Recumbent Bikes - Trikes - Velomobiles

An analysis of (single vehicle) crashes

H. Bunte[*], C. Hipp[#]

[*]HPV (Human Powered Vehicles) Deutschland e.V.
Industriestr. 133a, 21107 Hamburg, Germany
e-mail: premier@hpv.org

[#]HPV (Human Powered Vehicles) Deutschland e.V.
Industriestr. 133a, 21107 Hamburg, Germany
e-mail: federstift@hpv.org

ABSTRACT

For riders of recumbent bikes, trikes and velomobiles questions of safety on infrastructure planning is of importance due to travelled kilometres per year. On average 7,100km/year were ridden by these cyclists with the above mentioned bikes. Velomobile riders have crashes inside and outside cities whereas trike and recumbent bike riders suffer from crashes mostly inside cities. In general all riders of special bikes had difficulties with infrastructure i.e. slippery surfaces, curbs and in specific with roundabouts, intersections and cycle paths. The presented two months online survey intends to carry out (single-vehicle) crashes and causes with special bikes on different types of bicycle lanes and roads including further additional crash indicators as involvement of third persons, time of the day and last but not least human behaviour. Considering the fact that one third of all riders cover distances of more than 5,000 km per year (especially velomobile riders with 54.1%) with increasing speed physical damage decreased. So far, roundabout 160 participants have answered the questionnaire.

Keywords: trikes, recumbents, velomobiles, causes of (single) crashes, lack of official (accident) statistics and analysis.

1 INTRODUCTION

Although the numbers of vehicles sold has increased over the last 20 years, hardly any research exists in Germany from official authorities about cycling behaviour and analysis of single-vehicle crashes. A reasonably amount of research has taken place within the special bike community itself on a European and international level so far [1] [2]. Apart from that official statistics of crashes summarise all these vehicles under the sub-topic “Others”. Moreover, nothing is known about the causes or specific reasons for crashes. There is also additionally a lack of records of individual single-vehicle crashes.

During the 1980s/90s most of the research was done within the community [2] [2]. Even crash test behavior for these sorts of vehicles is an old topic for the ‘special bike-community’ itself. Nevertheless research needs to be updated with regard to the current technical state of the art developments of the vehicles themselves and more sold numbers of recumbent bikes, trikes and velomobiles. Furthermore traffic conditions have changed while increasing numbers

of vehicles in general on roads. Moreover official authorities do not care about reporting accidents with so-called unusual bikes. Therefore HPV Deutschland e.V. performed an online survey about recumbent bikes, trikes and velomobiles and the causes of crashes.

HPV Deutschland e.V. registered in 1986, is an NGO with around 1000 members and supports the technical development of recumbent bikes, trikes and velomobiles (and other human powered vehicles in the air and on water). These sorts of bikes are often used for riding longer distances due to their aerodynamic advantages and comfortable riding positions. Hence they are also perfect vehicles for every day commuters. The purpose of the online survey was to draw attention to special bikes (again) and to encourage a discussion about these bikes with the assumption that their relevance will increase in the future due to factors such as the demographic change [10] and environmental issues within cities concerning increasing CO_2 emissions caused by motorized vehicles [10].

The intention of the survey right from the beginning was NOT to compare (single vehicles) crashes with (single) crashes of so called “normal” bikes. Limited working and infrastructure capacities (i.e. professional online tools; SPSS etc.) of our NGO made it clear that the focus has to be kept on a certain aspects of crash related issues. Hence the presented online survey [5] asked for (single-vehicle) crashes and causes of common interest with special bikes. This paper will outline the pertinent results from the survey and will highlight on one hand causes of single-vehicle crashes and on the other hand the most important facts about crashes that involve a third party. Moreover, one third of all riders cover distances of more than 5,000 km per year (especially velomobile riders with 54.1% as they reach higher average speed rates). Finally, the time is ripe to also discuss common prejudices that these sorts of bikes are only “diabolically fast” and therefore they are dangerous to ride for people due to the severity of accidents.

2 METHODS

2.1 Study design

It is a well-known fact that cycling in Germany has become more and more popular over the last years. Consequently several topics are also becoming more apparent, such as single-vehicle crashes and discussions about improvements of infrastructure [14][7]. In terms of research on single-vehicle crashes there is a lack of data in Germany in general. Moreover nowadays the cargo bike is also a hot topic with regard to its strengths with regard to load capacity and speed (if equipped as an EAB - electrically assisted bicycle) and CO_2 savings for CEP (Courier Express Parcel) services in towns over the so called last kilometer/mile [11]. It is thought that if research is done on recumbents, velomobiles and trikes it might also help cargo bikes for future planning in towns and/or the other way round to encourage the acceptance of so called “unusual bikes” which would encourage diversity of human powered vehicles on roads. On the one hand, the phenomenon of trikes, recumbent bikes and velomobiles is not new at all [9]. During the 1920s/30s there was, for example, a strong industrial force in France for the production of recumbents and velomobiles. On the other hand recumbent bikes, trikes etc. are well-known not only for its early stage but also for technical developments, like i.e. the tilting technology [3] [12] and recent research has highlighted prejudices and marketing towards trikes [14] and space which is needed.

Currently the number of recumbent bikes, trikes and velomobiles sold in Germany is relatively high for Europe [15]. Therefore the differentiation between different types of vehicles, such as unfaired/full faired and single/two-track vehicles, vehicles with and without tilting technology made sense for a deeper analysis. Moreover, the difference in crashes with other vehicles and

single-vehicle crashes was of importance because no reliable official statistics exist about this topic in Germany (and other European countries). The survey gives a first hint of relevant aspects and reasons for (single)crashes in general and specific in terms of infrastructure. Participants were recruited over the HPV webpage [14], social media "Velomobile Forum" [15] and the HPV membership magazine [16]. The online survey was programmed in Google forms. Hence, 166 data sets were collected within a period of two months (January/February 2015); 158 data sets could be taken into account for the analysis[1i] where 150 men and eight women participated. Due to the small number of women the data from the women were analysed together with the men's data. From these 158 cases 63 (39.9 %) had accidents which involved another vehicle/person and 95 (60.1 %) had single-vehicle accidents.

Altogether 158 vehicles were used in the survey whereas one tandem, a young adult bike and another special bike (rickshaw) were not taken into account due to the limited number. Therefore 91 recumbent bikes (including also scooter bikes = "city recumbent") were put together into one group), 25 trikes and 39 velomobiles. The analysis of the data was carried out using Excel. An independent pre-test was carried out by N= 12 persons (men and women). The survey had its limitations around resources; as this survey was done by volunteers and volunteers work. The decision doing a two months survey and asking only for the last accident was simply taken to reduce work load in order to being handle the data within a limited resource of time. Therefore the number of accidents to be reported in total was "artificially" reduced. Standard statistical procedures as medians, standard average values and Chi-squared tests (named, when the values are greater 0.0000) and linear trendlines with the calculation of the coefficient of determination were used to do the analysis. The analyse is dominated by descriptive paragraphs.

3 RESULTS

The survey used common indicators and categories which can be found in surveys for "normal cyclists" [17]. Hence these indicators were used in order to have information for future research where the intention is to compare (single-vehicle) crashes of recumbent and "normal" bike riders. General speaking the focus lies on the attention of bringing the topic on the agenda (again) and in specific the survey has deeply to be identified as a first step. Chapter 3 gives firstly general information on usage, age and diversity of vehicles before the sub chapters "single crashes" and "crashes" show detailed results.

3.1 General aspects

3.1.1 Age of participants and cycled kilometres per year

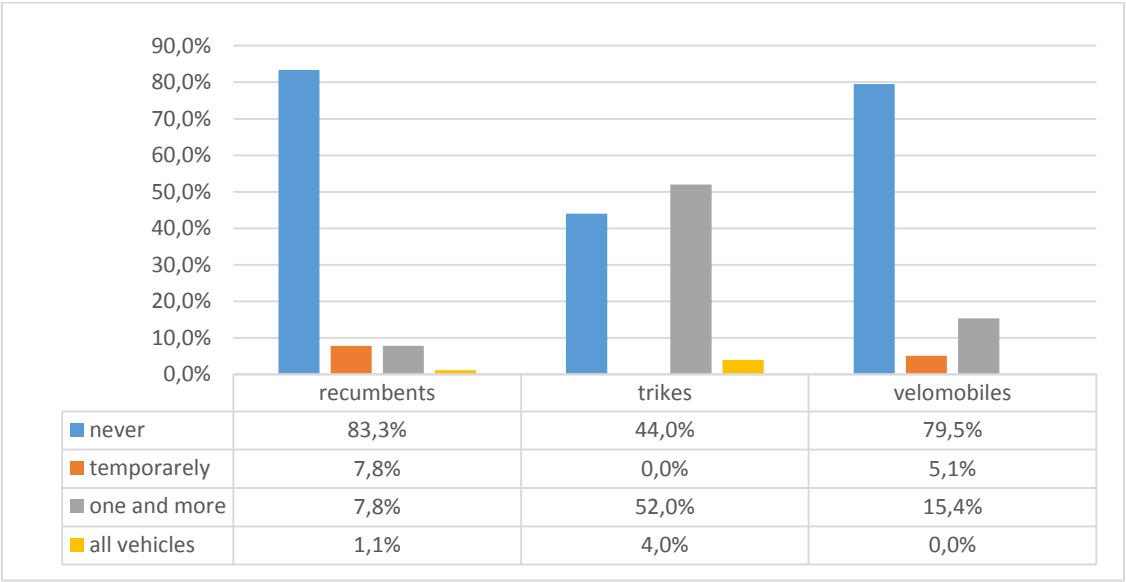
In total the mean distance travelled by each surveyed person with all their different vehicles was 7,176 km/year/person. If looking at each vehicle itself, recumbent riders cycled on average 5,043 km/year, trike riders 4,313 km/year and velomobile riders 7,068 km/year. The mean age of all subjects was 47.3 years; the subgroups of recumbent riders had a mean age of 46.0; trike riders 47.4 years and velomobile riders 50.3 years old at the point of study.

