

A scenic photograph of a winding asphalt road in a rural, mountainous area. The road curves to the right and is bordered by a silver metal guardrail. In the background, there are lush green pine trees on the left and a steep, rocky mountain slope on the right. A blue semi-transparent banner is overlaid on the bottom half of the image, containing the title and speaker information.

Rural infrastructure and the safety of PTW-users

Martin Winkelbauer | 09.04.2024, Madrid | Saving lives on rural roads

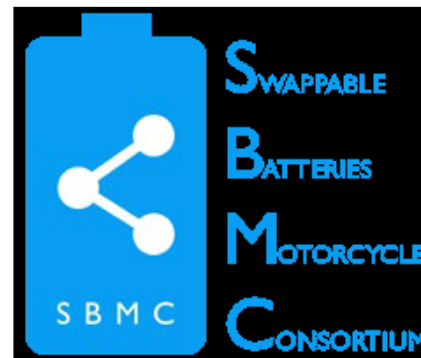
Motorcycling ...

- Recreation
- Weekends
- Holiday trips
- After work



Motorcycling ...

- **Escape from congestion**
- **Easy parking**
- **Free parking**
- **Cheaper operation**
- **More fuel efficient**
- **Electric motorcycles**



Year (1990 - 2013) →

A changing problem

Target group: 16 - 75

Motorcycle users Injuries by age 1990 – 2013 Austria

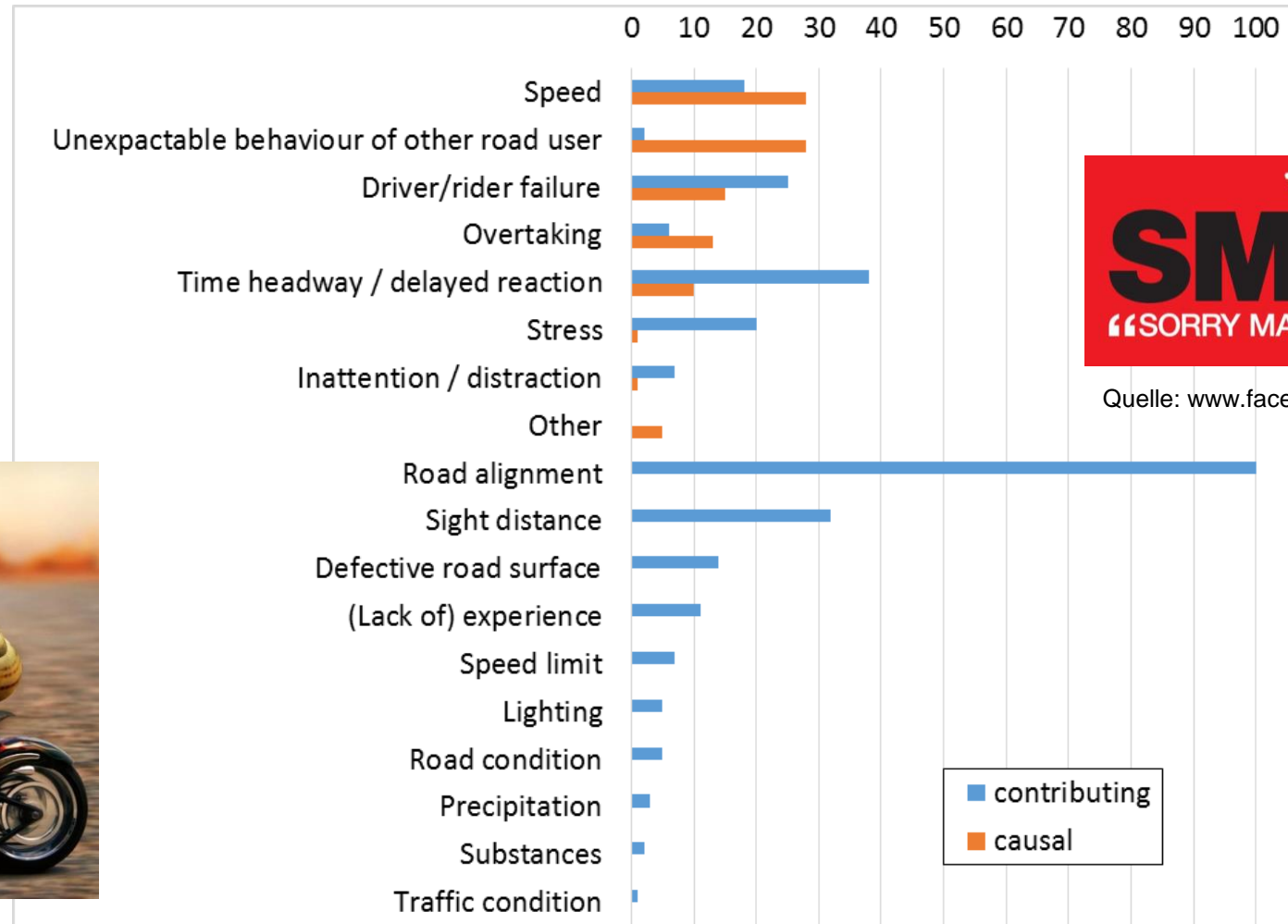
How to
approach
returning
riders?



