

Safety and Usability of Mandatory and Advisory Cycle Lanes

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ABSTRACT

In recent years, more and more mandatory and advisory cycle lanes have been marked in Germany. In a research project of the German Insurers Accident Research (UDV) the road safety of these facilities has been investigated. As the study shows, many cyclists do not feel safe on the cycle lanes. High accident figures were particularly evident for narrow cycle lanes and for cycle lanes with parking areas next to it. Many accidents occur in connection with car parking (in most cases “dooring” accidents). When overtaking cyclists, almost every second driver falls below a lateral distance of 150 cm (59 in.). The overtaking drivers orientate themselves mainly on the markings on the road and react only insufficiently to the position of the cyclists. In conclusion, it is recommended for advisory and mandatory cycle lanes to mark a safety separation strip to parking areas next to the cycle lanes. Both types of cycle lanes should be at least 1.85 m (6.07 ft) wide. Mandatory cycle lanes should also have a safety strip of 0.75 m (2.46 ft) separating them from the part of the roadway used by motor vehicles. When advisory cycle lanes are installed, the width of the remaining roadway for motorized traffic should be at least 5 m (14.4 ft).

Keywords: cycling, road design, marked cycle lanes, safety, usability.

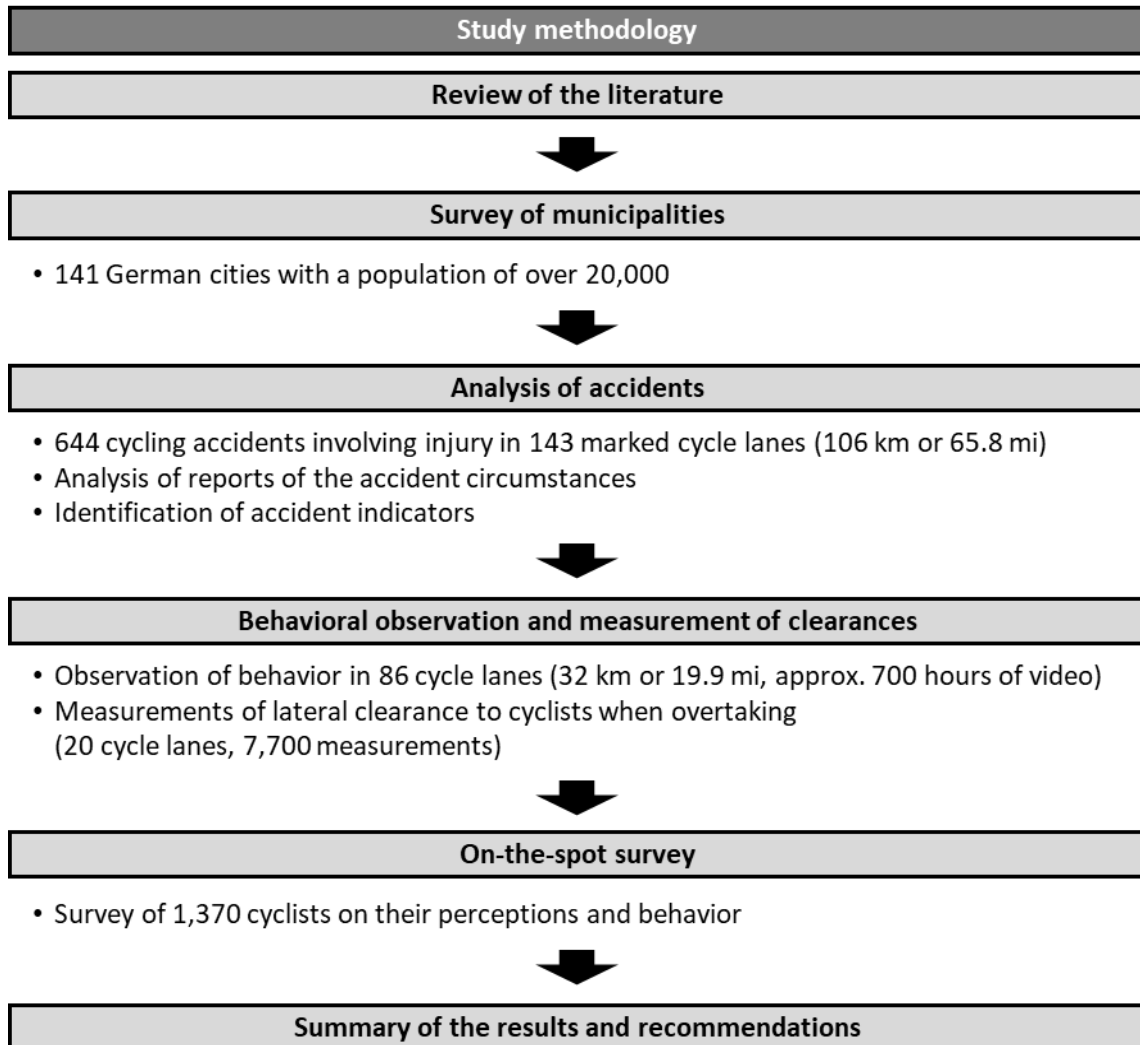
19 **1 BACKGROUND**

20 In Germany, advisory cycle lanes or mandatory cycle lanes have been introduced increasingly
21 for cycling traffic in recent years. Whereas mandatory cycle lanes are reserved for cyclists
22 exclusively, advisory cycle lanes can also be used by other road users when they need to.
23 Vehicles are also allowed to stop in advisory cycle lanes but not to park. In terms of subjective
24 and objective road safety, both of these types of cycle lanes are often the subject of controversy.
25 Some say that drivers can see cyclists well when they use these lanes; others point out that
26 cyclists using them often do not feel very safe.

27 In a research project commissioned by the UDV (German Insurers Accident Research), the
28 Department of Road Planning and Road Operation (Fachgebiet Straßenplanung und
29 Straßenbetrieb) at the Technische Universität Berlin conducted an in-depth study of these
30 marked cycle lanes.

31 **2 METHODOLOGY**

32 The project (methodology outlined in **Figure 1**) began with a review of the international
33 literature and a two-part online survey of 141 municipalities with populations of over 20,000.
34 The first part consisted of general questions about the use and design of marked cycle lanes and
35 the experiences the municipalities had had with them. In the second part, there were questions
36 about specific characteristics of different stretches of road that might be included in the study.
37 Based on the results of the survey, stretches of road of at least 200 m (656 ft) with mandatory
38 or advisory cycle lanes were selected. The cycling accidents involving injury that had occurred
39 on these stretches from 2013 to 2015 were studied, and descriptions of the circumstances of
40 the accidents were analyzed where available. The sample consisted of a total of 143 stretches
41 of road (single side only) in seven German federal states with a total length of 106 km (65.8 mi).