[1] Three invalid data sets were taken out of the analysis because accidents happened in foreign countries. Another five data sets were taken out due to technical problems while the program saved the data.

3.1.2 EAB (electrically assisted bikes)

Nowadays the importance of taking electrically assisted bikes (EAB) **Fehler! Verweisquelle konnte nicht gefunden werden.** in surveys seems of crucial importance. Here some participants had longer personal experiences with EAB in special bikes occasionally. Roundabout 80% of the recumbent riders (83.3%) and of the velomobile riders (79.5%) have never tested a bike with EAB while 56.0% of trike riders already use an EAB in at least in one or more of their vehicles or in all their (special) vehicles.

Table 1: Share of EAB periodically used in special bikes (N=90)

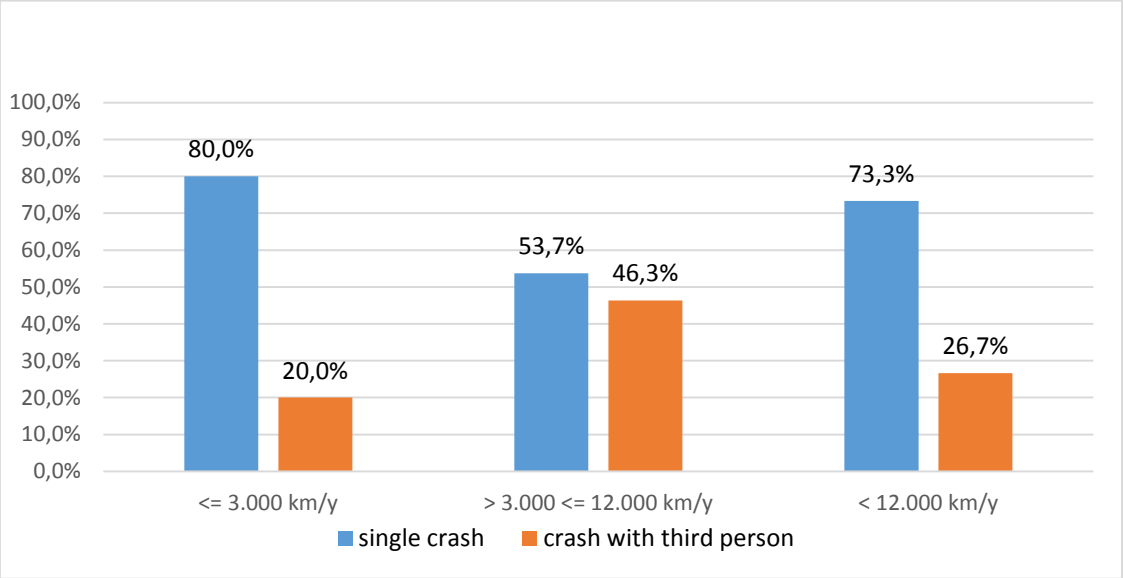


	recumbents	trikes	velomobiles
never	83,3%	44,0%	79,5%
temporarely	7,8%	0,0%	5,1%
one and more	7,8%	52,0%	15,4%
all vehicles	1,1%	4,0%	0,0%

3.1.3 Crashes and single-vehicle crashes

Taking the importance of yearly distance travelled and causes of accident into account there is a difference in the number of accidents with the involvement of a third party or single-vehicle crashes in those riding between 3,000 km/year and 12,000 km/year (N=97); with those riding under 3,000 km/year (N=20) and over 12,000 km/year (N=15) the share of single-vehicle accidents is significant higher.

Table 2: Kilometers cycled per year and types of crashes (N=132, chi^2=0.0041)

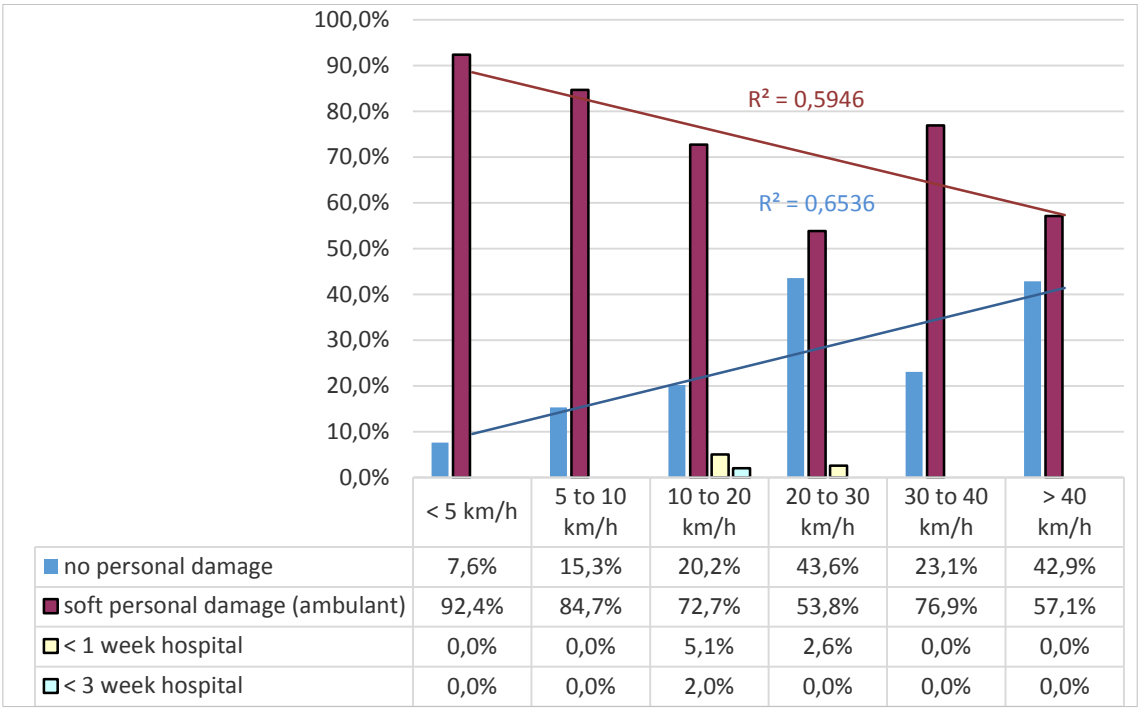


It's a well-known prejudice that recumbent riders are said to be cyclists which are only fast! The question was how fast was the cyclist's speed just before the crash happened? As seen from the results, one can factor into account that recumbent bikes and trike riders who ride more and longer distances each year have fewer single-vehicles crashes. The allocation for riders with over 12,000 km/year is similar to the allocation in the category of 3,000 km/year.

3.1.4 All crashes and personal damages with cycled speed

The following table shows that there is a reciprocal correlation between speed of accidents and physical injury (personal damage). One can notice that a higher speed does not necessarily lead to a higher personal damage. The 'middle speed' category (10 to 20km/h and 20 to 30km/h) leads to stays in hospital whereas higher speeds do not necessarily lead to stays in hospitals.