← Age (16 - 93)

Alter	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
16	23	33	25	24	29	46	38	47	33	32	12	8	6	8	7	9	8	12	2	3	1	4	10	24
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19	351	301	268	185	178	124	91	93	86	96	86	69	55	56	56	48	68	46	45	61	53	38	47	62
20	317	359	274	231	208	155	135	110	121	104	127	120	77	97	68	70	56	72	59	71	80	70	63	79
21	283	284	290	213	232	172	144	155	145	130	125	129	135	90	104	87	103	115	95	92	85	100	97	89
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28	106	99	108	103	107	118	108	124	139	138	130	130	95	107	91	94	85	75	75	100	72	75	96	93
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77	3	2	0	2	0	0	0	1	0	1	2	2	1	3	3	4	4	4	2	2	3	6	6	3
78	2	1	0	1	1	1	1	3	2	3	3	0	1	2	0	3	0	6	3	3	4	6	7	7
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80	1	1	2	1	0	1	1	0	0	2	0	0	0	0	1	1	1	1	4	2	4	6	5	4
81	0	0	0	0	2	0	1	1	0	0	1	0	2	1	0	0	0	1	0	1	1	1	1	0
82	1	2	0	2	3	3																		

Crash causes (according to KFV's in-depth study)



Quelle: www.facebook.com/stopsmidisy/



Source: bilder.4ever.eu/witzig/tiere/schnecke-164836

Source: CEDATU, Bearb.: TU Graz (VSI), KFV

SMIDSY Visual Conspicuity

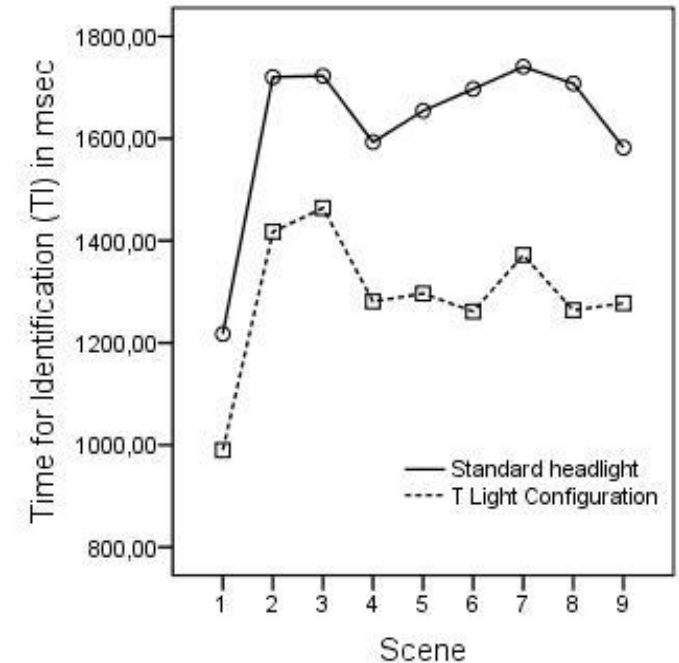
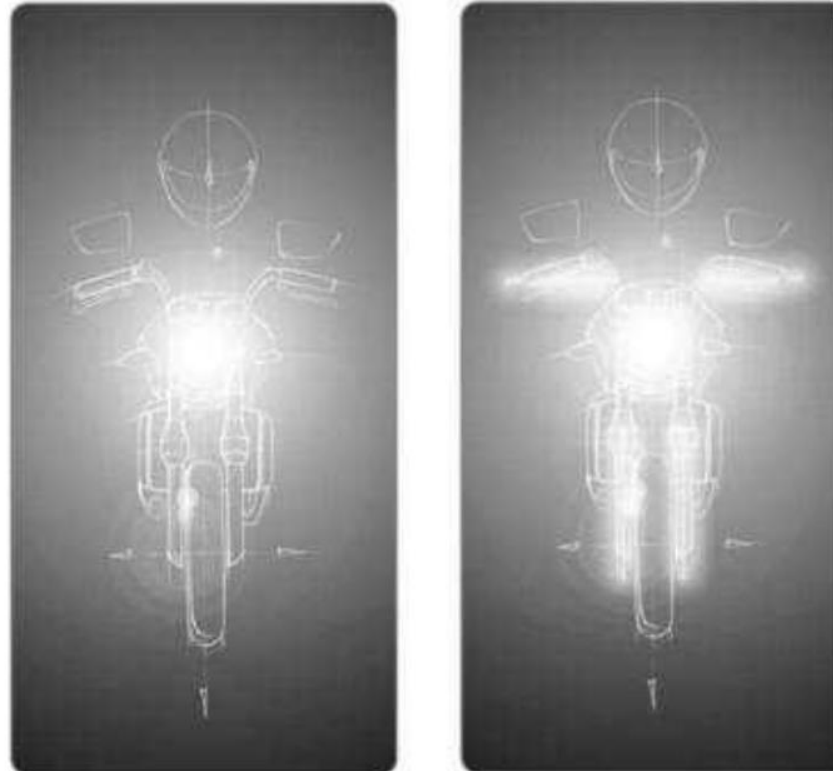
- Alternative lighting scheme
- 2 Be SAFE WP5.2
- High visibility clothing



SISYBIDEYSS



Rößger, Hagen, Krzywinski, Schlag, 2011



Speed: Too fast for the law



Speed

- Excessive speed
- Inappropriate speed
- Single vehicle crashes
- Curves
- Speed limits for motorcycles
- Speed cams
- Average speed enforcement
- Cross border enforcement
- Awareness and competence
- **Roll angle phobia & tolerance**

