Tu4/G1: Interaction and Conflicts between Cyclists and Public Transport in narrow Urban Space

Pecharda, Christian (AT)
FSV / BMVIT
Karlsgasse 5, 1040 Wien, Austria
pecharda@fsv.at

1. Introduction and definitions

An attractive transport network offers direct relations. That applies to both public transport and cyclists. In narrow urban spaces it sometimes is useful or necessary that cyclists and public transport share the same lanes, because there is not enough space to lead them separately. Recent studies in Germany dealt with cyclists on bus lanes and at bus stops. Even the good practice research of this study in Switzerland, Germany, Denmark and Sweden showed that there are many solutions concerning bicycles and busses but few for bicycles and trams. So far the recommendations and guidelines say: Do not use bicycles in lanes with rails! But in Vienna, for example, it often happens, that cyclists are using lanes with rails for trams even though official cycling routes are in parallel streets with no rails. Why?

The parts of the thesis (PECHARDA, 2007), which are presented here, deal with safety and comfort aspects for cyclists and trams on lanes with rails and at tram stops. It focuses on traffic flow, comfort, behaviour, interactions and conflicts between cyclists, trams, pedestrians and cars on tram lanes and stops. The main questions of this study are:

- How to make cycling safe, comfortable and flowing when sharing narrow urban space with public transport?
- What criteria are influencing safety, comfort and traffic flow of cyclists when sharing narrow urban space with public transport?

“Narrow urban space” is defined in this study as streets with one lane per direction that is shared by cars, public transport and bicycles. The maximum width of such lanes is 4,50 m. If the lanes are 4,50 m or broader, there is enough space to separate the cyclists from public transport and cars and make a cycling track or a separate cycling lane.

“Safety” is defined as the risk of having an accident. It is described in this study with the probability of having interactions and conflicts.

“Comfort” is defined as perceptibility and usability of urban space. It is described in this study with the choice of the route within the lane – Does the cyclist use the lane in the middle of the rails, next to the rails or is he displaced to the sidewalk?

“Traffic Flow” is defined as co-actions or disturbances between road users. It is described in this study with disturbances of cyclists and disturbances by cyclists.

“Tram-stop-capes” are tram-stops were the sidewalk is extended to the rails, so the passengers can enter or leave the tram without crossing the lane.

2. Methodology and analysis

After a literature research and a good practice research, interviews were done with experts of cycling, public transport and urban planning, and interviews with focus groups of cyclists and tramway drivers. An accident analysis, interviews on location with cyclists and video-based behavioural observations were done to collect data to find influence of decisive criteria on safety, comfort and traffic-flow of cyclists.

Within the **good practice research** some cities in Austria, Switzerland, Germany, Denmark and Sweden were visited to collect data to answer following questions:

- Is there a presence of cyclists in urban space of the visited cities?
- Where are cyclists supposed to ride? (Separated or mixed? In front or behind capes?)
- What is the impression of the characteristic of the traffic flow generally?

Analysing these qualitative data gave some significant conclusions: The bigger the cities, the more public transport they have in modal split. The smaller the cities, the more bicycle transport they have in modal split. You can feel or see the presence of bicycles in urban space in such smaller cities: cycling lanes or tracks, parking facilities for bicycles and cyclists themselves are everywhere. Concerning traffic flow, it seems that bicycles are more accepted in cities with higher presence of bicycles in urban space and the traffic is generally less aggressive. Finally the result of the literature research was confirmed, that there are many suggestions and solutions to share urban space between cyclists and busses, but few for trams and bicycles. So the focus of the thesis is on bicycles and trams in narrow urban space. That is “cycling in lanes with rails” and “cycling at tram-stop-capes” with 3 alternatives of leading the cyclists: 1) in front of the cape, 2) behind the cape and 3) across the cape.