Table 3: Personal damages just before crashing (N=156, incl. coefficient of determination)

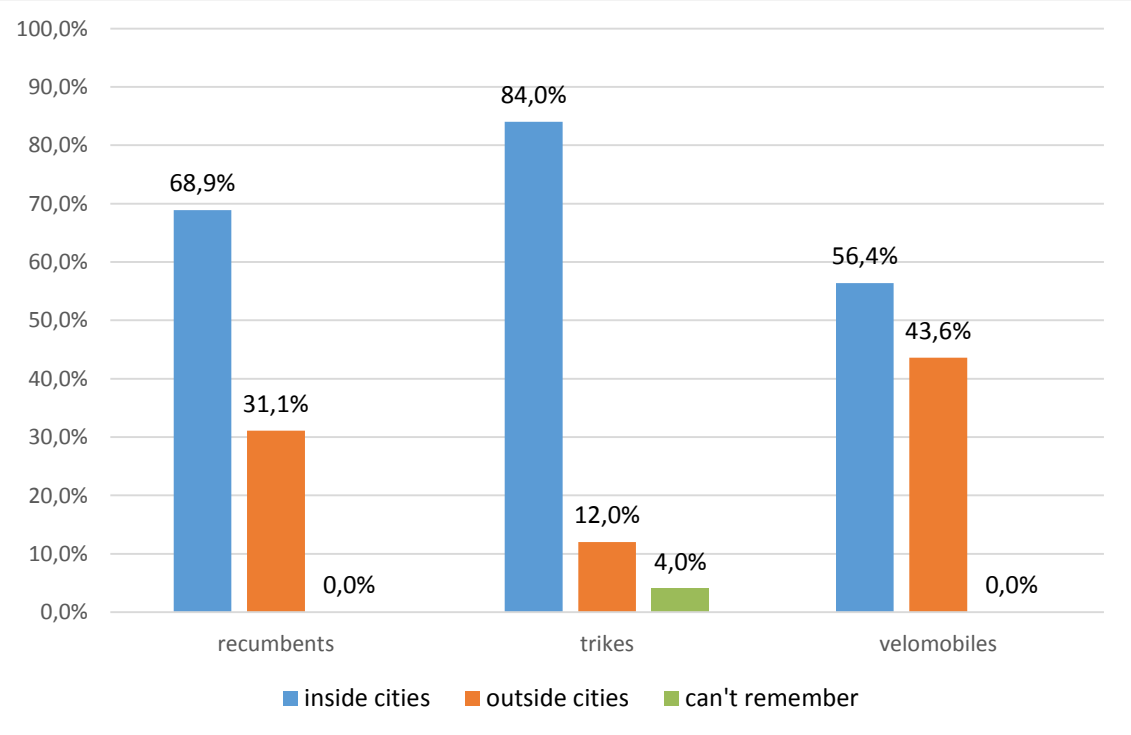


	< 5 km/h	5 to 10 km/h	10 to 20 km/h	20 to 30 km/h	30 to 40 km/h	> 40 km/h
no personal damage	7,6%	15,3%	20,2%	43,6%	23,1%	42,9%
soft personal damage (ambulant)	92,4%	84,7%	72,7%	53,8%	76,9%	57,1%
< 1 week hospital	0,0%	0,0%	5,1%	2,6%	0,0%	0,0%
< 3 week hospital	0,0%	0,0%	2,0%	0,0%	0,0%	0,0%

3.1.5 All crashes and all vehicles inside and outside the cities

Of importance is the accident situation inside and outside of cities [16]. Recumbent and trike riders have more accidents in inner cities (68.9%, outside 31.1%) whereas trike riders have an extremely high rate (84%) of accidents in the cities and only 12% outside of the city. This situation is completely different for velomobile riders: here in town the number is 56.4% and outside the city by 43.6%. Concerning infrastructure and problems with crashes on roads, cycle paths etc. the following causes can be identified. The share for all crashes on roads is for velomobiles significantly higher (69.2%) than it is for trikes (36.0%) and for recumbent bikes (47.8%). One reason for the high percentage of crashes of velomobiles on roads is that they ride predominately on roads rather than on cycle paths. Only for trikes is the share of crashes on cycle paths the highest with 40% (recumbent bikes 28.9% and velomobiles 15.4%). Here reasons might be the poor situation of cycle paths in general and the widths of some paths.

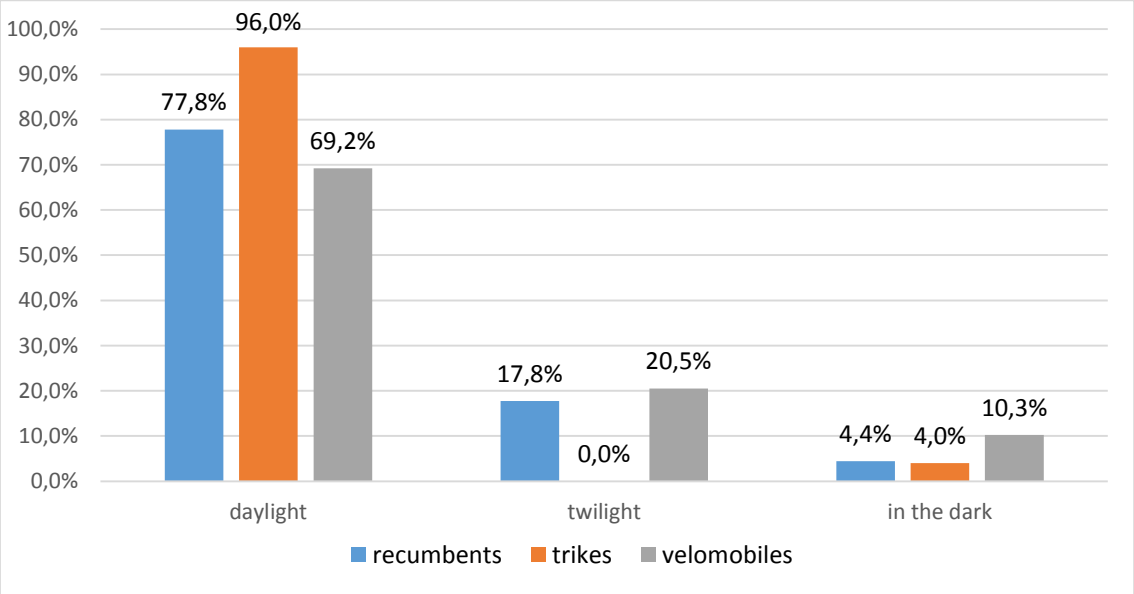
Table 4: All crashes inside and outside cities (N=158, chi^2=0.0010)



3.1.6 All crashes and all vehicles at time of the day

In daylight 77.8% of the recumbent riders, 96% of trike riders and 69.2% of velomobile riders had crashes. During twilight none (0.0%) of the trike riders had crashes whereas 17.8% of recumbent riders and 20.5% of velomobile riders had crashes. The situation in the dark is that recumbent riders (4.4%) and trike riders (4.0%) have nearly the same rate of crashes. While velomobile riders ride also during the night the percentage of crashes is around 10.3%. But velomobiles have a relatively higher risk to have a crash with another vehicle during twilight and dark (30.8%).

Table 5: All crashes at time of day (N=158, chi^2=0.0166)

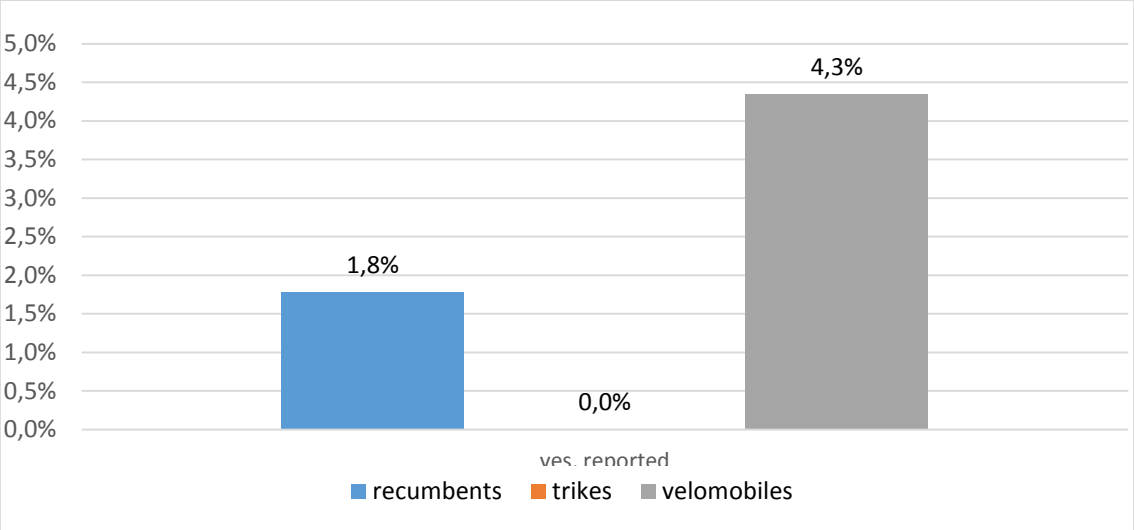


3.2 Single vehicle crashes

The phenomenon “single bike crash” is not an official issue in Germany at all. Hence it is important to emphasise this, as well as developing official results from this empirical data. One can estimate that roughly 60% of so-called “normal bike crashes” are single-vehicle crashes in Germany and possibly even more. One might also assume that there are even more single-vehicle crashes in Germany because statistics rely on police reports. But only one quarter of single-vehicle crashes with bikes are reported at all. In contrast, statistics from hospitals would be of importance **Fehler! Verweisquelle konnte nicht gefunden werden.** but one should bear in mind that people, especially the elderly, do not always report crashes to hospitals because of a fear of getting “captured” into hospital **Fehler! Verweisquelle konnte nicht gefunden werden.**. Therefore this survey adds first information of single-vehicle crashes with special bikes.

