Separation between pedestrians and bicyclists

Svensson, Åse; Sakshaug, Lisa; Hydén, Christer

2007

Document Version:
Publisher's PDF, also known as Version of record

TRB's 3rd Urban Street Symposium, June 25-27 2007, Seattle, USA

SEPARATION BETWEEN PEDESTRIANS AND BICYCLISTS

AUTHORS

Åse Svensson
PhD, Senior lecturer in Traffic Engineering
Dep of Technology and society
Lund Unversity
Box 188
SE-22100 Lund, Sweden
Tel: +46 46 2229142
Fax: +46 46 123272
ase.svensson@tft.lth.se

Lisa Jonsson
MSc, PhD student
Dep of Technology and society
Lund Unversity
Box 188
SE-22100 Lund, Sweden
Tel: +46 46 2229136
Fax: +46 46 123272
lisa.jonsson@tft.lth.se

Christer Hydén
Professor Traffic Engineering
Dep of Technology and society
Lund Unversity
Box 188
SE-22100 Lund, Sweden
Tel: +46 46 2229130
Fax: +46 46 123272
christer.hyden@tft.lth.se

Date of submission: May 4, 2007
Number of words: 4000

ABSTRACT

In the effort to separate pedestrian and bicycle traffic from motorised traffic the solution often is to let the pedestrians and bicyclists share space. However, combined pedestrian and bicycle paths lead to problems for both pedestrians and bicyclists; for pedestrians it is a security and safety problem and for bicyclists a mobility problem. Seniors and visually impaired pedestrians are especially concerned as they often feel insecure when cyclists pass close to them, especially as they neither can see nor hear cyclists coming from behind. The safety problem is primarily linked to pedestrians walking on the bicycle side of the tracks. Designing the tracks so that the pedestrians and bicyclists keep to their side respectively is important to improve the situation. Field studies were performed at over 100 pedestrian and bicycle tracks and the results were analysed with respect to materials, separation line, flow, signs, dimensions, road markings and surroundings. The results show that the design has a great impact on whether the road users keep to their side of the pedestrian and bicycle tracks or not. The most efficient design seems to be a difference in material, asphalt on the bicycle side and tiles on the pedestrian side, together with a separation of the two sides, e.g. by paving stones or curbs. Signing has no impact at all whereas the road markings has a great impact, which is interesting both from a perceptional view point and also from the point of view that Swedish rules do not support the use of markings but signing.

SEPARATION BETWEEN PEDESTRIANS AND BICYCLISTS

by Åse Svensson, Lisa Jonsson and Christer Hydén

INTRODUCTION

Background

In the effort to separate pedestrian and bicycle traffic from motor traffic the solution is often to let pedestrians and bicyclists share space. The shared space is either a joint path for pedestrians and cyclists or two paths separated by a separation line and/or different materials. Combined pedestrian- and bicycle-paths lead to problems for both pedestrians and bicyclists; for pedestrians it is a security and safety problem and for bicyclists a mobility problem. Visually impaired pedestrians are especially concerned as they often feel insecure when cyclists pass close to them. For visually impaired pedestrians it is also often difficult to know exactly where the border between the pedestrian and cycle path is located, which also increases the feeling of insecurity. Designing the paths so that pedestrians and bicyclists keep to their own path is important to improve the situation.

Visually impaired is the denomination of both partially sighted, seriously visually impaired and blind persons. The first two groups have “remains of eyesight” left and light contrasts are important for their possibility to orientate themselves. Blind people are completely dependent on movement sensors in the hand and they orientate with the long white cane along guidance surfaces. Guidance surfaces can be natural surfaces like a wall, kerbstone or kerb of grass, or artificial like tactile slabs (1). On a pedestrian and cycle path should guidance for blind pedestrians be located on the outer part of the pedestrian path to prevent the stick to get into the bicycle wheel. For security reasons it is still important to have the possibility to with the stick feel where the cycle path begins. The design of the separation between pedestrian and cycle path is accordingly important. For the groups that have remains of eyesight also the contrast between the pedestrian and cycle path is of great importance. Today, according to NCS (National Colour System), a 0.4 difference in light contrast is recommended. Possible design of the separation that works for visually impaired is studied in a PhD project ” Problems of the visually impaired in the built-up outdoor environment” at the Department of Technology and society, Lund University, Sweden.