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Figure 1. Study methodology¹

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There were 56 mandatory cycle lanes (46 km or 28.6 mi), 81 advisory cycle lanes (57 km or

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35.4 mi) and six older mandatory cycle lanes in Berlin with parallel parking spaces on the left of

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the lane separating them from the roadway for motor traffic (3 km or 1.9 mi). The latter are

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similar to the “protected cycle lanes” found in the US. However, since this was just a small

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sample of very old cycling facilities, the results for this group are not described or interpreted in

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this document (see the in-depth research report [UDV 2019] for more information).

¹ NOTE: 1 km = 0.62 mi

50 A comprehensive analysis of the accidents that occurred was conducted for the selected
51 stretches of road. A total of 644 cycling accidents involving injury occurred on these stretches of
52 road. In 174 cases, it was possible to analyze descriptions of the accident circumstances. For 406
53 accidents in Berlin, it was possible to analyze the circumstances of the accidents more closely
54 based on the collision symbols used in the Berlin accident statistics. A comparison group of
55 cycling accidents on main roads in built-up areas ("HVS io") was also used to assess the results.
56 This comparison group consisted of 15,900 cycling accidents involving injury on federal, state
57 and district highways in built-up areas with a speed limit of 50 km/h (31.1 mph) in the federal
58 states of Baden-Württemberg, Berlin, Bremen, Hamburg, Hesse, Saxony, Saxony-Anhalt and
59 Thuringia from 2013 to 2015. In addition, for different sub-samples of the stretches of road
60 studied, accident (cost) densities and accident (cost) rates were calculated. It was possible to
61 calculate the accident (cost) densities for all stretches of road but accident (cost) rates for only
62 86 stretches of road by collecting data on the spot, since that was the only way to obtain the
63 volume of cycling traffic as a reference parameter.

64 On a selection of 86 stretches of road (35 mandatory cycle lanes, 47 advisory cycle lanes and
65 four "protected cycle lanes" similar to those in the US and Australia), data was collected on the
66 spot with the help of video in order to study both the behavior of cyclists and drivers and the
67 conflicts that occurred. These stretches of road were between 240 m (787 ft) and 680 m (2230 ft)
68 in length and were observed in each case for a period of eight hours. This involved a total of
69 around 32 km (19.9 mi) of road and almost 700 hours of video material.

70 The behavior of cyclists was examined at a representative cross-section of the stretches of road.
71 In addition to other characteristics, the parts of the infrastructure used by the cyclists and their
72 distance from the lefthand border marking (the motor traffic side) of the cycle lanes were
73 recorded. The use of the mandatory and advisory cycle lanes by drivers was recorded over the

74 whole length of the stretches of road studied. Distinctions were drawn between driving,
75 stopping and parking, and the researchers recorded how long the drivers spent in the cycle lanes
76 and their apparent reason for using them. The conflicts that occurred involving cyclists were also
77 recorded over the entire length of the stretches of road studied. The data recorded included the
78 seriousness of the conflict, the cyclist's counterpart in the conflict, how the conflict arose and
79 how the conflict was resolved. The conflicts were divided into minor conflicts, serious conflicts
80 and accidents. Common to each of these conflict levels was a more or less critical situation. In
81 other words, when cyclists had to take evasive, non-critical action to avoid stopping, stationary
82 or parked vehicles, this was recorded merely as a hindrance. Consequently, it was possible to
83 calculate the ratio of the number of hindrances to the number of incidents that were actually
84 relevant to safety.

85 In addition, on 20 selected stretches of road in Berlin, a measurement cycle belonging to
86 Unfallanalyse Berlin was used to measure the clearance between overtaking motor vehicles and
87 cyclists by means of a laser system. The type of the overtaking vehicle, the traffic situation at
88 the point of overtaking (with or without oncoming traffic) and the position of the measurement
89 cycle in the mandatory or advisory cycle lane were recorded. The clearances involved in a total
90 of 7,688 overtaking cases were analyzed.

91 Furthermore, a total of 1,370 cyclists were surveyed on the 86 stretches of road studied. They
92 answered questions about their behavior in traffic and what they thought about the marked
93 cycle lanes that were being studied.

94 In the course of the project, the UDV also commissioned Prof. Dr. jur. Dieter Müller to produce
95 a legal opinion on marked cycle lanes [UDV 2018]. The purpose of this was to clarify when drivers
96 would be justified in using advisory cycle lanes and what lateral clearance must be maintained
97 when overtaking cyclists in marked mandatory and advisory cycle lanes.

98 **3 REVIEW OF THE LITERATURE**

99 The use of marked cycle lanes on the roadway is described in detail in the General Administrative
100 Regulations of the Road Traffic Regulations (VwV-StVO) and the German guidelines for the
101 design of road infrastructure [above all, FGSV 2006 and FGSV 2010]. According to those,
102 mandatory cycle lanes must generally be 1.85 m (6.07 ft) wide, including the marking, and be
103 separated from the roadway for motor vehicles by a continuous line with a width of 0.25 m
104 (0.82 ft). Depending on the speed limit, they are recommended for roads with a traffic volume
105 of around 1,000 to 1,800 motor vehicles an hour. Advisory cycle lanes, on the other hand, should
106 have a standard width of 1.5 m (4.92 ft) and be separated from the part of the roadway intended
107 for motor vehicles by a broken line with a width of 0.125 m (0.4 ft). They are recommended on
108 roads with traffic volumes of up to 1,000 trucks a day and around 400 to 1,000 motor vehicles
109 an hour, depending on the speed limit. However, the guidelines currently do still permit smaller
110 widths for both types of lane. Thus, in exceptional cases, mandatory cycle lanes only 1.5 m
111 (4.92 ft) wide and advisory cycle lanes only 1.25 m (4.10 ft) wide are permitted.

112 Alongside parking strips, there must also be a safety strip with a width of 0.50 m to 0.75 m (1.64
113 to 2.46 ft) next to a mandatory cycle lane. In the case of advisory cycle lanes, the guidelines
114 currently require this only when they are alongside parking strips where there is frequent
115 parking activity.

116 If mandatory cycle lanes are created on roads with heavy motor traffic, the VwV-StVO
117 regulations stipulate that they must be wider than usual or that there must be an additional
118 safety space between the lane and the motor traffic.

119 Marked cycle lanes are also used in other countries but, based on the material examined in the
120 study, not to the extent that they are in Germany. Whereas mandatory cycle lanes are also used
121 in most of the other countries studied, advisory cycle lanes are rarer. The threshold for the traffic

122 volume at which cycle lanes are to be used on the roadway is generally stricter in other
123 countries. The guidelines in traditionally strong cycling nations such as Denmark or the
124 Netherlands, above all, recommend that cycling traffic should keep to the sidewalk as of
125 significantly lower motor traffic volumes.