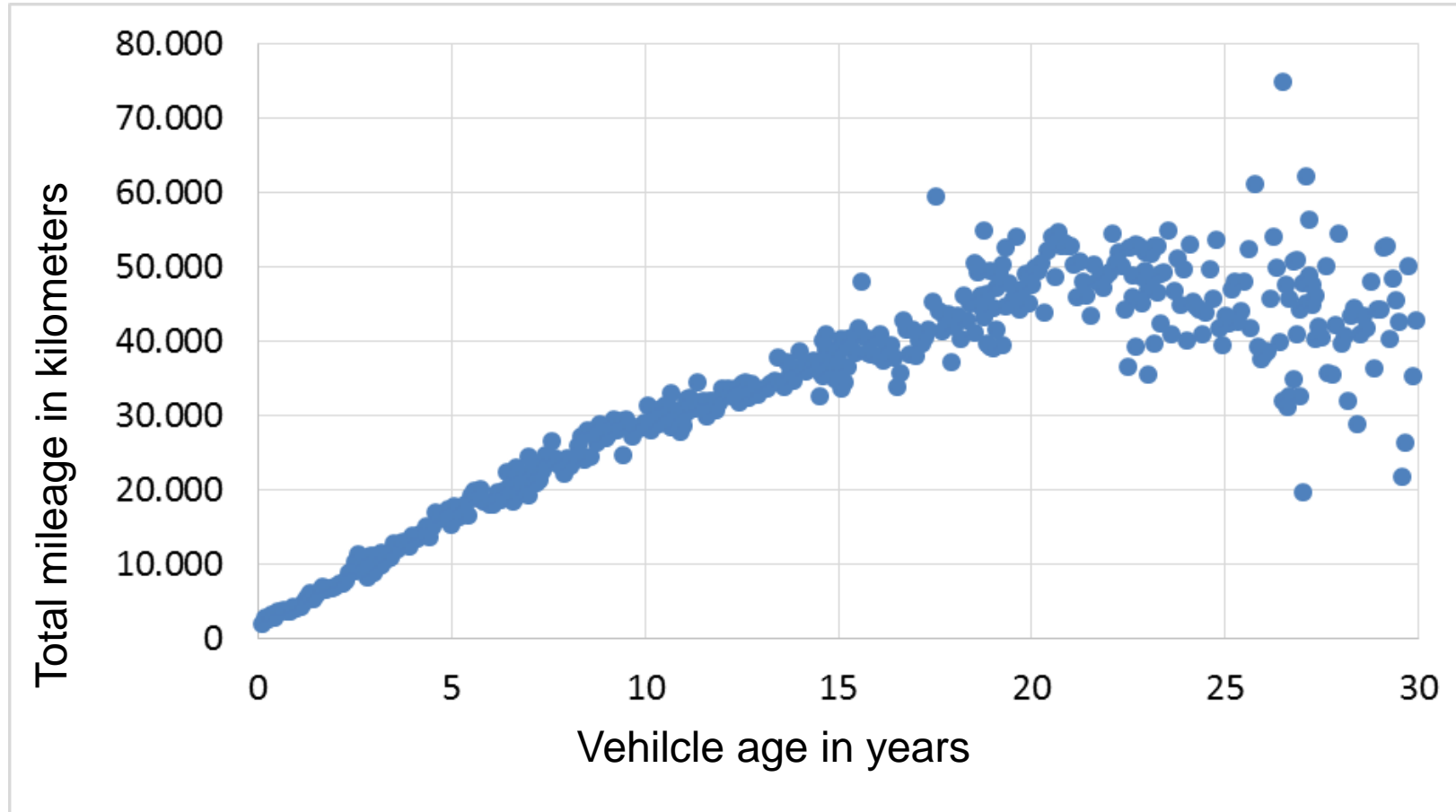


Vehicle safety? Rider assistance – connected vehicles

- **ABS**
- **ISA, LDW, ACC**
- **Emergency breaking**
- **Intersection Movement Assist (IMA)**
- **Left Turn Assist (LTA)**
- **Stationary Vehicle Warning (SVW)**
- **Electronic Emergency Brake Light (EEBL)**
- **PTW digital conspicuity**
- **<https://www.cmc-info.net/>**



Lifetime of a motorcylce ... wait for 20 years



Infrastructure

Find the error!



Infrastructure Find the error!



Source: <https://www.google.at/maps/@48.2756773,16.1103479,199m/data=!3m1!1e3?entry=ttu>



Infrastructure

Find the error!

Source: <https://www.google.at/maps/@47.1143617,10.9392779,3a,75y,314.59h,83.12t/data=!3m7!1e1!3m5!1sAF1QipN2OzzkHb4-RtBuKwuxYhblk3DmKUDpfzuz9HLz!2e10!3e11!7i7680!8i3840>



Two kinds of curves



There's no sense in negotiating with friction and gravity



Too fast for yourself

Source: <https://www.youtube.com/watch?v=6L8QfbSj2j4>



<https://www.youtube.com/watch?v=jRyFhZ6Oe3k>



Or just the road too narrow?