Knowledge about where the cycle path starts, is however of limited help to the visually impaired pedestrian if the cyclists do not keep to the cycle path. From a security point of view it is important, not only for visually impaired but also for other mobility impaired and elderly, that cyclists do not use the pedestrian path. Today there are no norms when designing the separation between pedestrian and cycle paths which has lead to a large amount of solutions where the separation is performed by combinations of roadside signs, road markings, surface material and separation line. Knowledge on how the design affects pedestrian and cyclist behaviour is very scarce.

As the cycle path is designed for the cyclist the surface material should be easy and convenient to wheel on. If it is not convenient to wheel on the pedestrian path the share of cyclists on the pedestrian path will probably be very low. On the other hand will the risk increase that also wheel-chair users, pedestrians with rollator (wheeled walker) and pedestrians with baby carriage chose to use the cycle path. Wheel-chair users and pedestrians with rollator (wheeled walker) are road user groups that are more sensitive to uneven surface than other pedestrians

without mobility impairment. At the same time may these groups, and pedestrians with carriage, be exceptionally conscious of safety or sensitive to insecurity.

Aim

The aim of this study was to investigate to what extent pedestrians and bicyclists keep to their sides respectively and how that is affected by ground material, separation measure, width, traffic flow, road markings and surroundings.

Clarifications

The bicycle is a vehicle and cyclists are vehicle drivers. Traffic rules applicable to other vehicles like cars are also applicable to cycle traffic. The pedestrian is a road user that moves on foot. Also roller skaters, persons walking with the bicycle, baby carriage or wheel carriage or sitting in the wheel carriage (if it is moving in walking pace) are included in the category pedestrian. Guidance of visually impaired is not covered in this paper. How visually impaired apprehend different materials and separation lines are neither studied specifically. Focus is on to which degree "average" pedestrians and cyclists keep to their paths and factors influencing this behaviour. The paper only covers links in urban areas during summer. Pedestrian and cycle paths with different types of separation are studied while traffic conditions where cars and bicycles are integrated e.g. cycle lanes are not covered in this paper.

METHOD

There were made an inventory of 106 randomly selected pedestrian- and bicycle areas in two cities in southern Sweden (Lund and Malmö). The inventory included description of surface material, type of separation line, contrast, road side signs, road markings, widths, environment; the standard was also assessed. Field studies were performed at each location. At each location a stretch of 20 meters was observed for 90 minutes; 30 minutes in the early morning, 30 minutes just before noon and 30 minutes in the afternoon. The position of pedestrians and bicyclists that passed by were noted together with gender and their estimated age. Pedestrians with rollator (wheeled walker), wheelchair, etc were noted separately. Observers were trained in the methodology and results from a test study showed that the reliability of the observers was good. The field studies were complemented with short on-site interviews at a couple of locations. In addition, interviews with traffic planners in six municipalities were performed to find out how they approach these questions.

RESULTS AND ANALYSES

Impact of type of separation

At the 106 studied locations, a total of 15277 pedestrians and cyclists passed by during the observation period; approximately twice as many cyclists as pedestrians. Their positions, on the "pedestrian area" and on the "cyclist area", for different types of separation, were distributed according to the figures in Table 1. The figures in Table 1 are then illustrated as graphs in Figures 1 – 3.