126 The widths of the lanes in the different countries studied are similar. Mandatory cycle lanes
127 including their markings must be between 1.50 m (4.92 ft) and 2.00 m (6.56 ft) wide in almost
128 every country. In the Netherlands, however, mandatory cycle lanes with a width of up to 2.50 m
129 (8.2 ft) are also recommended. The standard widths of advisory cycle lanes internationally are
130 between 1.50 m (4.92 ft) and 2.00 m (6.56 ft). With a standard width of 1.50 m (4.92 ft), Germany
131 is at the lower end of the range. In most countries, mandatory and advisory cycle lanes next to
132 strips of parking spaces are separated from them by an additional safety strip with a width of
133 0.50 m to 0.75 m (1.64 to 2.46 ft).

134 A number of older studies provide information on the safety level of marked cycle lanes.
135 According to Alrutz et al. (2009), advisory cycle lanes away from signal-controlled intersections
136 have lower accident (cost) rates than mandatory cycle lanes or cycle paths (based on the volume
137 of cycling traffic). However, a disproportionately large number of accidents in connection with
138 parking were found to occur in advisory cycle lanes. In addition, cyclists were found to be
139 hindered by other road users significantly more often in advisory cycle lanes than in mandatory
140 cycle lanes. Parkin and Meyers (2009) found in the United Kingdom that marked cycle lanes can
141 also result in narrower lateral clearances between cyclists and overtaking vehicles than in mixed
142 traffic and can therefore also have a negative impact. Ohm et al. (2015) demonstrated that
143 advisory cycle lanes had a positive impact on both the level of acceptance for cyclists on the
144 roadway and the level of severity of the accidents.

145 There have been a small number of studies of alternative forms of lane for cycles, such as the
146 protected cycle lanes found in the US and Australia, but as yet no specific studies of their impact
147 on safety.

148 **4 SURVEY OF MUNICIPALITIES**

149 The 141 responses from municipalities showed that both types of cycle lanes are very
150 widespread. Advisory cycle lanes are even more common than mandatory cycle lanes. The
151 results of the survey provided a mixed picture in terms of the width and markings of the two
152 types of cycle lanes. According to the information provided by the municipalities, their cycle
153 lanes largely met the requirements of the VwV-StVO and the design guidelines. However, they
154 were also deviations from these, presumably based on outdated editions of these guidelines.
155 Accordingly, there are currently still many facilities that no longer meet the current
156 recommendations in the guidelines. The shortcomings of these facilities are, above all, that they
157 are too narrow and that there are either no safety strips separating them from parked vehicles,
158 or the safety strips are too narrow.

159 The municipalities' assessments of marked cycle lanes were largely positive. Only a few
160 municipalities stated that they had any negative impact on road safety (**Table 1**). In contrast,
161 however, users very often expressed their concerns about safety to the municipalities (**Table 1**).
162 Consequently, many municipalities also reported that the level of acceptance of cycle lanes
163 among cyclists was low. A further problem often referred to by both users and the municipalities
164 themselves was that cycling traffic in the cycle lanes was often hindered by motor vehicles
165 stopping or parking.

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Table 1. Reported concerns in survey of municipalities

Concerns	119 municipalities, multiple responses possible	
	Reported by the municipalities	Reported to the municipalities by users
Hindrances (e.g. vehicles parking or pulling over)	39 %	46 %
Low level of acceptance (use of other parts of the infrastructure)	19 %	
Infrastructure too narrow	10 %	15 %
Negative impact on safety	2 %	48 %
Other complaints or remarks	13 %	15 %
No concerns	39 %	22 %
Not specified	7 %	6 %

167 **5 ANALYSIS OF ACCIDENTS**

168 Around 60 % of cycling accidents involving injury in both types of cycle lanes happened at
 169 intersections and T-junctions, particularly the typical turning-off, turning-into or crossing
 170 accidents (86 % for mandatory cycle lanes and 83 % for advisory cycle lanes; **Figure 2**). The
 171 proportion of these accidents in the marked cycle lanes corresponds roughly to that at the
 172 intersections of the comparison group of main roads in built-up areas (87 %). The very high
 173 proportion of turning-off accidents in the marked cycle lanes stood out (48 % for mandatory
 174 cycle lanes and 47 % for advisory cycle lanes). There was insufficient data to determine
 175 conclusively whether these higher proportions can be explained by higher volumes of traffic
 176 turning off the road or by lower volumes of traffic turning into or crossing the road on the
 177 stretches of road studied.

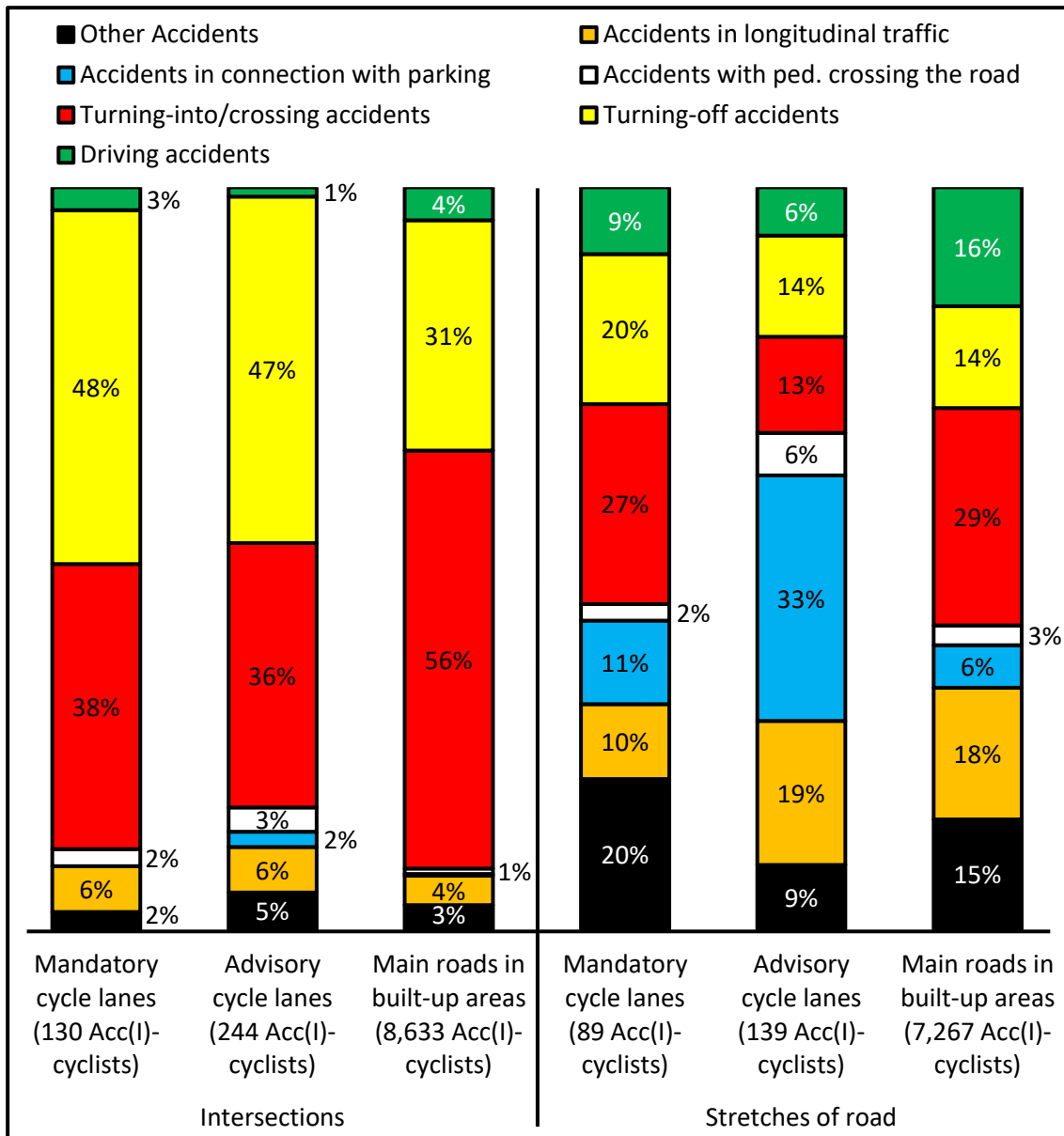
178 On the stretches of road with the marked cycle lanes, many accidents away from intersections
 179 occurred in connection with parking (**Figure 2**). This was particularly true in the case of advisory
 180 cycle lanes. One in three accidents on the stretches of road with advisory cycle lanes were in