3.2.1 Single-vehicle crashes reported to the police

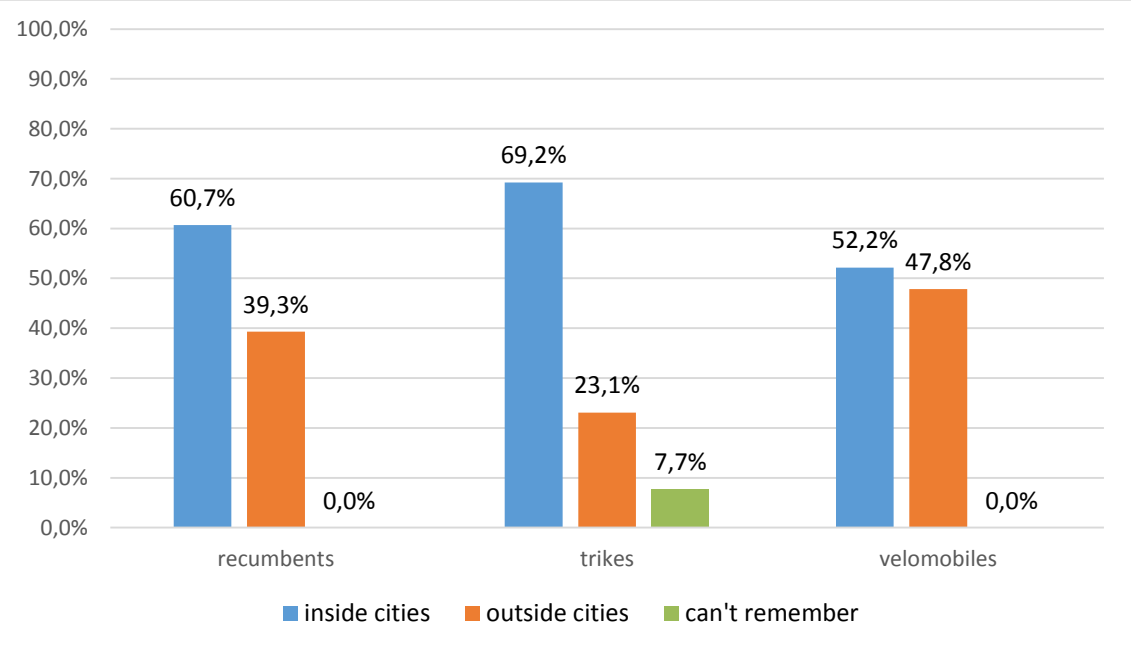
Only 1.8% of the recumbent riders and 4.3% of the velomobile riders reported their last single bike crash to the police. None of the trike riders reported them.



3.2.2 Single-vehicle crashes inside and outside cities

Recumbent (60.7%) and trike riders (69.2%) have many more single crashes within towns than outside. Recumbent riders have 39.3% and trike riders have 23.1% of single-vehicle crashes outside. Velomobile riders also have more or less the same amount of single-vehicle crashes (inside: 52.2% and outside: 47.8%).

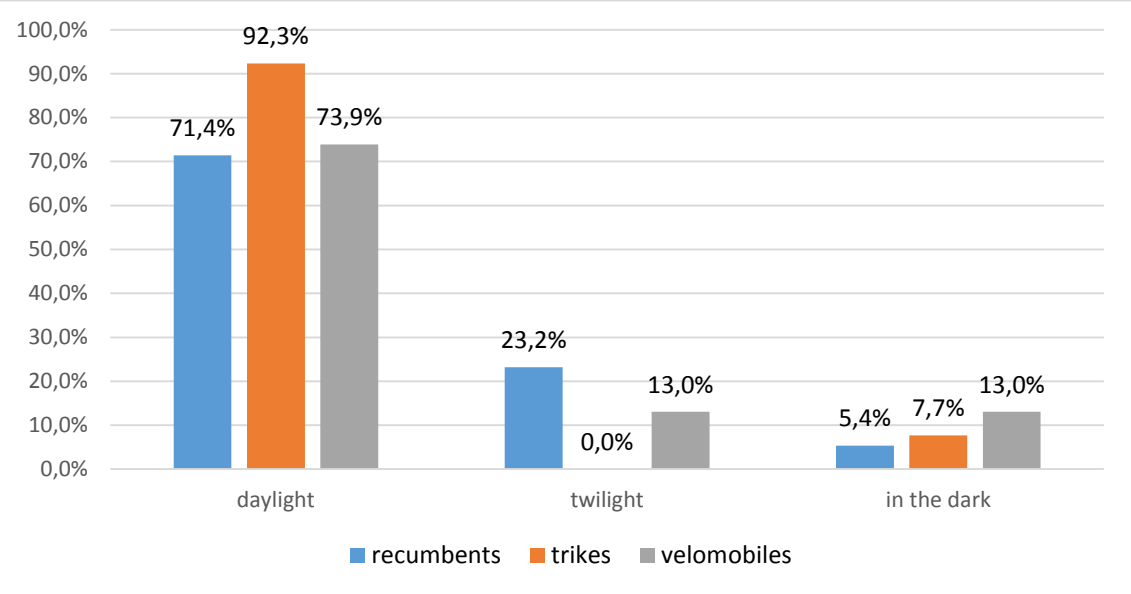
Table 6: Single-vehicle crashes inside and outside cities (N=95, chi^2=0.0640)



3.2.3 Single-vehicle crashes and time of the day

The high number of single-vehicle crashes during daylight might be explained by covering travelled kilometers during daytime. During twilight, recumbent riders have problems with single-vehicle accidents. However, velomobile riders have during the night, in comparison to the other vehicle types, a significantly higher risk of single-vehicle accidents (13.0%). In comparison to travels all over the year (average 7,068km/year) the percentage of single crashes during night is low.

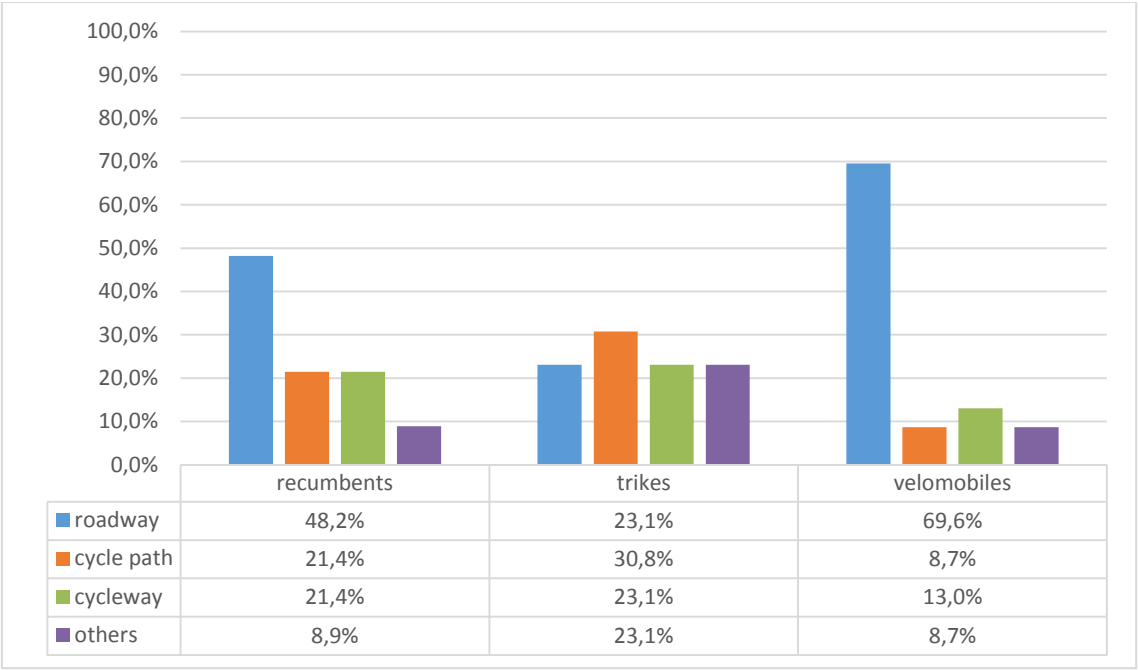
Table 7: Single crashes and time of day (N=95, chi^2=0.0029)



3.2.4 Single-vehicle crashes on roads and cycle paths

In most cases single-vehicle crashes happened on the road (48.2% recumbent riders and 69.6% velomobile riders) whereas trikes have most of their single-vehicle crashes on cycle paths (30.8%). Even if the number of single-vehicle crashes on roads by velomobile riders seems high (69.6%) in comparison to the other infrastructure designs it's "only" a consequence of their use. In contrast, recumbent riders also have a high number of single crashes on roads (48.2%) although their total amount of cycled kilometers is lower than for velomobile riders. Trikes suffer from single crashes on cycle paths with 30.8%, followed by similar numbers for using cycle ways (23.1%) and roads (23.1%).