TABLE 1 Impact of Type of Separation on Choice of Path

		Cyclists			Pedestrian		
		Ped path	Cycle path	Total	Cycle path	Ped path	Total
asphalt – no separation	Number	386	443	829	103	176	279
		46,6 %	**53,4 %**	100,0 %	**36,9 %**	**63,1 %**	100,0 %
asphalt/asphalt - white solid line	Number	254	1343	1597	79	428	507
		15,9 %	**84,1 %**	100,0 %	**15,6 %**	**84,4 %**	100,0 %
tiles/asphalt	Number	232	3481	3713	190	1507	1697
		6,2 %	**93,8 %**	100,0 %	**11,2 %**	**88,8 %**	100,0 %
tiles/asphalt – 3-4 paving stones	Number	10	749	759	13	377	390
		1,3 %	**98,7 %**	100,0 %	**3,3 %**	**96,7 %**	100,0 %
tiles/asphalt – curb	Number	40	817	857	19	285	304
		4,7 %	**95,3 %**	100,0 %	**6,3 %**	**93,8 %**	100,0 %
tiles/asphalt – grass	Number	19	1205	1224	87	328	415
		1,6 %	**98,4 %**	100,0 %	**21,0 %**	**79,0 %**	100,0 %
Total	Number	941	8038	8979	491	3101	3592

Impact of no separation versus separation

To examine the impact of separation between pedestrian- and cycle paths the joint asphalt path was chosen to represent the "no separation" alternative. To be on the correct side is defined as pedestrians walking on the designated pedestrian path and cyclists cycling on the designated cycle path. For the joint asphalt path the "correct" behaviour is when pedestrians choose to walk further from car traffic and consequently when cyclists choose a path closer to car traffic. Table 1 and Figure 1 show that at the "no separation" alternative 53% of the cyclists and 63% of the pedestrians keep to the correct side. Table 1 and Figure 1 further show that separating combined pedestrian- and bicycle-paths by a painted white solid separation line on the asphalt affects the proportion of pedestrians and bicyclists that keep to the correct side. At the locations with a painted white solid separation line on the asphalt: 84% of both cyclists and pedestrians keep to the correct side. The on-site interviews strengthen this result as all road users were positive to separation of the paths. However, the road users did not seem to have any idea of how or why the road design affected them. The comments were in general negative at locations that did not work too well i.e. where pedestrians and cyclists interfered with each other. The comments dealt however more with other road users' "bad behaviour" than with bad road design.

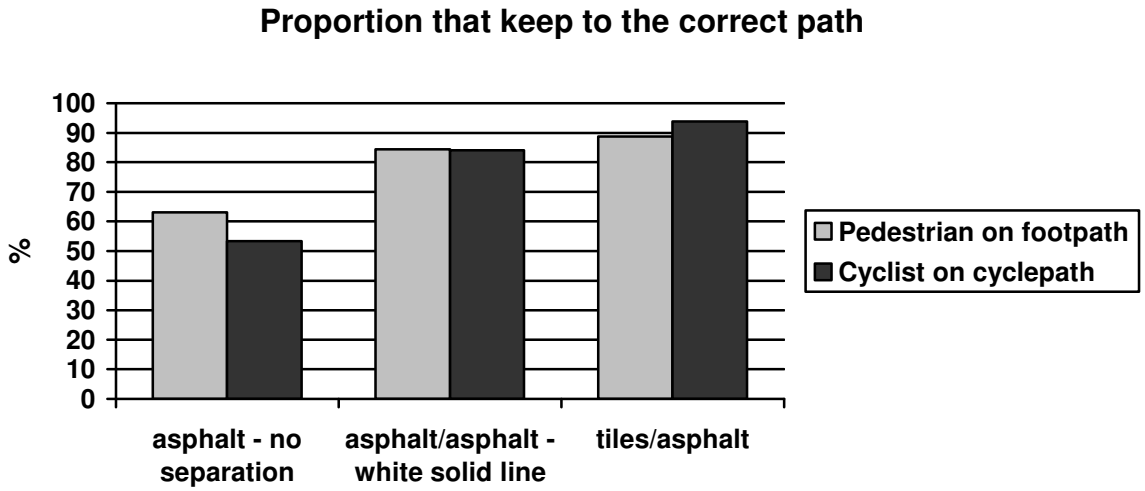

FIGURE 1 Proportion of pedestrians and cyclists that keep to the correct path i.e. pedestrians on the footpath and cyclists on the cycle path, with regard to separation or no separation.