181 connection with parking (33 %). In the mandatory cycle lanes, parking/parked vehicles were
182 involved in 11 % of accidents, whereas in the comparison group of main roads in built-up areas
183 the figure was only 6 %. The analysis of the circumstances of the accidents revealed that at least
184 65 % of the accidents that occurred in connection with parking were caused by vehicle doors
185 being opened (“dooring” accidents).

186 The significant role played by parking in the accidents in advisory cycle lanes was also evident in
187 the accident statistics. The accident density on stretches of road with advisory cycle lanes with
188 adjacent parking was almost four times as high as for advisory cycle lanes without adjacent
189 parking (**Figure 3**).

190 In order to assess the accident risk on the stretches of road studied, as part of the behavioral
191 observation, traffic counts were conducted of the cycling traffic, and the corresponding accident
192 rates were calculated. There was a strongly increased accident risk for cyclists particularly in
193 narrow lanes (**Figure 4**) and again on stretches of road with adjacent parking (**Figure 5**).

194 In particular, lanes with less than the standard widths stipulated in the guidelines (under 1.85 m
195 (6.07 ft) for mandatory cycle lanes and under 1.5 m (4.92 ft) for advisory cycle lanes) had
196 particularly high accident rates. The advisory cycle lanes with the lowest accident rates were at
197 least 1.85 m (6.07 ft) wide.



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Figure 2. Accident types at intersections and stretches of road

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Mandatory cycle lanes with adjacent parking were found to be particularly unfavorable in the

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analysis of the accident rates. The accident risk for cyclists and mandatory cycle lanes with

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adjacent parking was more than twice as high as for stretches without adjacent parking

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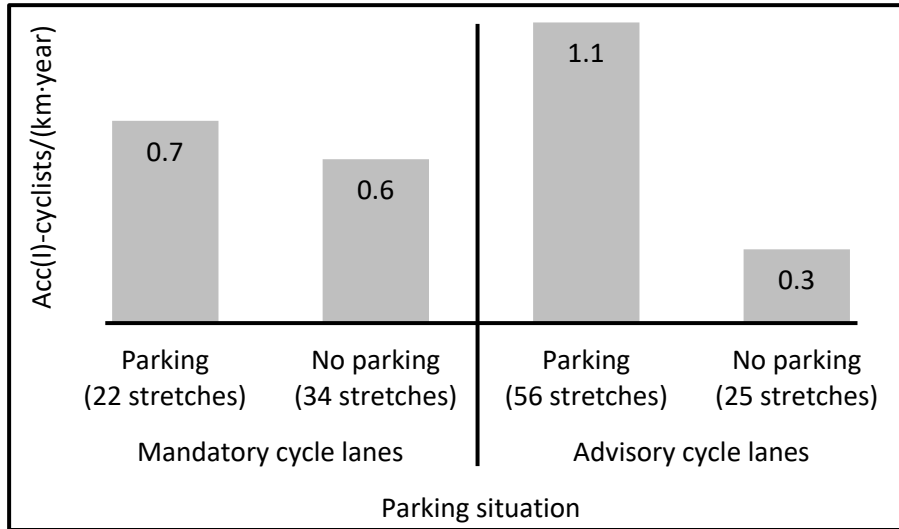
(**Figure 5**). Adjacent parking also had a negative impact, although not quite such a strong one,

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on the accident risk of cyclists in advisory cycle lanes. No evidence was found for the negative

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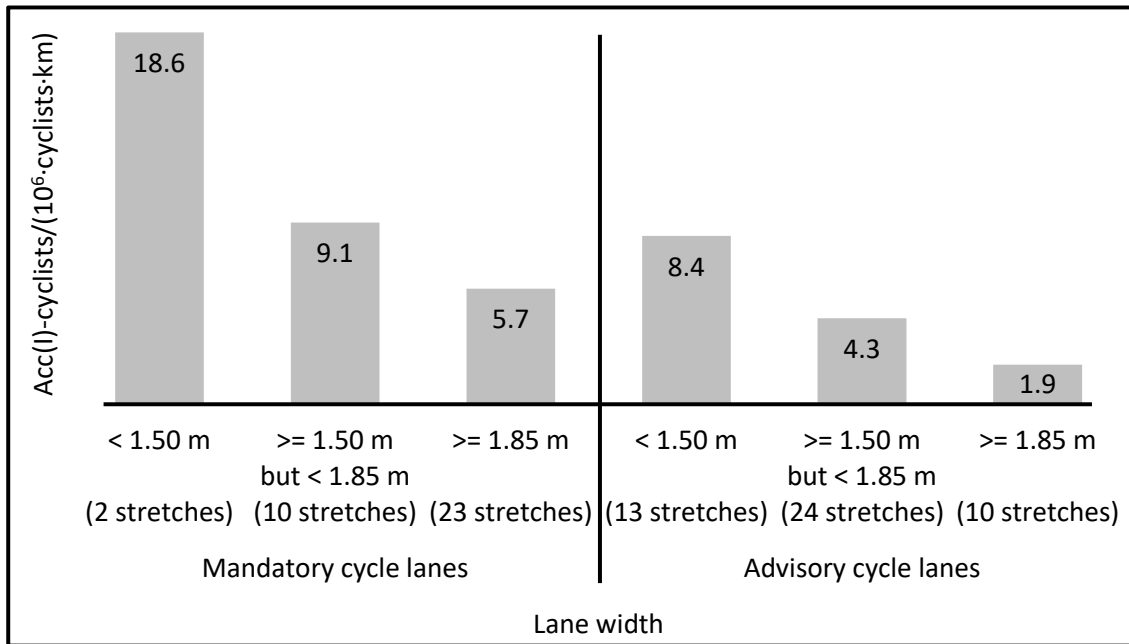
impact of higher motor traffic volumes on the accident statistics.