Table 8: Single crashes and infrastructure (N=95)

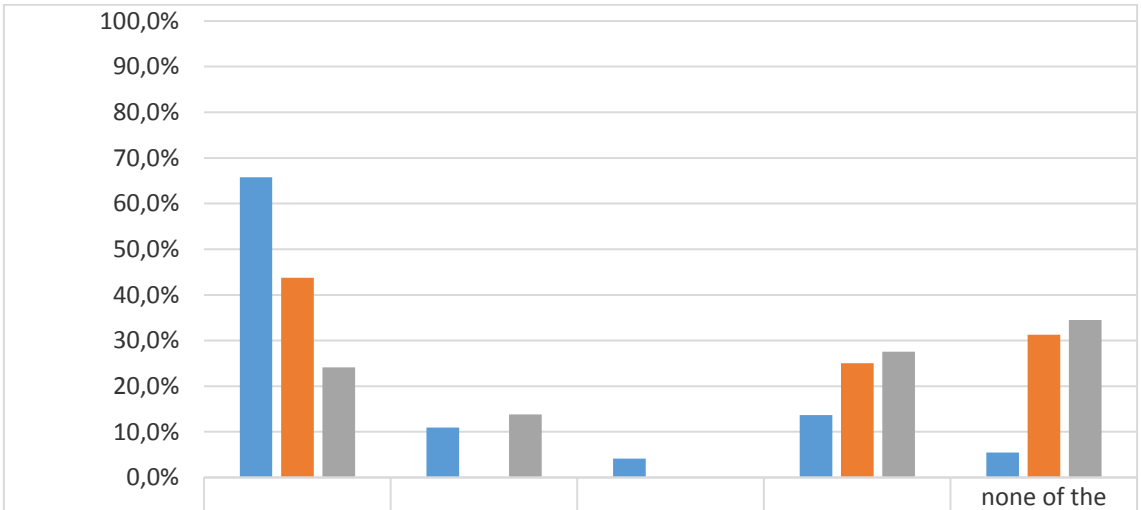


	recumbents	trikes	velomobiles
roadway	48,2%	23,1%	69,6%
cycle path	21,4%	30,8%	8,7%
cycleway	21,4%	23,1%	13,0%
others	8,9%	23,1%	8,7%

3.2.5 Single-vehicle crashes and certain infrastructure

An infrastructural cause of single accidents in case of recumbent bikes is, for over 60%, the surface itself. Here trike riders also have problems (40%), whereas velomobile riders did have fewer problems with the surface. Recumbent riders have problems with “railway lines” (4,1%). Curbs and ridges are problems for recumbent and velomobile riders but not for trike riders.

Table 9: Single crashes and their infrastructural factors (N=113, chi^2=0.0001)

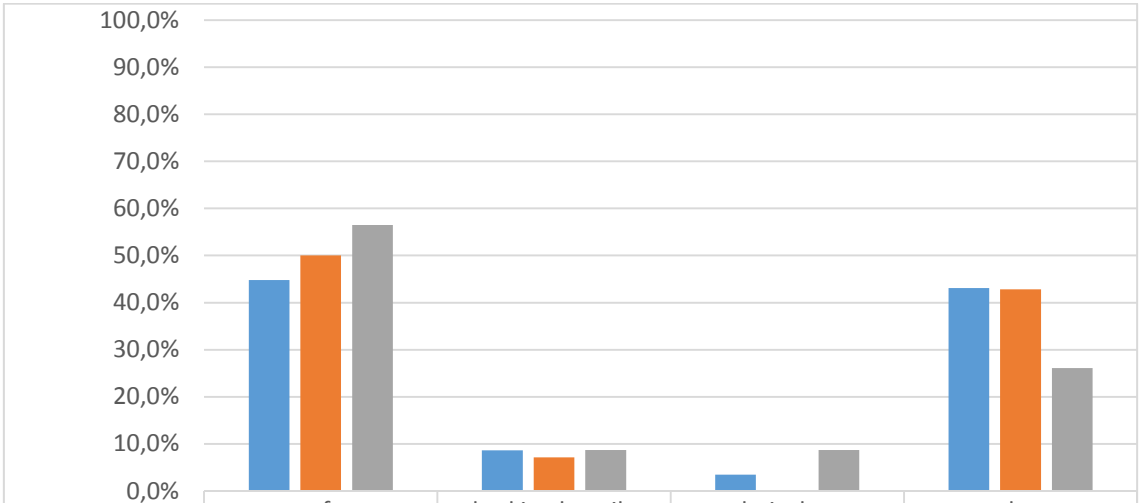


	surface	curbs	railway lines	others	none of the designated causes
recumbents	65,8%	11,0%	4,1%	13,7%	5,5%
trikes	43,8%	0,0%	0,0%	25,0%	31,3%
velomobiles	24,1%	13,8%	0,0%	27,6%	34,5%

3.2.6 Single crashes and personal and technical factors

Coming back to the common view that these vehicles are always “diabolically fast”, here this target group confirm the prejudice; even so the statements are of subjective value. While 56.5% of velomobile riders said they were too fast, 50% of trike riders and 44.8% of recumbent bikes cited speed as the cause of the crash. Another important factor is “braking [too] heavily”. A technical defect is only significant in a small proportion of velomobile crashes (8.7%). These reasons for single-vehicle crashes highlight the idea of “no constraints”, that infrastructure is in most of the cases a contributory cause of single-vehicle crashes and the riders’ actions perhaps less significant, although the idea of “inattentiveness” should be mentioned. Subjects had also problems with luggage and stuck clothing while cycling and unknown reasons (summarized as “others”).

Table 10: Single crashes and personal and technical factors (N=98)

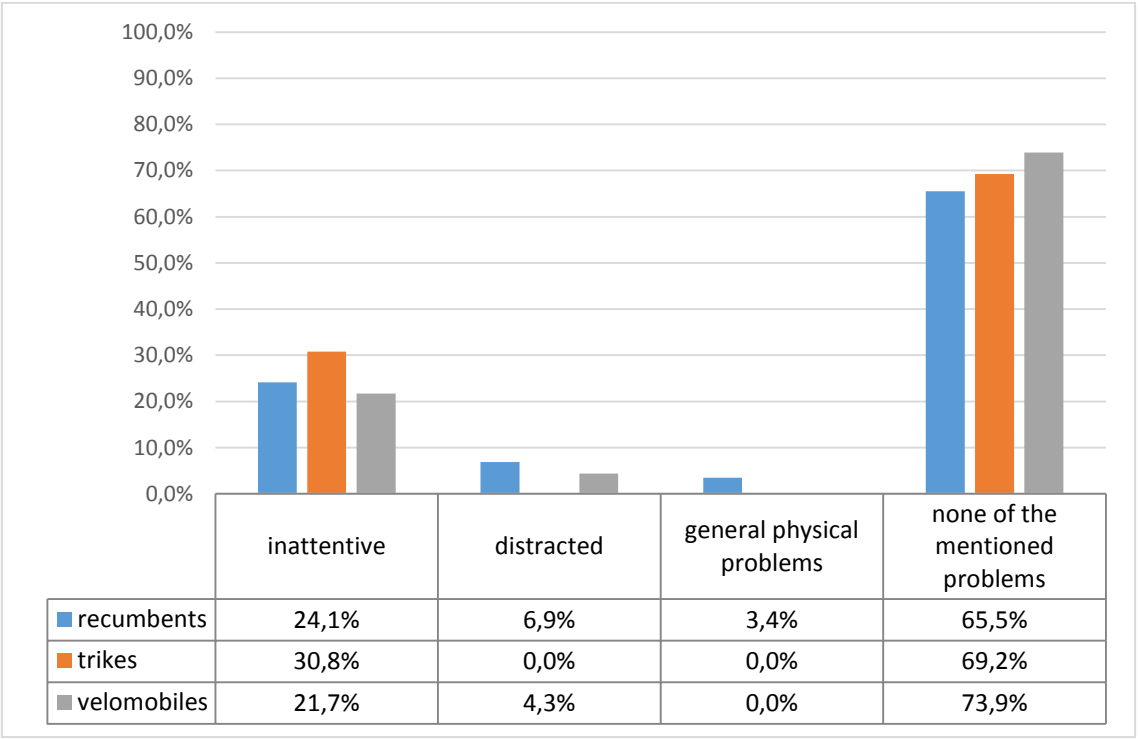


	too fast	braking heavily	technical error	others
recumbents	44,8%	8,6%	3,4%	43,1%
trikes	50,0%	7,1%	0,0%	42,9%
velomobiles	56,5%	8,7%	8,7%	26,1%

3.2.7 Single-vehicle crashes and human behaviour

There is hardly any difference in the choice of vehicle one rides if taking into account the correlation between "human behaviour" and single-vehicle crashes. Or the other way round: the kind of vehicle has no influence how attentive or inattentive one rides.