Impact of difference in material

The most common separation forms were separation by different materials – asphalt on the bicycle-path and tiles on the foot-path – or separation by a white solid line on asphalt. When comparing the behaviour at these two types of separation the results show, Figure 1, that the asphalt/tile separation was the most efficient design of the two. Compared to 84% of both cyclists and pedestrians keeping to the correct side at locations with white solid line on asphalt, corresponding 94% of the cyclists and 89% of the pedestrians keep to the correct side when the paths are separated by difference in material. This result was also supported by the on-site interviews; road users had a better knowledge of where to keep when the paths were of asphalt/tiles than when an asphalt-area was separated by a white solid line. Despite this knowledge, still many of the interviewed road users went on the wrong side at both types of separations. According to the interviewed traffic planners asphalt/tiles is the most common separation form in central areas, while the most common separation in the outskirts of the cities is either asphalt with a white solid line or an asphalt path without separation between bicyclists and pedestrians. Therefore the traffic flows were also generally higher at the asphalt/tiles paths. When locations with similar traffic flow were compared (40-100 road users/30 minutes) the difference is smaller, however still statistically significant. When the inventory was made, the contrast in lightness between the paths was measured. Asphalt paths separated by a white, solid line was the only separation form with a contrast above 0.4 on the NCS (National Color System) scale. However, when the asphalt was bleached by the sun or wet the contrast was often unsatisfactory also on these paths.

Impact of difference in material and type of separation

According to the results in Figure 2 the most efficient design is a difference in material, asphalt on the bicycle side and tiles on the pedestrian side, together with a separation of the two sides, either by 3-4 rows of paving stones or a curb stone. On these paths almost everyone kept to the correct side; paving stones were slightly more efficient (99% of the cyclists and 97% of the pedestrians kept to the correct side) than curb stones (where the corresponding figures were 95%

and 94%). It is, however, worth mentioning that all these paths were quite wide and also had bicycle road markings, which might contribute to their higher efficiency to induce correct behaviour.

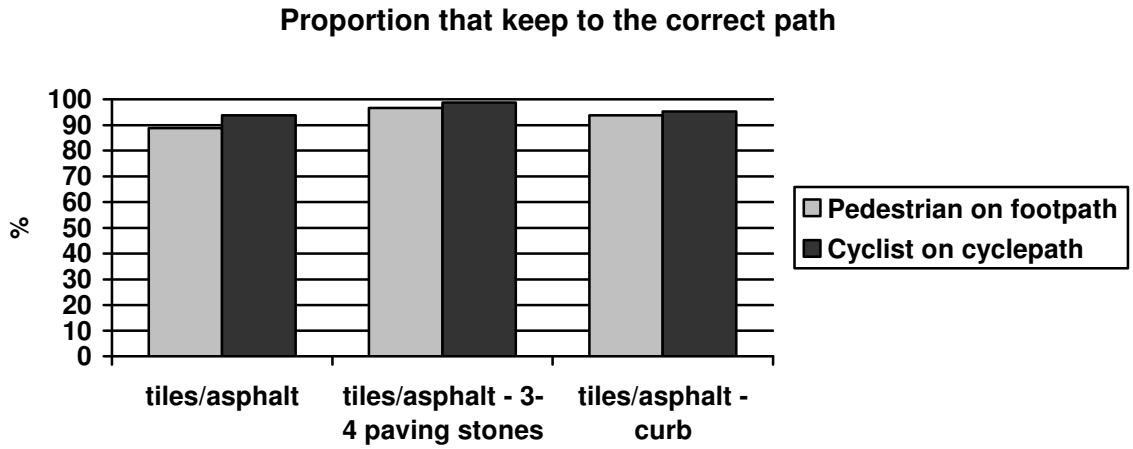

FIGURE 2 Proportion of pedestrians and cyclists that keep to the correct path i.e. pedestrians on the footpath and cyclists on the cycle path, with regard to difference in material and type of separation.