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Figure 3. Accident densities² on stretches of road, by parking situation



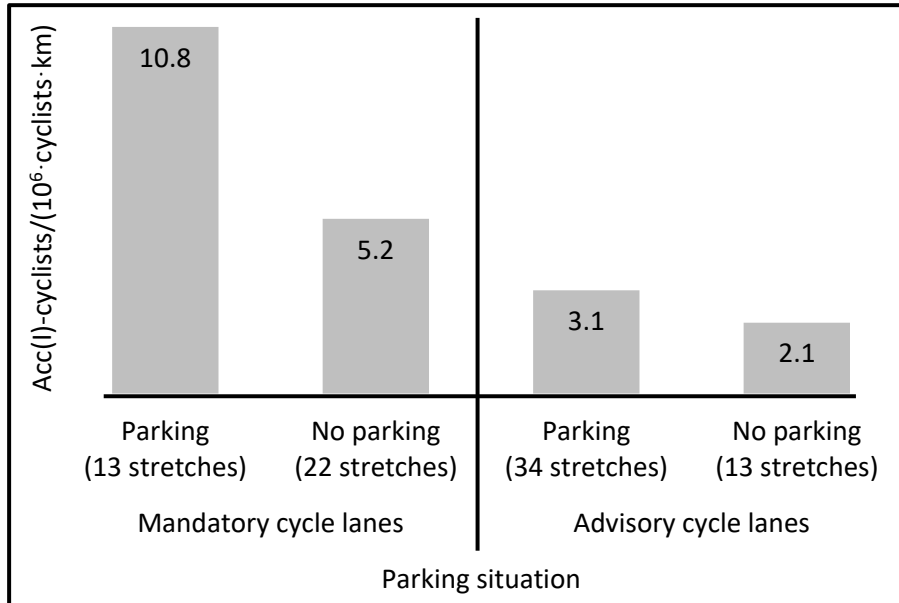
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Figure 4. Accident rates² on stretches of road, by cycle lane width³

² NOTE: 1 km = 0.62 mi

³ NOTE: 1 m = 3.28 ft



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Figure 5. Accident rates⁴ on stretches of road, by parking situation

212 6 BEHAVIORAL OBSERVATION

213 89 % of the cyclists observed were cycling in the marked cycle lanes, as required by the rules.

214 Violations of the rules almost always involved cyclists cycling on the sidewalk at the side of the

215 road. No negative effects of motor traffic volumes in terms of the parts of the road infrastructure

216 used were ascertained during the behavioral observation part of the study. However, the

217 analysis of the accidents revealed that 70 % of those in which the cyclists were found to be

218 violating the rules in the cycle lanes occurred on stretches of road with a high volume of motor

219 traffic (over 10,000 vehicles a day).

220 The width of the lane was observed to have a significant effect on the parts of the infrastructure

221 used by the cyclists. The narrower the lane, the more frequently they violated the rules and used

222 the sidewalk (**Figure 6**). Cyclists failed to use mandatory cycle lanes with less than the standard

223 width of 1.85 m (6.07 ft) particularly often. Almost one in five cyclists cycled on the sidewalk in

⁴ NOTE: 1 km = 0.62 mi

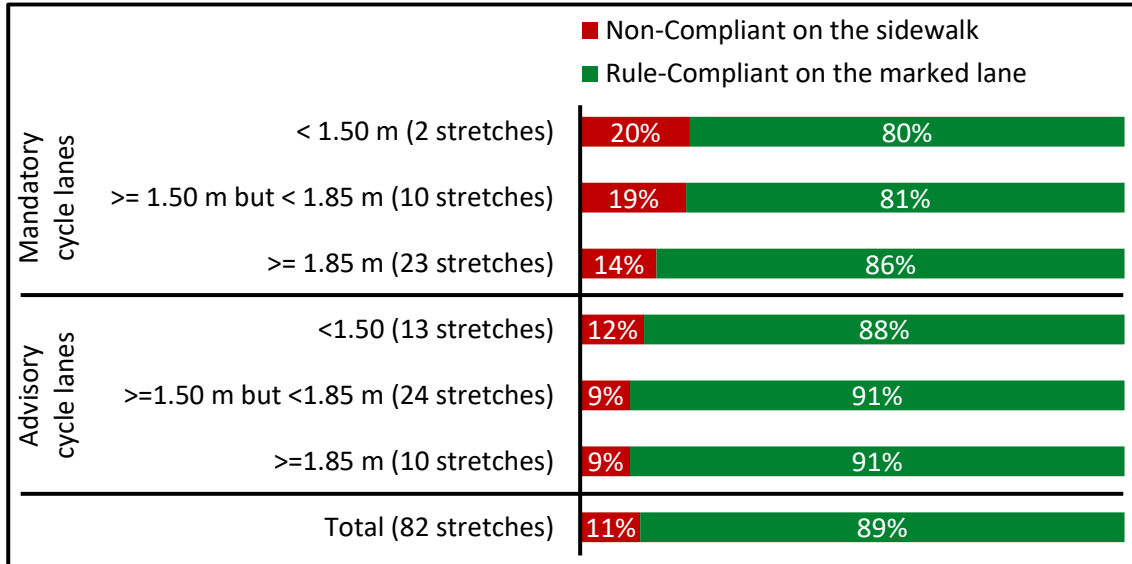
224 these cases. The proportion of cyclists cycling on the sidewalk in violation of the rules was also
225 very high (19 %) for mandatory cycle lanes with adjacent parking.

226 When cyclists used the lanes, they tended to cycle in the middle of them. At higher traffic
227 volumes (more than 10,000 motor vehicles a day), the cyclists tended to cycle on the right in the
228 lane and thus closer to parked vehicles. In narrow lanes they cycled on the left in the lane and
229 thus closer to the motor traffic (**Figure 7**). Parked vehicles to the right of the lane had no effect
230 on the line taken by the cyclists.