To find out what problems are expected when cycling is allowed in lanes with rails and on tram-stop-capes and to get a broad overview, **interviews with experts** of public transport, cycling and transport planning **and with focus groups** of cyclists and tram drivers were done. In the experts opinion it is dangerous to cycle in lanes with rails because of the risk of stumbling at rails and the doors of parked cars might be opened suddenly. And they expect conflicts between trams and bicycles. Also both focus groups think that it is dangerous to cycle in lanes with rails because of risk of stumbling and the opening of car doors. Contrary to the expert opinion both focus groups expressed mutual respect instead of risk of conflicts. Whilst the tram drivers stated that they drive more carefully when meeting cyclists and, that cyclists mostly let them pass at the first possibility, the cyclists independently stated that they usually let the trams pass as soon as possible and that most tram-drivers are considerate. At tram stops experts expect conflicts between cyclists and pedestrians, cars or passengers. The focus group of cyclists basically stated that it is just uncomfortable to pass a tram stop because of the rails and the narrow space that is shared with the cars. The tram drivers mentioned that at tram stops the bicycles usually overtake the trams and consequently the trams overtake the cyclists again at the lane, and so on.

The result of these pre-studies was an overview and impression of possible and expected problems and defined criteria that presumably influence safety, comfort and traffic flow of the cyclists.

Those “presumably influencing criteria” were:

- Car speed and intensity,
- Parking cars and suddenly opened car doors,
- Pedestrians intensity at tram stops,
- Tramways intensity at lanes or stops,
- Rails and the risk of stumbling,
- Space for bicycles and the actual bicycle infrastructure and

- Alternatives of passing tram-stop-capes.

As a next step data were collected with **interviews on location** and video-based behaviour observation to find out what criteria actually influence safety, comfort and traffic flow.

Interviews on location were done to find out why cyclists use lanes with rails, what disturbs them, what makes it dangerous, how would they feel more safe and how they do assess the criteria? About 50% of the cyclists were on the way to or from work, 20% did the ride in their leisure time and 17% were on the way to or from university or school. 53% of the cyclists chose the route with the rails in the lane because it was the shortest route to get from A to B and 27% chose it because their destination was along that route. Most cyclists felt disturbed by trams, cars and the few space for cyclists and they felt endangered by trams, cars and the possibility of suddenly opened car doors from parking cars. According to the cyclists, having more space for cyclists or even separate tracks and having fewer cars on the lane, could increase the feeling of being safe. First conclusions after the interviews were that even though trams and rails were assessed "unpleasant" by the cyclists, they would nevertheless use lanes with rails if they are the shortest routes to their destinations and that feeling of safety is primary influenced by the cars intensity. On lanes with rails men felt safer than women. About two thirds of the cyclists were male and one third female.

To collect behaviour criteria that describe safety, comfort and traffic flow a **video observation** was done: during 42 hours 1721 cyclists were observed on 15 locations in Vienna in the inner districts. Finally every observed cyclist got related with data of "location criteria" and "behaviour criteria". "Location criteria" were the defined "influencing criteria" (Intensity of cars, tams, cyclists, speed, width of lane…) and "behaviour criteria" were safety (interactions or conflicts), comfort (choice of the route within the lane) and traffic flow (mutual disturbance). To find actual influence of the location criteria on safety, comfort and traffic flow of the cyclists descriptive-analysis were done and models were developed using logit-analysis. The main results are presented here:

Available space, cars intensity and cars speed have main influence on **safety** of cyclists. The probability of having a critical interaction or worse would be below 10% if lanes width is >4,00 m, cars intensity is <400 cars/h per direction and the average car speed is <40 km/h. Looking at interactions between trams and cyclists (Table 1) it is remarkable that most cyclists have no interaction with a tram. On lanes with rails and at tram-stop-capes the predominant majority of cyclists have no interaction with trams. Some critical interactions were observed at capes with cyclists in front of the cape and few conflicts between cyclists and trams were observed at lanes with rails.