Impact of pedestrian and cycle flows

Pedestrian and cycle flows have great impact on the individual's choice of path; with larger flows a larger proportion keep to the correct path. Pedestrians are affected by both the pedestrian and the bicycle flow; with higher pedestrian and cycle flows a larger proportion of the pedestrians keep to their path. Bicyclists however, are mainly affected by the bicycle flow; with larger cycle flows a larger proportion of the bicyclists keep to the correct path.

Impact of path width

The width of the paths has no unambiguous impact on the pedestrians' choice of path. The bicyclists on the other hand, are clearly affected by the width; with wider paths a larger proportion of bicyclists keep to the bicycle-path. The on-site interviews showed that road users consider the width being an important factor for how well the pedestrian and bicycle-paths work.

Impact of the surroundings

When the foot-path is closest to the roadway a larger proportion of pedestrians walk on the bicycle-path. Apart from that, no statistically significant differences between behaviour and the surroundings were found. This could be due to the limitation of the study, only including links without shops, side streets, bus stops etc.

Impact of bicycle road marking and road signs

The bicycle road marking has great impact on both the proportion of pedestrians and bicyclists that keep to the correct path. Remarkably, the pedestrians are even more affected than bicyclists. The on-site interviews showed that road users are positive to the bicycle road marking; a wish for road markings were expressed on both interview sites.

There was no impact found of road signs on the proportion of pedestrians and bicyclists that kept to the correct path.

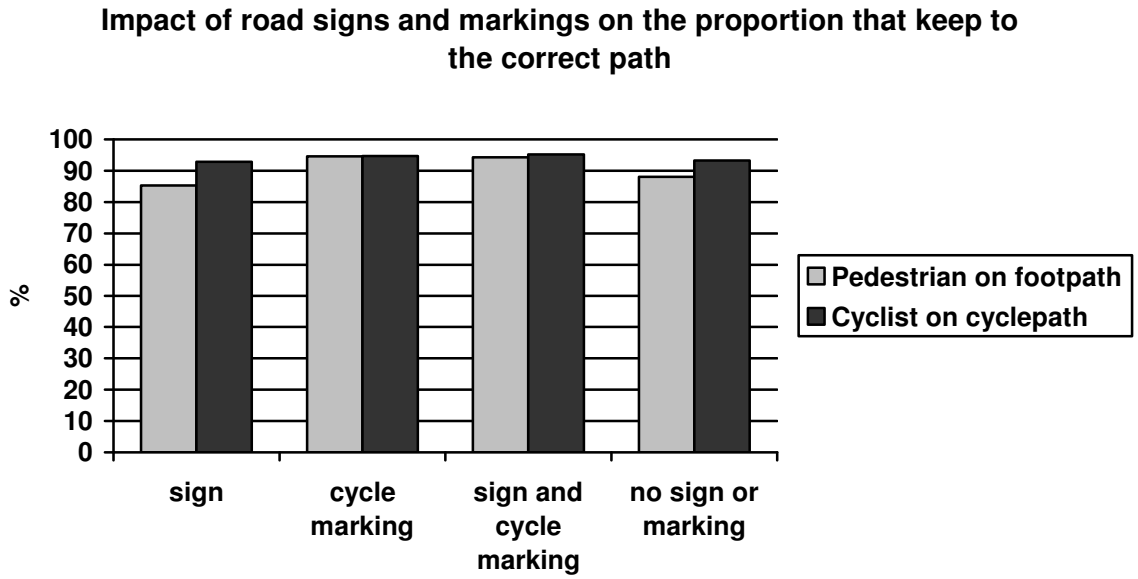

FIGURE 3 Impact of road signs and markings on the proportion of pedestrians and cyclists that keep to the correct path i.e. pedestrians on the footpath and cyclists on the cyclepath.