231 Many drivers used the cycle lanes for stopping or parking. During the 688-hour period of the
232 study, vehicles parked in the lanes around 1,000 times and stopped almost 3,000 times. This
233 happened very often in the advisory cycle lanes. Parked vehicles hindered one in three of over
234 25,000 cyclists here. If you add to this the number of hindrances caused by vehicles stopping
235 legally, 39 % of cyclists in the advisory cycle lanes were hindered by vehicles stopping or parking
236 in these lanes. Vehicles parked in the mandatory cycle lanes significantly less often, but they also
237 quite often stopped in these lanes. Stationary or parked vehicles hindered around one in ten of
238 the approximately 10,500 cyclists in the mandatory lanes.

239 In longitudinal traffic, as well, the markings of both types of lane were very often crossed by
240 vehicles (not counting cases where vehicles were parking or pulling away after parking). With
241 173 cases per kilometer and hour (107 per mile and hour) for mandatory cycle lanes and 176
242 per kilometer and hour (109 per mile and hour) for advisory cycle lanes, the numbers were
243 almost identical. Mandatory cycle lanes were crossed quite often for short stretches, advisory
244 cycle lanes also often for longer stretches. Drivers mostly crossed the markings when there was
245 no cyclist present. It was thus relatively rare for them to hinder cyclists. Less than 1 % of cyclists
246 were hindered in mandatory cycle lanes, whereas just over 2 % were hindered in advisory lanes.
247 Drivers were observed using the lanes for a significant stretch of road, above all, when avoiding

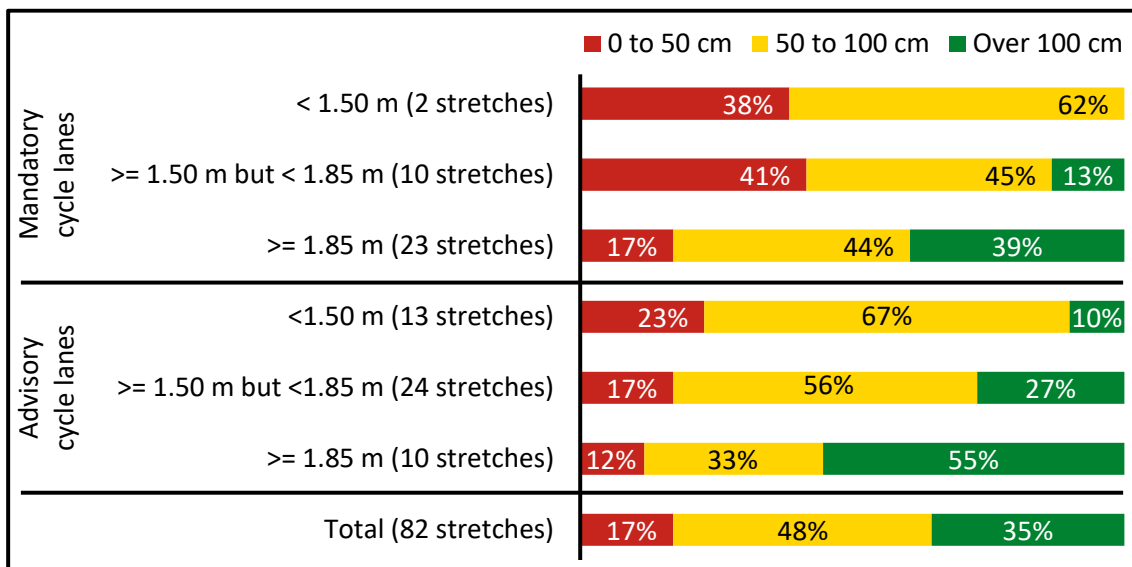
248 oncoming traffic, looking for a parking space or before turning off the road. When avoiding
 249 oncoming traffic, drivers often remained in the cycle lane much longer than necessary.



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Figure 6. Part of the infrastructure used by cyclists, by cycle lane width⁵



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Figure 7. Clearance⁶ of cyclists (wheels) from the left lane marking, by cycle lane width⁵

⁵ NOTE: 1 m = 3.28 ft

⁶ NOTE: 1 cm = 0.39 in.

254 In the analysis of conflicts, 154 conflicts were identified in the marked cycle lanes. Around 7 %
255 were serious. There was also one accident involving a pedestrian. 70 % of the conflicts in the
256 cycle lanes were caused by drivers' errors or inappropriate actions. Vehicles stopping, parking
257 or driving in these lanes caused a third of the conflicts. Nearly a further third (27 %) were caused
258 by vehicles turning off the road. 8 % happened when vehicles were parking or leaving a parking
259 space or when their doors were opened.

260 27 % of the conflicts were due to cyclists' errors or inappropriate actions. However, these were
261 often also incorrect reactions to a preceding error or inappropriate action of a driver. In 17 % of
262 the conflicts, for example, cyclists failed to take into account the traffic behind them in the lane
263 for motor vehicles when overtaking vehicles parked in the cycle lane, resulting in a conflict. The
264 illegally parked vehicles in these cases contributed at least indirectly to the subsequent error or
265 inappropriate action of the cyclists.

266 **7 MEASUREMENT OF CLEARANCES**

267 In the approximately 7,700 cases in which the lateral clearance was measured between
268 an overtaking vehicle and a cyclist in a marked cycle lane, the clearance for almost one in two
269 vehicles was found to be less than 150 cm (59 in.). 15 % of drivers maintained a clearance of less
270 than 100 cm (39.4 in.) when overtaking, and almost 1 % maintained a clearance of less than 50
271 cm (19.7 in.). Trucks and buses drove very close to cyclists significantly more often when passing
272 them. The clearance maintained from cyclists was very similar whether they were using
273 mandatory or advisory cycle lanes. However, vehicles passed very close to cyclists a little more
274 often when the cyclists were using mandatory lanes (**Tables 2 and 3**).