Table 1: Interactions between cyclists and trams on lanes with rails and at tram-stop-capes

With trams...	Cyclists	No interaction	Interaction	Critical interaction	Conflict
Lane with rails	430	94%	5%	0,5%	0,5%
In front of cape	352	81%	17%	2%	0%
Behind the cape	126	88%	12%	0%	0%

Available space, cars intensity and type of tram-stop-capes have main influence on cyclists' comfort. The probability of cyclists taking refuge to the sidewalk would be below 10% if lanes width is >4,00 m and cars intensity is <500 cars/h per direction. On lanes with rails most cyclists chose to ride next to the rails (Table 2), at capes with cyclists in front of the cape half of the cyclists chose to ride in the middle of the rails and about one third rode next to the rails – even though that space between rail and cape is only 0,60 m in Vienna. At capes with cyclists behind the cape along a cycling track about 10% chose to stay on the lane in front of the cape instead of using the cycling track.

Table 2: Cyclists choice of driving route within the lane on lanes with rails and at tram-stop-capes

	Cyclists	Middle of rails	Next to rails	Cycling track	Sidewalk
Lane with rails	430	7%	89%	-	4%
In front of cape	352	54%	33%	-	13%
Behind the cape	126	5%	6%	85%	4%

Available space, average speed of cars and intensity of tramways have main influence on cyclists' traffic flow. The probability of mutual disturbance would be below 10% if lanes width is >4,00 m, tramway intensity is <15 trams/h per direction and the average car speed is <40 km/h. As a consequence of having few interactions there was also few disturbance (Table 3) between cyclists and others. If others disturb cyclists, those are cars in front of capes and pedestrians behind capes. If cyclists are disturbing others, it is mainly in front of the cape disturbing cars.

Table 3: Mutual disturbance between cyclists and others on lanes with rails and at tram-stop-capes

	Cyclists	Cyclist disturbs nobody	Cyclist is not disturbed
Lane with rails	430	94%	97%
In front of cape	352	89%	83%
Behind the cape	126	98%	87%

The alternative of **cycling across the tram-stop-cape** has not been implemented yet in Vienna. To get some answers to two main questions concerning this alternative two locations were observed which represent the situation of the questions:

- What happens if passengers cross the cycling track at the tram-stop-cape?
- What happens if cyclists ride between the waiting area at the tram-stop-cape and the tramway?

Concerning "passengers crossing a cycling track" the metro exit at "Schottentor" was observed. At that location 290 bicycles/h and 780 pedestrians/h (in both directions) could be observed. 45% of the cyclists had no interaction with pedestrians, 11% had a critical interaction and 1% of the cyclists had a conflict with pedestrians. Pedestrians did disturb 19% of the cyclists and 14% of the cyclists did disturb pedestrians.

Concerning "cycling between waiting area and tramway" the tram stop "Sensengasse" was observed. At this stop passengers have to cross a lane with cars and consequently also with cyclists when entering the tram. 97 bicycles/h, 278 passengers/h and 44 trams/h were observed. 89% of the cyclists had no interaction with passengers, 3% has a critical interaction and 1% had a conflict with passengers. Others did not disturb 81% of the cyclists and 86% did disturb nobody.

The advantage of tram-stop-capes with cycling across the cape is that interactions or conflicts with cars and pedestrians can be avoided and that cyclists do not have to cross the rails to pass the tram stop in the middle of the rails. Only possible conflicts are with passengers. But it seems that at only few cyclist might have interactions with passengers. According to this and other studies usually only about 15% of the cyclists meet trams at the stops. And in this study only 4% of cyclists had critical interactions or conflicts with passengers. And contrary to prejudices cyclists seem to be more considerably than expected. Even at a crossing of cyclists and pedestrians with a very high intensity only about 10% of the cyclists had critical interactions.