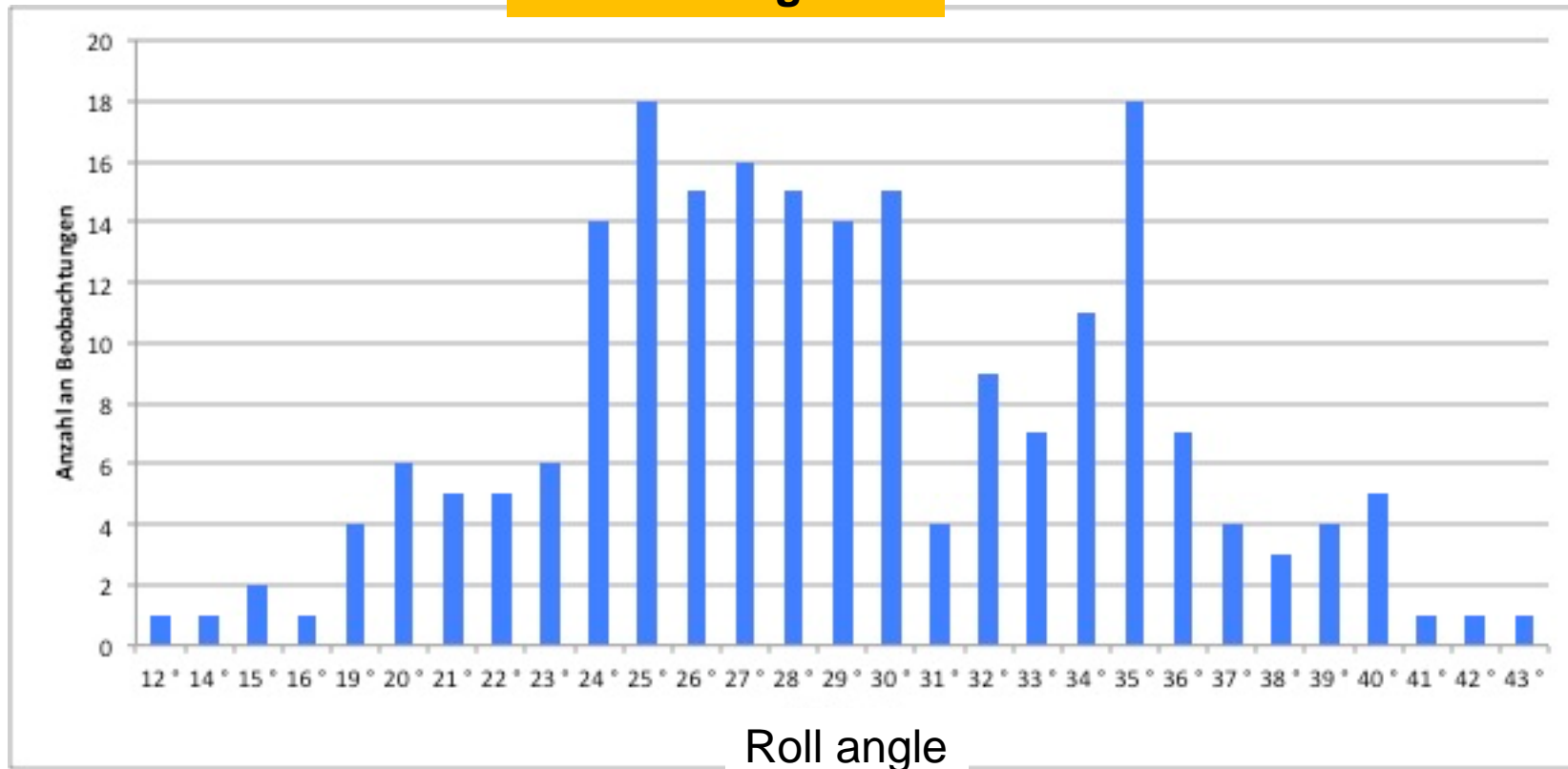


Riders' overall roll angle (295 cases)