Table 11: Single-vehicle crashes and causes of crashes towards human behaviour (N=97)

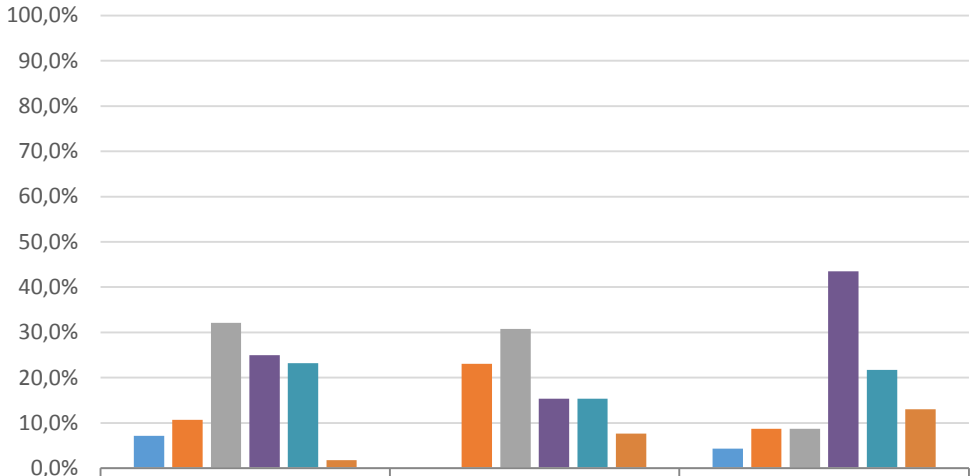


	inattentive	distracted	general physical problems	none of the mentioned problems
recumbents	24,1%	6,9%	3,4%	65,5%
trikes	30,8%	0,0%	0,0%	69,2%
velomobiles	21,7%	4,3%	0,0%	73,9%

3.2.8 Single-vehicle crashes and speed

Of interest was how fast riders were just before a crash happened. Even if all vehicles can be labelled as “special”, one really can’t compare the vehicles because differences between faired and unfaired vehicles are huge in terms of speed. Hence the following numbers have to be analysed for themselves. Here one can notice that recumbent riders have single crashes with average speeds between 10 to 40km/h (80.3%) while trike riders have single crashes between 5 to 20km/h (53.9%). Velomobile riders have single crashes while riding between 20 to 40km/h (65.2%).

Table 12: Single crashes and speed just before crash happened (N=94, chi^2=0.0026)

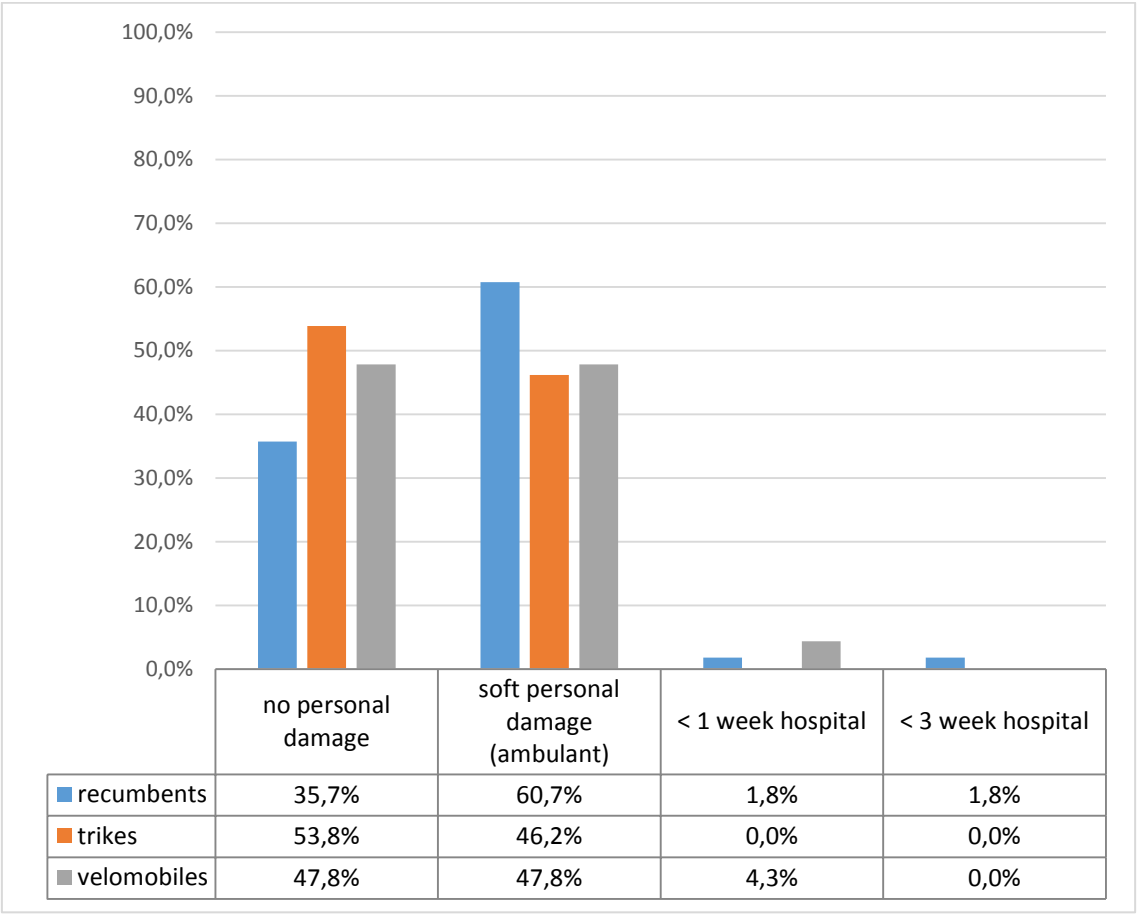


	recumbents	trikes	velomobiles
< 5 km/h	7,1%	0,0%	4,3%
5 to 10 km/h	10,7%	23,1%	8,7%
10 to 20 km/h	32,1%	30,8%	8,7%
20 to 30 km/h	25,0%	15,4%	43,5%
30 to 40 km/h	23,2%	15,4%	21,7%
> 40 km/h	1,8%	7,7%	13,0%

3.2.9 Single-vehicle crashes and personal damage

Taking into account that average speeds are higher, one can notice that stays in hospitals are rare. In most cases minor physical damage occurred which was treated at the roadside or the subject had no physical damage which shows the safety aspects of the vehicles. Furthermore, one should also take into account the number of kilometers cycled.

Table 13: Single crashes and personal damage (N=95, chi^2=0.0014)



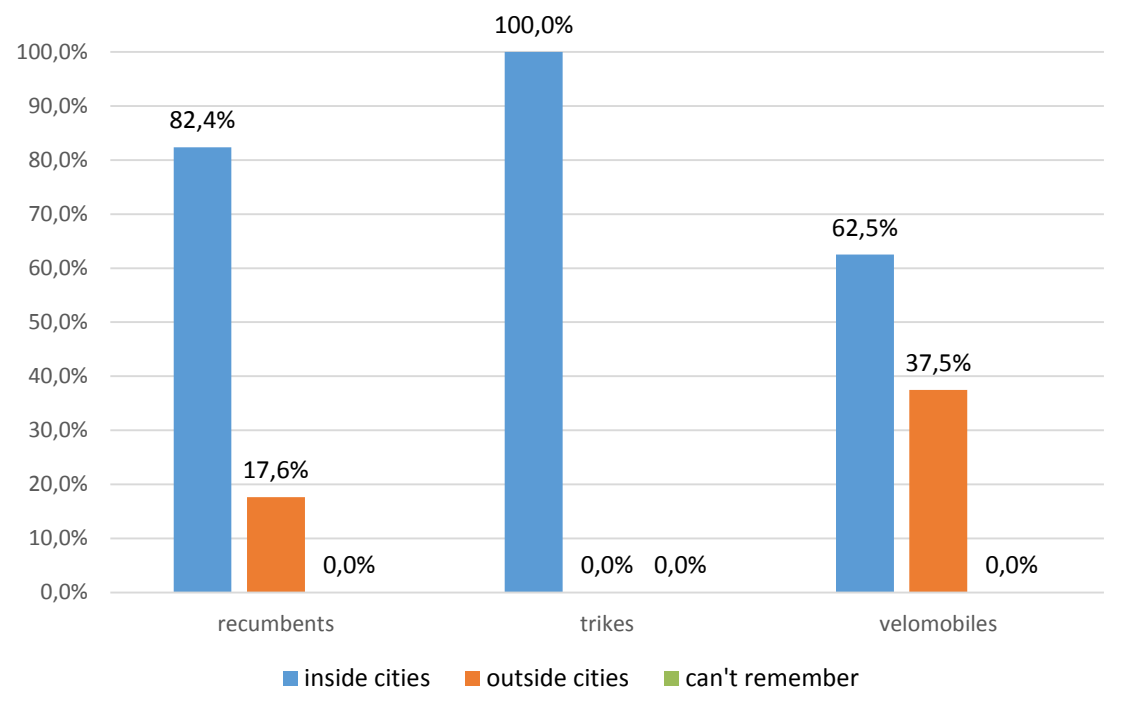
	no personal damage	soft personal damage (ambulant)	< 1 week hospital	< 3 week hospital
recumbents	35,7%	60,7%	1,8%	1,8%
trikes	53,8%	46,2%	0,0%	0,0%
velomobiles	47,8%	47,8%	4,3%	0,0%

3.3 CRASHES WITH INVOLVMENT OF THIRD PARTY AND DIFFERENT INDICATORS

3.3.1 Crashes with involvement of third party inside and outside cities

The share of crashes with a third party is in all cases within cities high in comparison to crashes outside cities. Here trike riders had no crashes with a third party outside the city. In terms of velomobile riders (62.5% in cities and 37.5% outside cities) two tendencies might be taken into account: on one hand velomobiles are mainly used outside cities covering longer distances and here the number of crashes is relatively low (37.5%) and on the other hand the number inside cities is high (62.5%). Trikes have a huge (100%) number of crashes inside cities. Here an explanation can't be made due to the 100%.