Impact of gender, age and type of mobility impairment

There was no statistically significant difference between the proportion of male and female pedestrians that kept to the correct path. A small but statistically significant higher proportion of women cycle on the correct path as compared to men.

Both pedestrians and bicyclists keep to a greater extent to the correct path the older they are. The difference between young and adult pedestrians is small but retired keep to a larger extent to the correct path. When it comes to bicyclists the young demonstrate a deviant behaviour by biking more frequently than adults and retired on the wrong side.

The tendency is that wheel-chair users and pedestrians with rollator (wheeled walker) to a greater extent than other pedestrians keep to their path. However, the amount of passing wheel-chair users and pedestrians with rollators (wheeled walkers) during the field study was not big enough to be able to state firmly whether their choice of path diverge from other pedestrians and whether the design of the foot-path and bicycle-path has any impact.

DISCUSSION

Implementation of the results

The results from this study should be applied at a number of locations to confirm the results regarding the importance of design. Some of the locations, that according to this study functioned less well e.g. asphalt paths separated by a solid white line, could be rebuilt to tiles/asphalt with additional separation with 3-4 rows of paving stones or a curb stone. Then changes in cyclists' and pedestrians' behaviours could be studied. In that way the influence of flow and location in the city could be taken care of.

Supplemented studies during different conditions

The studies in this project were carried out on links with a minimal influence of other factors than the separation as such. In the next phase the studies of different types of separation should include intersections, locations with bus stops, streets with shops close by, etc. The studies should also be performed in cities with a different character compared to Lund and Malmö, for example with different size and different cycling culture. The studies should also include behaviour during winter i.e. during slippery conditions and when the paths are covered by snow.

The type of separation that according this study worked best (tile/asphalt with 3-4 rows of paving stones or a curb stone) were only found on comparatively wide paths. Supplementary studies of this separation should therefore be performed to find out adequate widths for good performance and how well they work in different types of environments, central areas, outskirts of the city, etc. According to the interviewed planners, the width of the pedestrian- cycle area is one of the biggest restraints when designing the pedestrian- cycle paths. Optimum design of narrow areas should therefore be specifically studied.

Cycle lane and mixed traffic

According to the interviews with the traffic planners, the number of cyclists using the pavement increase when there is no designated area for cycle traffic i.e. the cyclists are obliged to use a cycle lane or cycle in mixed traffic with motorised traffic. Further studies should be performed to find out how cycle lanes and cycling in mixed traffic affect the subjective safety and to what extent this influences the cyclists to use the pavement.

Studies with visually impaired pedestrians

In this project the behaviour of pedestrians with “normal” eyesight has been studied. That pedestrians and cyclists keep to their paths is of uttermost importance for the subjective safety of visually impaired and their mobility. In future studies the paths with different types of separation must also be tested by visually impaired persons to make sure that their specific requirements are fulfilled. The suggestion would be to start with the types of separation that until now seem to work best – tile/asphalt with 3-4 rows of paving stones or a curb stone and perhaps also with grass.

ACKNOWLEDGEMENT

This paper is based on a Swedish report by Lisa Jonsson “Utformning av separering av gående och cyklande” in 2005 (2); a report that was produced within a project financed by the Swedish Road administration with the aim to analyse different forms of separation between pedestrians and cyclists.

REFERENCES

(1) Ståhl A., (2004), Att orientera sig med hjälp av ledytor – Blinda testar taktiliteten med olika material och struktur. Borlänge, Vägverket, Publikation 2004:158, ISSN: 1401- 9612

(2) Jonsson L., (2005), Utformning av separering av gående och cyklande (A Swedish report with an English Summary on the topic Separation between pedestrians and bicyclists), Department of technology and society, Lund University, Lund, Sweden.