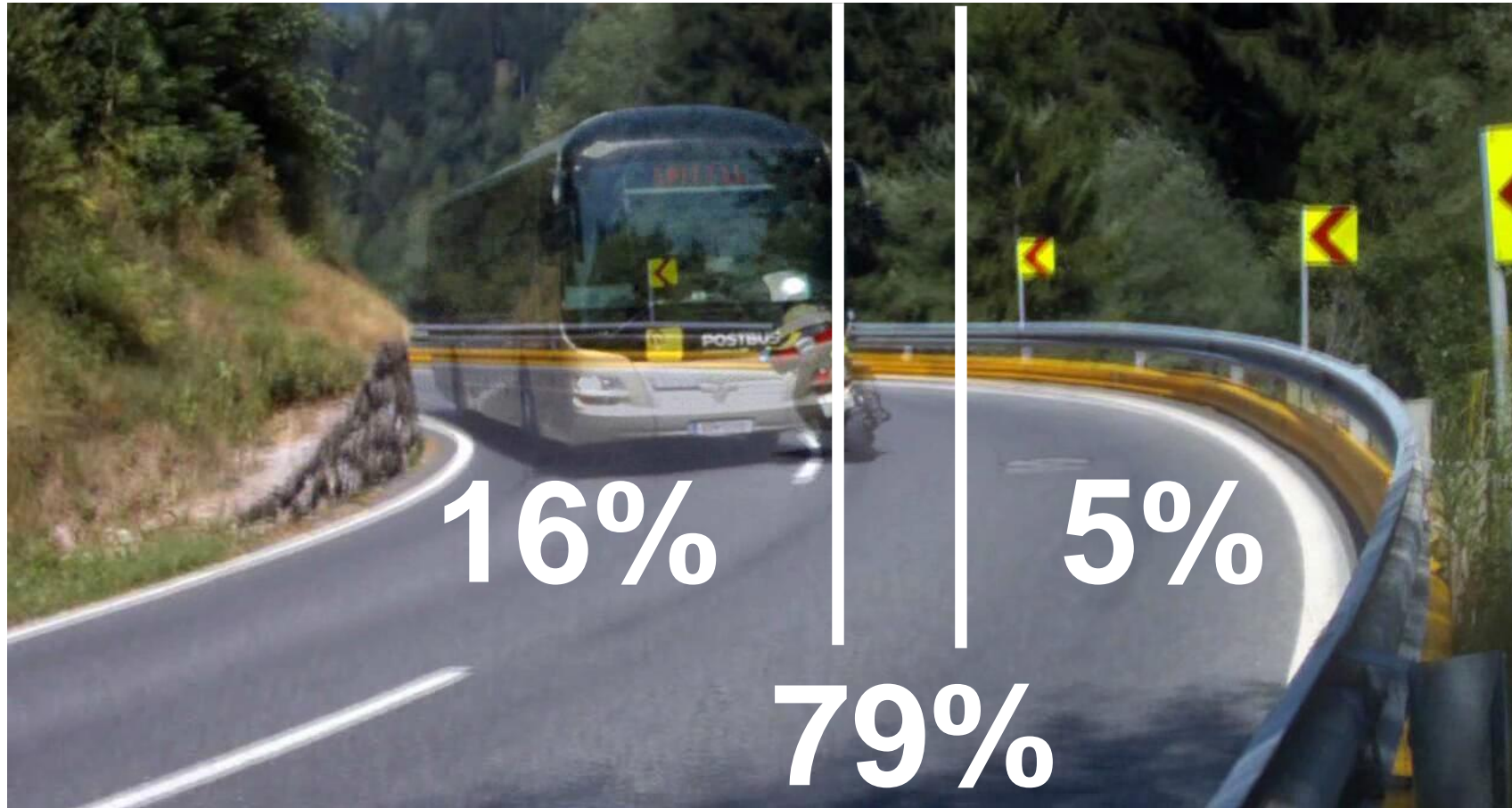
narrow margin between comfort and catastrophe