3. Conclusion and recommendation

First off all it is to say that this was just a pilot study with a relatively small sample that just gives a clue or a direction. The first recommendation is to initiate some follow-up in-depth studies to get more significant results. The conclusions and recommendations can surly be put into question, but there is **good evidence**, that:

- Bicycles and tramways are not enemies in urban space.
- Decisive criteria to allow cyclists on lanes with rails are space and cars concerning safety and comfort and space, cars and trams concerning traffic flow.
- Cycling in front of a tram-stop-cape depends primary on cars intensity and speed.
- Cycling behind a tram-stop-cape is difficult to put into practice due to lack of urban space.
- Cycling across a tram-stop-cape would be a good compromise and deserves further research!

It seems that cyclists will always use lanes with rails if they are the shortest connection between two destinations. Similar to lanes without rails (where space and cars are criteria to decide on whether to separate cyclists), the main criteria that influence safety, comfort and traffic flow of cyclists on lanes with rails are the available space, the average speed of cars and the intensity of cars and trams. It seems to be possible to lead cyclists along lanes with rails if…

- they are 4,00 m or more wide,
- the average speed of cars is below 40 km/h and
- there are less than 400 cars/h and 15 trams/h per direction.

Furthermore it is of importance to **increase the presence of bicycles in urban space**. So suggestive lanes (dt: “Mehrzweckstreifen”, “Angebotsstreifen”) for bicycles should be implemented even on lanes with rails. If the average speed of the cars is below 40 km/h and there are less than 400 cars/h and 15 trams/h per direction it seems also possible to lead cyclists safely, comfortable and flowing along lanes with rails that are lass than 4,00 m wide without a suggestive lane, but maybe with pictograms that call attention to the cyclists.

At **tram-stop-capes** it seems that cycling across capes is a good alternative. The remaining disadvantage of possible conflicts between passengers and cyclists can be minimised if cyclists that meet a tram at the stop would not overtake the tram. This could be achieved if the stop is designed in a way that makes it not attractive to cycle across the cape with a tram waiting at the stop and makes it attractive if no tram is at the stop. A suggestion of such a design is to lead a cycling track of 1,50 m width along the cape (Figure 1). This would be a local compromise. If a tram is at the stop the 1,50 m are too narrow and thus uncomfortable for cyclists to pass the tram. But if no tram is at the stop it is broad enough to pass it safely and comfortable because the cars do not pass the cape as close as the tram.

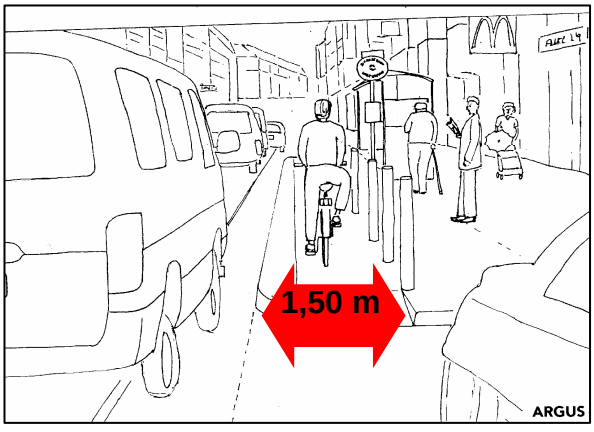

Figure 1: Suggestion of tram-stop-cape with a narrow cycling track across the cape (picture: ARGUS, 1997; additional width: PECHARDA, 2007)

This pilot study gave input to the discussion and good evidence that it is possible even for bicycles and tramways to share narrow urban space efficiently in a safe, comfortable and flowing way. As a follow-up studies the recommendations of making suggestive lanes and leading cyclists across tram-stop-capes along narrow cycling tracks should be put into practice and be checked.

If road users meet frequently in urban space and get used to each other, mutual acceptance and tolerance will increase and that finally leads to more safety, comfort and a better traffic flow!

Sources:

ARGUS (1997) picture: Suggestion of tram-stop-cape with cycling across the cape (not published), Vienna

PECHARDA, C. (2007) Gemeinsame Nutzung von Verkehrsflächen durch öffentlichen Verkehr und Radverkehr, Dissertationsarbeit, Institut für Verkehrswesen, Universität für Bodenkultur, Wien