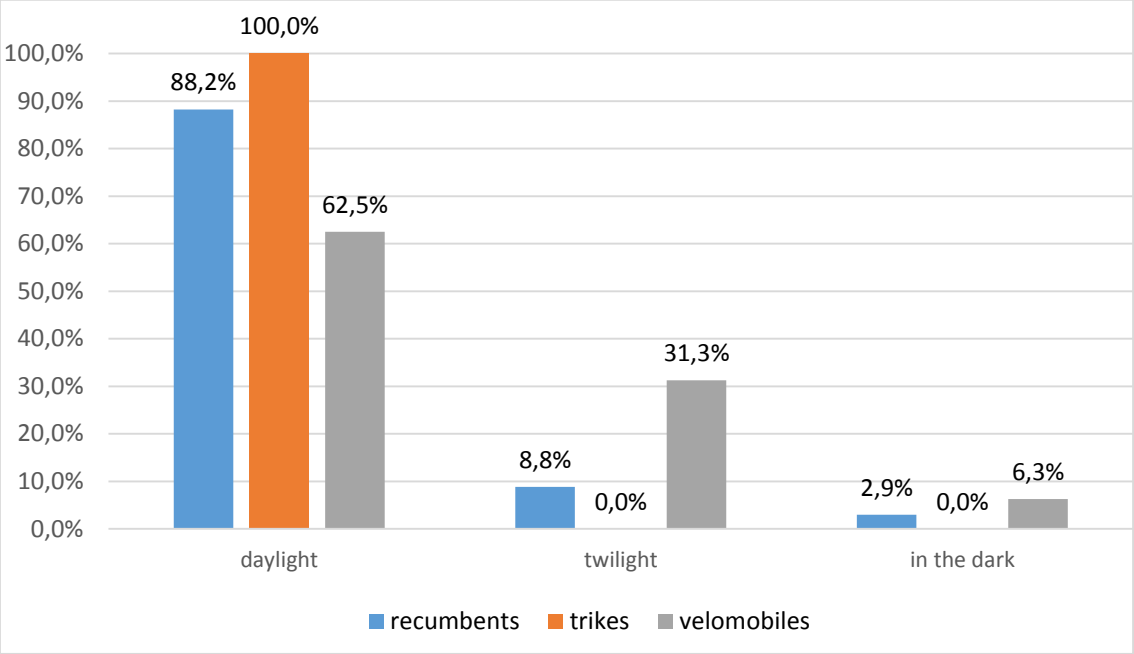
Table 14: Crashes with involvement of third party inside and outside cities (N=63, chi^2=0.0016)



3.3.2 Crashes with involvement of third party and time of the day

During daylight the risk of having a crash with a third party was the highest while velomobile riders faced that risk in all “time of the day” situations. Here the risk is significant, with 31.3% for velomobile riders and trike riders have no problem during twilight and night.

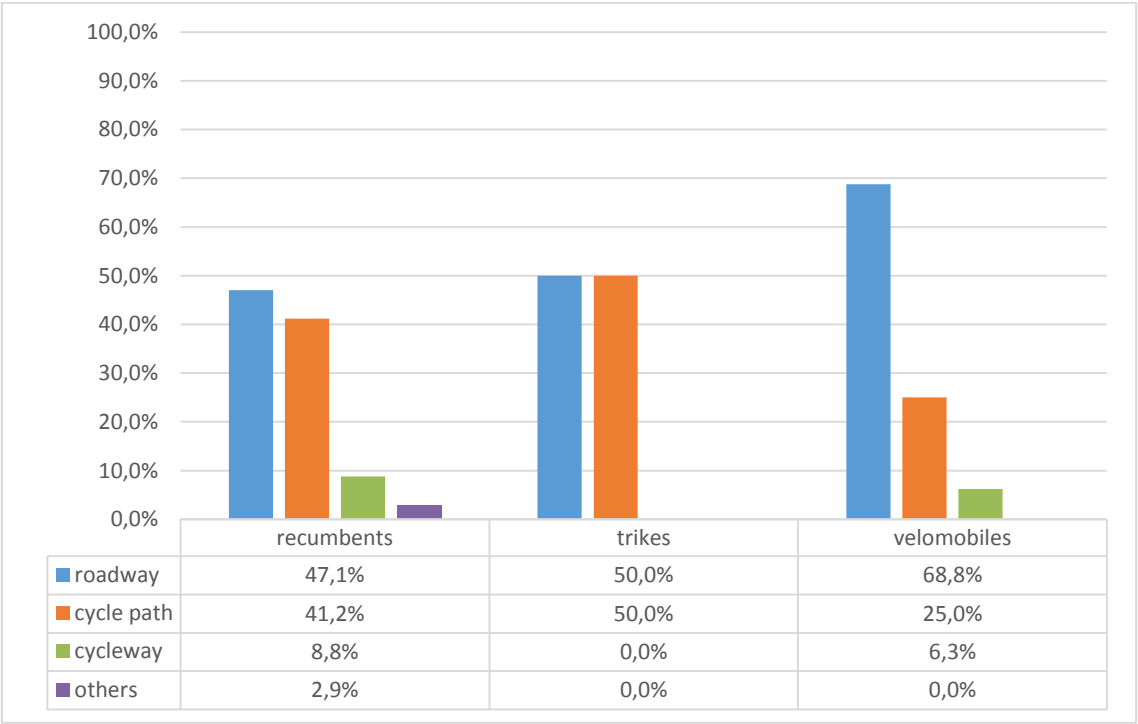
Table 15: Crashes with involvement of third party time of the day (N=63, chi^2=0.0299)



3.3.2 Crashes with involvement of third party and types of infrastructure

While looking at the infrastructure AND involvement of a third party it can be seen for all vehicles that crashes mainly happen on roads and on cycle paths whereas accidents on cycle ways play no important role.

Table 16: Crashes with involvement of third party and types of infrastructure (N= 63)

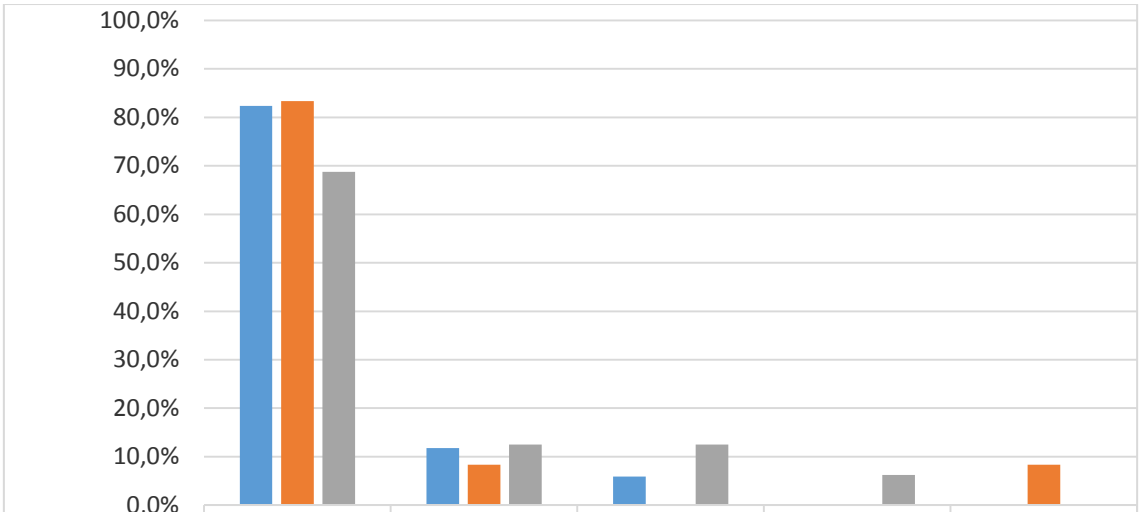


	recumbents	trikes	velomobiles
roadway	47,1%	50,0%	68,8%
cycle path	41,2%	50,0%	25,0%
cycleway	8,8%	0,0%	6,3%
others	2,9%	0,0%	0,0%

3.3.3 Crashes with involvement of third party and type of other vehicle

In most of the cases a car was the other party in the involvement of the crash, followed by other cyclists. For velomobile riders the pick-up truck was a cause for crashes. In terms of infrastructure, the following table gives insights where crashes happened. Here one should notice that roundabouts are of crucial danger for trike riders (58.3%). Velomobile riders often have collisions at intersections (50.0%). The survey asked also for crashes with pedestrians. Here none of the vehicles had any crash with the involvement of pedestrians in any infrastructure situation. The same result can be mentioned for public transport.