24 – 30 degrees

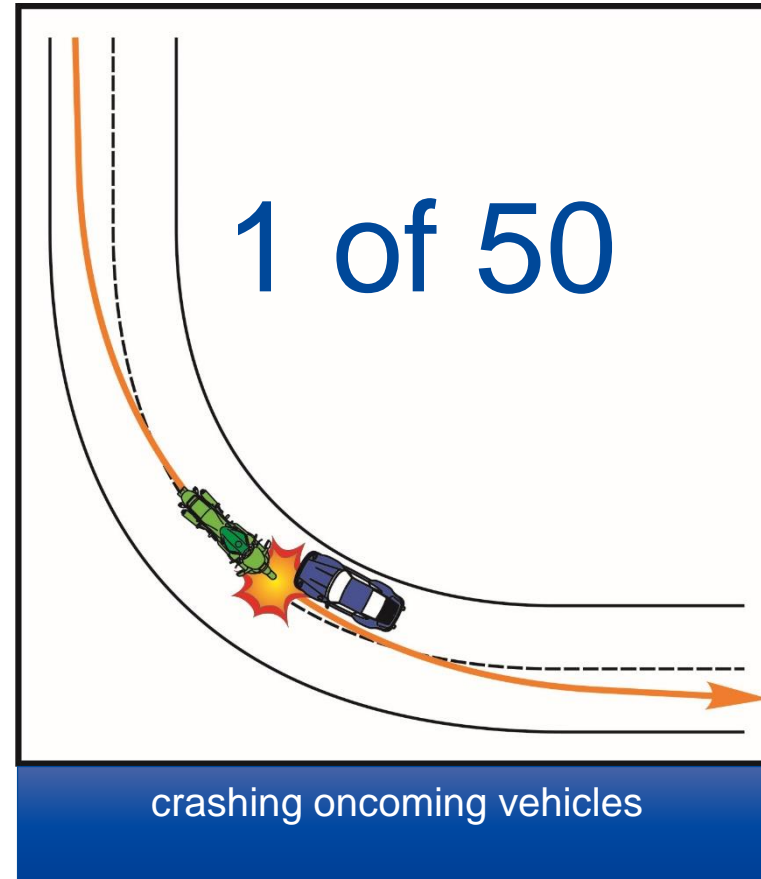
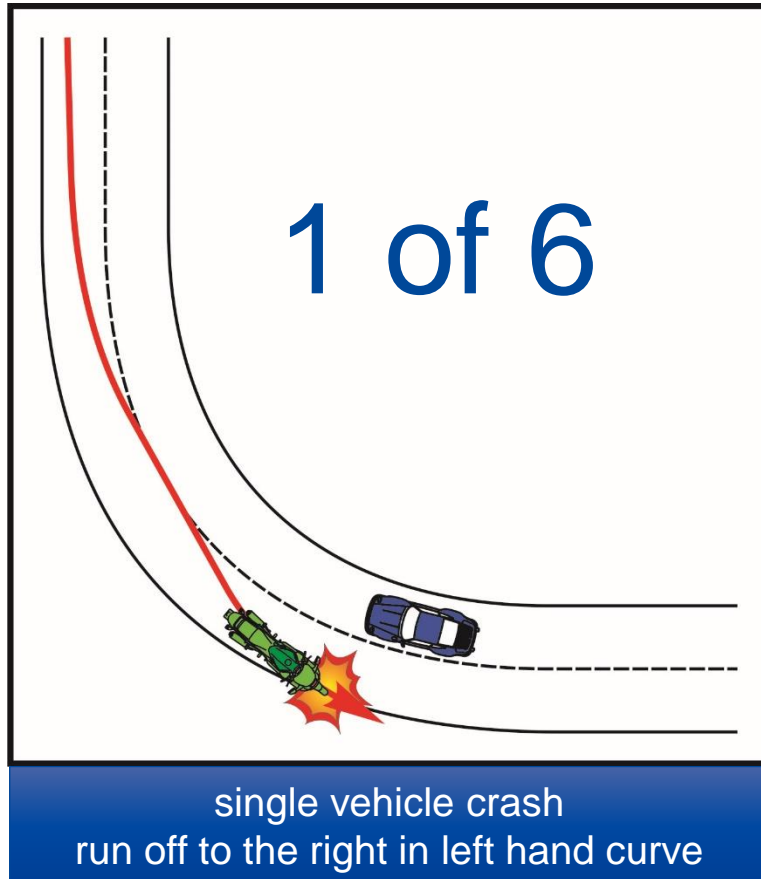
Number of observations



