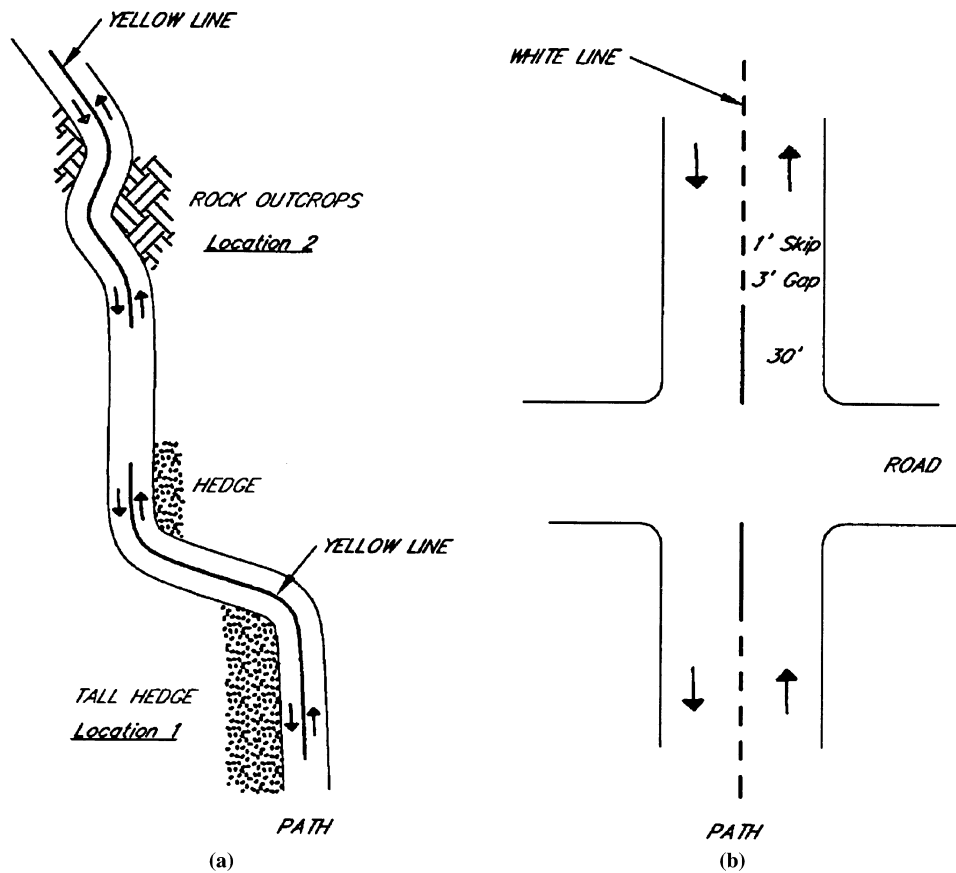


FIGURE 1 Philadelphia's River Drive path: (a) yellow-lined path; (b) white-lined path.

The purpose of the research was to see if the line and directional arrows alone would make a difference. The practice of painting single solid yellow center lines at blind corners is used on other portions of the Freedom Valley Trail.

At Location 1, the hedge is 2.5 m (8 ft) tall and the trail takes a sharp double turn (an S-turn), with both turns obscured by hedges. At Location 2, the rock outcrop, the trail was recently widened and the curve made gentler, but it is still a blind curve with one of the only changes in elevation along this portion of the path. At Location 3, the fish ladder, is a pair of abrupt turns created by a car pull-off/parking spot at a fish ladder at the falls in the river. Lines of sight are good if there is no car parked and poor if there is a car parked.

There are numerous locations where driveways into parking lots cross the path. At some of these intersections, a 9.1-m (30-ft) white center line with four skiplines and directional arrows was painted on the path on each side of the crossing roadway (Figure 1b). The purpose of the white line with skips is to educate users as they enter the trail and to remind those on the path to stay on the cor-

rect side. These were painted at Art Museum Drive, Aquarium Drive, the three entrances to the public boat launch, and the Saint David statue parking lot.

RESULTS

The single solid yellow line worked quite well. The percentage of wrong-side travel dropped dramatically (Table 1). At the hedge (Location 1), the percentage of Wrong and Pass usage dropped from 35 percent to 13 percent. At the rock outcrop (Location 2), the percentage of Wrong and Pass declined from 28 percent to 14 percent. At the fish ladder (Location 3), the percentage of Wrong and Pass dropped from 47 percent to 40 percent.

The white lines had a dramatic effect. A higher percentage of users were on the Right side in the before situation and there are no obvious obstacles. At Boathouse Row, the percentage of Wrong and Pass declined from 36 percent to 6 percent. At the public boat

TABLE 1 Changes in Percent in Wrong or Passing, Before and After

		Before		After		Percent Difference
White Lined Locations	% Wrong or Passing	30%		10%		65% Drop
Yellow Lined Locations	% Wrong or Passing	35%		15%		57% Drop

launch, the percentage of Wrong and Pass declined from 25 percent to 19 percent (Table 2).

DISCUSSION OF RESULTS

Heavy use self-enforces the custom of traveling on the right. When there is a lot of opposing traffic, people get the constant reminder of people coming at them, and thus they are less likely to stray over the center line and travel on the wrong side. When the path is quieter, the reminder of oncoming traffic is not as constant and users seem more likely to stray over the center and use the entire width of the trail (i.e., to travel on the wrong side). There are fewer potential conflicts when the volumes are low, but conflicts are more likely to occur per user because of a higher percentage of wrong-side travel per person.