Table 17: Crashes with involvement of third party and crash opponents (N=63, chi^2=0.0710)

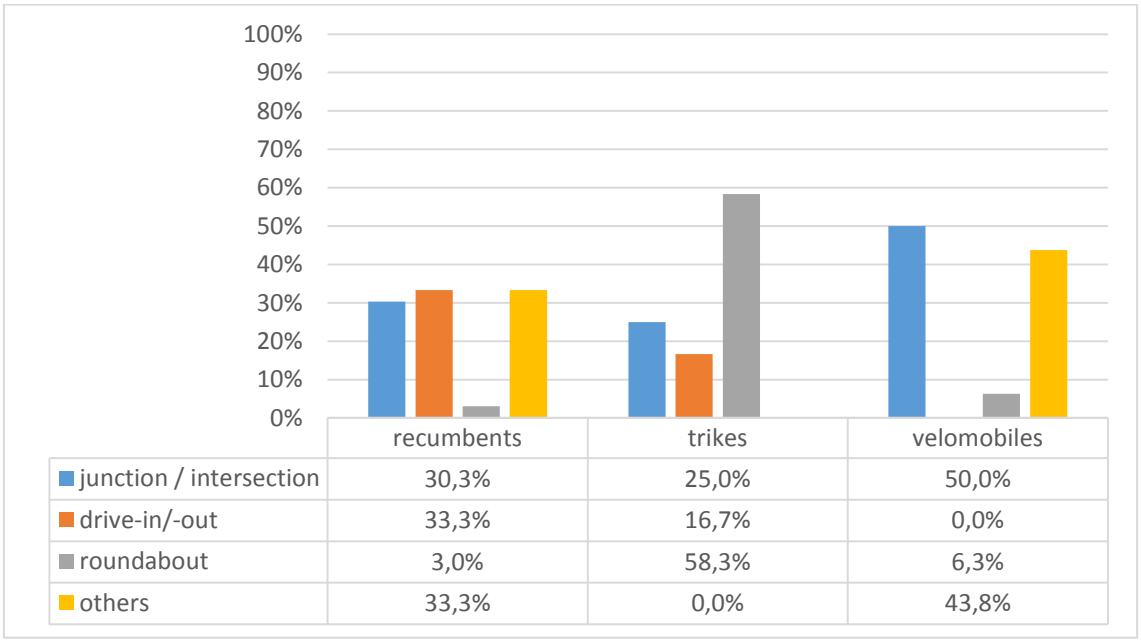


	passenger car	other bike rider	pickups / trucks	motorbikes	pets
recumbents	82,4%	11,8%	5,9%	0,0%	0,0%
trikes	83,3%	8,3%	0,0%	0,0%	8,3%
velomobiles	68,8%	12,5%	12,5%	6,3%	0,0%

3.3.4 Crashes with involvement of third party and different types of infrastructure

The tendency for crashes involving a third party is that the speed of recumbent bikes and trikes just before the crash is little bit higher than in comparison to single-vehicle crashes. With velomobiles the speed limits look less significant and the tendency is lower than with single-vehicle crashes.

Table 18: Crashes with involvement of third party and types of infrastructure (N=62)

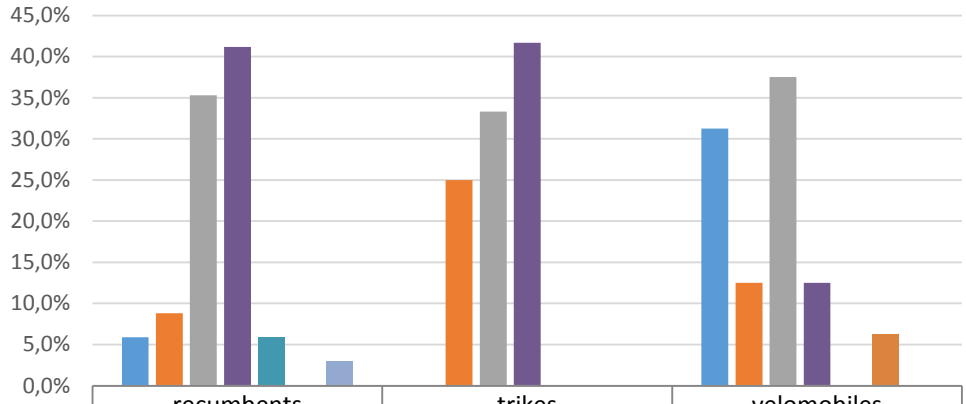


	recumbents	trikes	velomobiles
junction / intersection	30,3%	25,0%	50,0%
drive-in/-out	33,3%	16,7%	0,0%
roundabout	3,0%	58,3%	6,3%
others	33,3%	0,0%	43,8%

3.3.6 Crashes with involvement of third party and speed

For all types of examined vehicles one can notice that the crash situation with a third party is more severe when the estimated speed ridden is from 10 to 20km/h up to 20 to 30km/h. Between 20 to 30km/h one can notice that recumbent bikes (41.2%) and trikes (41.7%) suffer from a much higher percentage of involvements than velomobile riders with just 12.5% in the mentioned speed category. Of importance is that with velomobile riders and the speed category <5km/h the number of crashes with involvement of third parties is higher in comparison to the other two vehicle categories.

Table 19: Crashes with involvement of third party and speed just before crash happened (N=62, chi^2=0.0001)



	recumbents	trikes	velomobiles
< 5 km/h	5,9%	0,0%	31,3%
5 to 10 km/h	8,8%	25,0%	12,5%
10 to 20 km/h	35,3%	33,3%	37,5%
20 to 30 km/h	41,2%	41,7%	12,5%
30 to 40 km/h	5,9%	0,0%	0,0%
> 40 km/h	0,0%	0,0%	6,3%
unknown	2,9%	0,0%	0,0%

4 DISCUSSION

The number of ridden kilometers per year on average for each subject is up to 7,100 km which leads to the conclusion that owners of special bikes obviously enjoy riding their bikes in everyday situations and for leisure. While velomobiles have crashes within and outside cities, trike and recumbent riders have more crashes within cities. Moreover, trike riders should pay more attention within cities to avoid single-vehicle crashes. One reason might be the overall higher proportion of using cycle paths. On the other hand, the speed of velomobile riders might be underestimated by other traffic participants. One indication might be the higher proportions of crashes with others during twilight. Another aspect is that this vehicle category has a relatively high risk of single-vehicle crashes in combination with speed, but in comparison they have a lower rate of crashes with a third party while their speed is lower. Here one explanation might be that velomobile riders have a better overall view over traffic in general while using normal roads and are able to avoid riding cycle paths.

Furthermore, relevant issues for having single-vehicle crashes in general are bad and slippery surfaces for all vehicles. Roundabouts are a higher risk for trike riders. One explanation might be the higher rate of using cycle paths in roundabouts whereas velomobile riders have crash problems at intersections and recumbent riders have difficulties with drive in and outs. Last but not least there is an interesting tendency in terms of high speed and lower risks of physical damage. From speeds of 30km/h and higher physical damage and also medical treatments are less severe than under 30km/h. Here the fact is that with increasing speed, physical damage decreased. Moreover there is a correlation between age and physical damage. Furthermore older riders have fewer single-vehicle crashes than younger riders but more crashes with the involvement of a third party. Also riders of special bikes do not report their single crashes officially to the police. In terms of the involvement of a third party an assumption is that velomobile riders ride mostly on roads and therefore recognise crash situations possibly earlier than the other riders often using cycle paths alongside roads.

5 CONCLUSIONS

While the topic “diversity of vehicles in society” is not a well discussed topic within the common bike community, it seems that time is ripe to put it on the agenda. Not only growing numbers of purchased trikes and velomobiles make it relevant but also because of demographic changes bringing more elderly people in the future. It is not necessarily speed that causes higher risks of physical damage. It’s not about speed - it’s about safety on infrastructure (and future) planning. Lastly velomobile riders avoid constantly cycling on pavements which protects pedestrians and prevents conflicts between these two weak traffic groups.

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