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Table 2. Lateral overtaking clearances⁷ to cyclists in mandatory cycle lanes

Lateral overtaking clearance to the cyclist	Mandatory cycle lanes (n = 1,584 overtaking cases)					
	Motor vehicles					Bicycles
	Cars (n = 1,086)	Trucks (n = 42)	Buses (n = 14)	Two-wheel (n = 47)	Total (n = 1,189)	(n = 395)
Under 150 cm	51 %	69 %	43 %	15 %	50 %	93 %
Under 100 cm	19 %	24 %	21 %	6 %	19 %	68 %
Under 50 cm	0.4 %	0 %	0 %	0 %	0.4 %	6.6 %
Narrowest clearance	30 cm	55 cm	50 cm	85 cm	30 cm	17 cm

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Table 3. Lateral overtaking clearances⁷ to cyclists in advisory cycle lanes

Lateral overtaking clearance to the cyclist	Advisory cycle lanes (n = 6,104 overtaking cases)					
	Motor vehicles					Bicycles
	Cars (n = 4,835)	Trucks (n = 95)	Buses (n = 27)	Two-wheel (n = 194)	Total (n = 5,151)	(n = 953)
Under 150 cm	48 %	69 %	89 %	30 %	48 %	93 %
Under 100 cm	14 %	20 %	44 %	7 %	14 %	71 %
Under 50 cm	0.8 %	4.2 %	7.4 %	0.5 %	0.9 %	12.7 %
Narrowest clearance	14 cm	12 cm	35 cm	30 cm	12 cm	5 cm

277 Overtaking drivers were guided, above all, by the markings on the roadway. Even when the
 278 adjacent lane on the left-hand side or the lane for oncoming traffic was free, drivers still stayed
 279 very close to cyclists when overtaking. Often the drivers overtook the cyclists without leaving
 280 their own lane. The measurements of clearances also showed that the overtaking drivers did not

⁷ NOTE: 1 cm = 0.39 in.

281 react well enough to the position of the cyclists in the cycle lane. If the cyclist was in the left-
282 hand half of the marked cycle lane, this resulted in lateral clearances that were 40 cm (15.7 in.)
283 narrower on average.

284 Cyclists were also often very close when they overtook each other. 11 % of cyclists overtaking
285 other cyclists in the cycle lane failed to maintain a lateral clearance of at least 50 cm (19.7 in.).
286 In advisory cycle lanes the clearances were on average around 10 cm (3.9 in.) narrower than in
287 mandatory cycle lanes. In mandatory cycle lanes the position of the cyclist being overtaken was
288 also observed to have consequences. If the cyclist being overtaken was in the left-hand half of
289 the lane, the average clearance was around 10 cm (3.9 in.) narrower than for cyclists in the right-
290 hand half of the lane. In contrast, this was not observed in advisory cycle lanes. The clearances
291 between cyclists during overtaking were particularly narrow, above all, when the overtaking
292 cyclist tried to remain within the cycle lane.

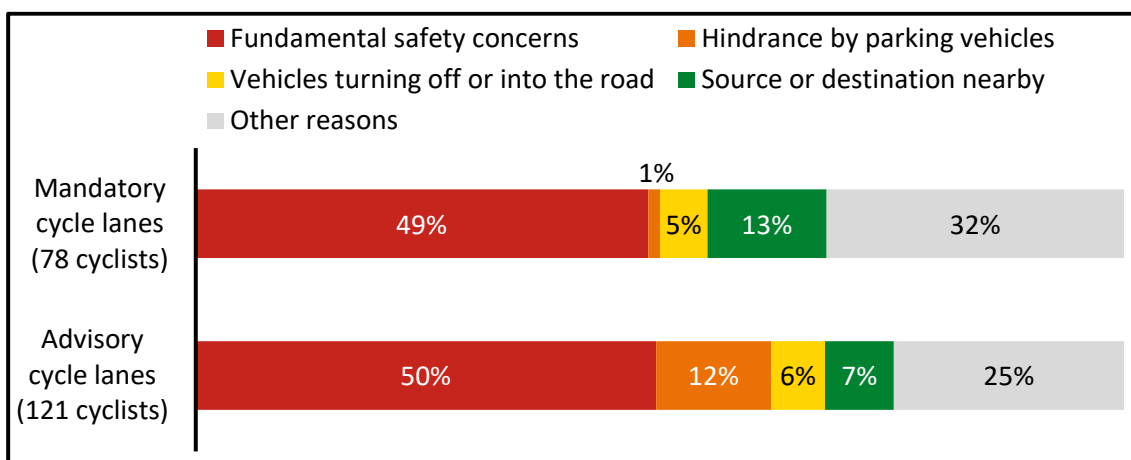
293 **8 SURVEY OF CYCLISTS**

294 When the cyclists were surveyed on the spot, they rated mandatory cycle lanes as somewhat
295 safer than advisory cycle lanes. Advisory cycle lanes narrower than the standard width of 1.50 m,
296 in particular, were rated as less safe.

297 37 % of cyclists in mandatory cycle lanes and 42 % in advisory cycle lanes who rated them as
298 unsafe stated that the reason was the narrow clearance to overtaking motor vehicles. Being
299 hindered by motor vehicles in the cycle lane was given as the reason by 12 % and 18 %,
300 respectively. The danger from vehicle doors being opened ("dooring"), on the other hand,
301 played only a minor role according to the cyclists surveyed (4 %).

302 Over a third of the cyclists rated the clearance of overtaking motor vehicles to cyclists in the
303 cycle lanes as insufficient. In advisory cycle lanes narrower than the standard width of 1.50 m,
304 that rose to 46 % of the cyclists.

305 Most cyclists stated that they generally used the marked lanes (83 %). It was again found that
306 cyclists avoided lanes narrower than the standard width (under 1.85 m (6.07 ft) for mandatory
307 cycle lanes and under 1.5 m (4.92 ft) for advisory cycle lanes) more often than lanes of the
308 standard width. About one in four cyclists stated here that they generally used the sidewalk
309 rather than the cycle lane. Most of the cyclists mentioned fundamental safety concerns as the
310 reason for using the sidewalk, and in the case of advisory cycle lanes, they also often mentioned
311 being hindered by motor vehicles in the cycle lanes (**Figure 8**).



312

313 **Figure 8.** Reasons given by cyclists for not using the cycle lanes

314 Most of the cyclists stated that there was not enough space in the cycle lane for cyclists to
315 overtake each other (42 % for mandatory cycle lanes and 49 % for advisory cycle lanes).
316 Accordingly, very many cyclists also stated that they left the lane in order to overtake other
317 cyclists. Although this is not allowed when using mandatory cycle lanes, 64 % of the cyclists
318 stated that they generally leave the lane when overtaking. 71 % of the cyclists surveyed stated
319 that they do this when using mandatory cycle lanes narrower than the standard width of 1.85 m
320 (6.07 ft).

321 **9 LEGAL OPINION**

322 In the legal opinion obtained by the UDV on marked cycle lanes [UDV 2018], the following two
323 undefined legal phrases were evaluated: “the need of other vehicles to use advisory cycle lanes”
324 and “the required lateral clearance when overtaking cyclists using mandatory and advisory cycle
325 lanes”.

326 According to the legal opinion, drivers are not considered to "need" to cross over into a marked
327 advisory cycle lane unless they have to do it to avoid oncoming vehicles. Other scenarios, such
328 as the use of the advisory cycle lane to turn off to the right or to pass vehicles that are stopping
329 for traffic, do not constitute a need to use the advisory cycle lane, according to the legal opinion.