In-line skaters had by far the highest percentage of wrong-side travel, both before and after. This may be for a number of reasons. In-line skaters are “wide” because they skate. They use more horizontal space, and they take up a wide cross section of the path because of the oscillating sideways movement they employ as locomotion. Skates

also seem to be more recreational in use than bicycles, which travel on the normal motor vehicle roads for most of their use. Skaters thus have less experience in the right-side rule. When skaters skate side by side in pairs, one of them must be wrong-side traveling since most of the path is 3- to 3.6-m (10- to 12-ft) wide. Skating is also the newest mode and perhaps there is less experience and custom of right-way skating. A human factor question is whether side-by-side skaters and bicyclists are looking at each other and are less attentive to the path, the line, and other users. Perhaps they take cues from each other and do less looking out for themselves.

Bicycle riders and many skaters clearly tried to stay on the right side of the yellow line, as if it were a challenge to be able to handle the bike or skates and not cross the line. Bicyclists did the most passing. This was predictable, since bicyclists usually go faster than in-line skaters, runners, and walkers because they can easily do so.

Runners had the highest right-way travel of all the modes.

Pedestrians were a varied lot. Walker personal profiles were the most varied by age. Walkers are not necessarily going anyplace. “Out for a stroll,” they are most likely among all user categories to take a sudden and unpredictable turn on or off the path. They seem less likely to be concentrating on where they are going than do cyclists,

TABLE 2 Summary of White-Lined and Yellow-Lined Locations

SUMMARY OF WHITE-LINED LOCATIONS							
	Before			After			Percent Difference
	Total	Wrong + Passing	% Wrong + Passing	Total	Wrong + Passing	% Wrong + Passing	
Bikes	230	82	36%	100	13	13%	63% Drop
Pedestrians	57	7	12%	33	1	3%	75% Drop
In-Line	137	48	35%	48	6	13%	63% Drop
Runners	91	16	18%	76	5	6%	66% Drop
Total	515	153	30%	257	25	10%	66% Drop
SUMMARY OF YELLOW-LINED LOCATIONS							
	Before			After			Percent Difference
	Total	Wrong + Passing	% Wrong + Passing	Total	Wrong + Passing	% Wrong + Passing	
Bikes	333	139	42%	273	36	13%	69% Drop
Pedestrians	109	22	20%	84	6	7%	65% Drop
In-Line	167	70	42%	193	49	25%	41% Drop
Runners	132	25	19%	84	5	6%	66% Drop
Total	741	256	35%	634	96	15%	58% Drop

skaters, or runners. The wrong-side pedestrians seemed oblivious to any danger.

Very few skateboards were observed.

Children in groups with other children were often on the wrong side. When the research was discussed with passersby, children were often mentioned as a problem because of their wrong-side traveling.

CONCLUSIONS

This primary research shows that selectively and intermittently painted center lines and directional arrows do help keep users on the right side of the path and reduce dangerous conflicts. The lines are easy to implement since they are quickly installed and inexpensive. The center line with directional arrows seems to work without any education of the user. Where there is a sharp blind curve, painting a solid yellow line with directional arrows reduces the risk of head-on collisions. The geometry of a sharp turn, along with inertia, often forces users to cross over the center of the path. The path sometimes narrows at these critical locations. The author suggests that the yellow line should be reserved for places where you really do mean to say "Danger! Slow down and stay on your side." The solid yellow line also seems to reduce the percentage of passing. Many bicyclists seemed willing to wait to pass slower users until after the bicyclists and the users had left the yellow-line zones.

The white line is educational and a reminder to all users that the path is a two-way facility. It is not just a compromise between having to paint a continuous center line on the entire path and doing nothing. It is the opinion of the author that a continuous line loses

impact on the user and is more expensive. As the old wag says, "If every place is a no pass zone, then no place is a no pass zone." The yellow line tells people where it is really dangerous to pass, and this is reinforced by the fact that users cannot see the end of the yellow line because of the blind curve geometry. Thus the user begins to respect the solid yellow line as a legitimate warning. The white line is a reminder at intersections to stay on your side of the path. It should be noted that the Australian design manual for paths recommends exactly this concept of a noncontinuous center line, using yellow at dangerous places and white at intersections.

This research shows that noncontinuous lines work quite well in keeping users on the correct side of a multiuse path. A question is whether AASHTO and MUTCD are correct in suggesting a continuous yellow dashed line. A noncontinuous line or use of a dashed white line may well be better than a continuous or a dashed yellow line, for a variety of human factor reasons. Using a continuous line is like "crying wolf." If the line only occasionally exists, people give it more attention, especially if the yellow only coincides with locations of obvious danger or poor lines of sight. The use of solid yellow at blind corners cues users to a real and noticeable danger. Research is planned in order to confirm that the MUTCD and AASHTO use of continuous dashed yellow lines is safer than noncontinuous lines or white lines. The existing markings will be freshened and the counts redone. Then, a continuous yellow dashed line will be painted and the counts redone. The hypothesis is that the percentage of wrong-side travel will increase because of the presence of the continuous yellow dashed line.

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