330 With regard to the required lateral clearance when overtaking cyclists in marked mandatory and
331 advisory cycle lanes, the legal opinion concludes: “In accordance with the relevant case law and
332 the fundamental principle of road safety being the uppermost maxim when interpreting the
333 stipulations of the German Road Traffic Regulations (StVO), a minimum lateral clearance of
334 1.5 m (4.92 ft) must be maintained when overtaking or passing cyclists, regardless of the
335 prescribed type of cycling facility. If this cannot be maintained, drivers are effectively prohibited
336 from overtaking, pursuant to section 5, paragraph 4, sentence 2 of the German Road Traffic
337 Regulations (StVO).”

338 **10 SUMMARY**

339 As the study shows, mandatory and advisory cycle lanes are already very widespread in
340 Germany. In addition to many cycle lanes that comply with the guidelines, however, there are
341 also many that do not adhere to the recommendations in the current guidelines. Many
342 municipalities and cyclists complain that cyclists are frequently hindered in cycle lanes by
343 vehicles stopping or parking. Many cyclists do not feel safe in marked cycle lanes. Cyclists
344 frequently avoid using narrow lanes, in particular, and prefer to use the sidewalk instead. Cyclists

345 generally cycle in the center of the cycle lanes, a little further to the left in narrow lanes and a
346 little further to the right when there is a high volume of motor traffic. Parked vehicles to the
347 right of the cycle lane had no effect on the line taken by the cyclists.

348 Many drivers were observed using the cycle lanes for stopping or parking. Nearly 30 % of the
349 more than 35,000 cyclists observed in the study were hindered in their progress in the cycle
350 lanes as a result of this. Vehicles also often cross into the cycle lanes in longitudinal traffic, but
351 this rarely hinders cyclists. A third of the conflicts observed were caused by drivers stopping,
352 parking or driving in these lanes. Almost a further third of the conflicts were with vehicles turning
353 off the road, and 8 % were caused by drivers parking or leaving parking spaces or by vehicle
354 doors being opened.

355 When overtaking cyclists in mandatory and advisory cycle lanes, almost one in two drivers failed
356 to maintain a lateral clearance of 150 cm (59 in.). 15 % of drivers maintained a clearance of less
357 than 100 cm (39.4 in.) when overtaking, and almost 1 % maintained a clearance of less than 50
358 cm (19.7 in.). Overtaking drivers were guided, above all, by the markings on the roadway. They
359 also reacted only inadequately to the position of the cyclists in the cycle lanes. Even when the
360 adjacent lane on the left-hand side or the lane for oncoming traffic was free, drivers still stayed
361 very close to cyclists when overtaking. Often the drivers overtook the cyclists without leaving
362 their own lane. In the survey of cyclists, many of them stated that the clearance between them
363 and overtaking vehicles was narrow. Cyclists were also often very close when they overtook each
364 other. The clearances were found to be particularly narrow when cyclists tried to overtake each
365 other within their lane. The survey of road users confirmed these results.

366 At intersections in the course of marked cycle lanes, the typical turning-off, turning-into and
367 crossing accidents occurred, above all. On the free stretches of road with the marked cycle lanes,
368 many accidents occurred in connection with parking. Many were caused when vehicle doors

369 were opened. The significant role played by parking in the cycling accidents that occurred in
370 advisory cycle lanes was also evident in the accident statistics. A high risk of accidents was found,
371 in particular, for narrow cycle lanes and for cycle lanes with adjacent parking spaces.

372 **11 RECOMMENDATIONS**

373 Due to the large number of related accidents, the UDV recommends the mandatory marking of
374 safety strips with a width of 0.75 m (2.46 ft) separating both mandatory and advisory cycle lanes
375 from parking strips. To ensure an adequate safety clearance to passing vehicles, mandatory cycle
376 lanes should also (like cycle paths) have a safety strip of 0.75 m (2.46 ft) separating them from
377 the part of the roadway used by motor vehicles. In locations without parking spaces, this could
378 also be implemented as a hatched area.

379 The current width specifications for marked cycle lanes must also be reconsidered. In particular,
380 the minimum width of 1.25 m (4.1 ft) stipulated in the guidelines for advisory cycle lanes is
381 completely inadequate and should no longer be used. Advisory cycle lanes should have a width
382 of at least 1.5 m (4.92 ft) even in the case of well-justified exceptions. Given the findings about
383 clearances when overtaking, the different required widths for advisory and mandatory cycle
384 lanes can no longer be justified from a road safety perspective. The UDV therefore recommends
385 a standard width of 1.85 m (6.07 ft) for both advisory and mandatory cycle lanes. In fact, in order
386 to enable cyclists in mandatory cycle lanes to overtake safely within the marking, widths of at
387 least 2.25 m (7.38 ft) (including the marking on the left) are required, because cyclists are not
388 allowed to leave the lane even when overtaking (as in the case of cycle paths).

389 When advisory cycle lanes are created, the width of the roadway remaining for motor vehicles
390 must be at least 5.0 m (16.4 ft). In accordance with Section 2 of the German General
391 Administrative Regulations of the Road Traffic Regulations (VwV-StVO), "the remaining part of
392 the roadway not taken up by the advisory cycle lane ... must be wide enough to allow two cars

393 moving in opposite directions to pass each other without any danger”. Given that the broken
394 line of advisory cycle lanes should be crossed only in exceptional cases according to the
395 regulations [see UDV 2018], the width currently specified in the guidelines for the part of the
396 roadway not taken up by the advisory cycle lane is inadequate. Even with narrow overtaking
397 clearances, the widths of current vehicles require a roadway width (not counting advisory cycle
398 lanes) of at least 5.0 m (16.4 ft) to provide enough space for oncoming traffic. For example, the
399 width of the most common new car in Germany in 2018 (the Volkswagen Golf VII) is 2.027 m
400 (6.65 ft) including its wing mirrors. Taking into account the space required for lateral movement
401 and safety when there is oncoming traffic [see FGSV 2006], the currently stipulated roadway
402 width (not counting advisory cycle lanes) of 4.5 m (14.75 ft) is not enough to allow two of these
403 common cars to pass each other.

404 Given the high number of violations of the rule against parking or stopping in marked cycle lanes
405 and the resulting hindrances and risks for cyclists, these violations must also be rigorously
406 monitored and penalized.

407 The legal opinion written on the subject states is that it is necessary to define more closely the
408 vague term “need” that is used in the German Road Traffic Regulations (StVO) in the context of
409 crossing into advisory cycle lanes. Work also needs to be done to explain to road users the
410 required safety clearance when passing or overtaking cyclists in marked cycle lanes [see UDV
411 2018 for more information].

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