Why interfere with trajectories? (Naturalistic-Riding-Project, 2013)



Typical crashes



... half of them upright into the guardrail

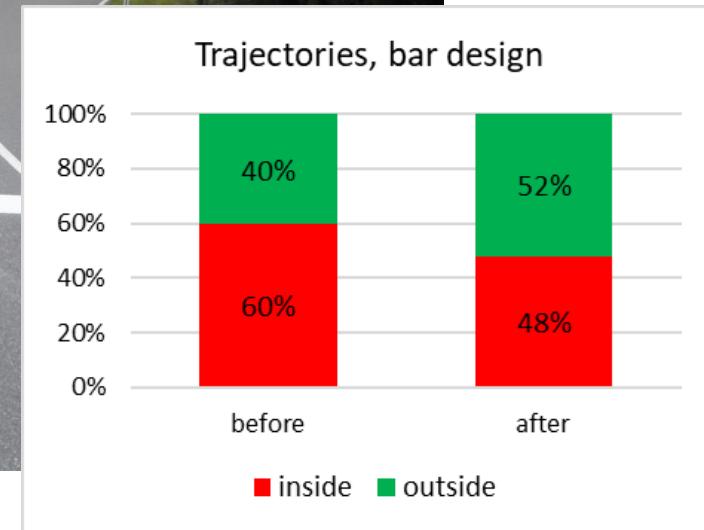
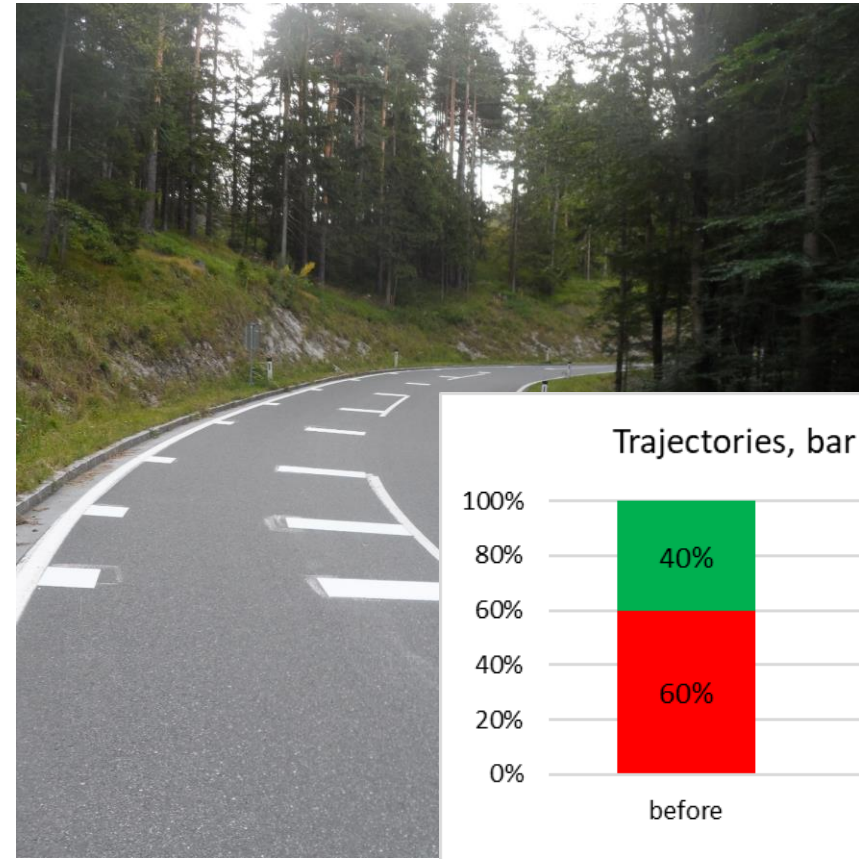
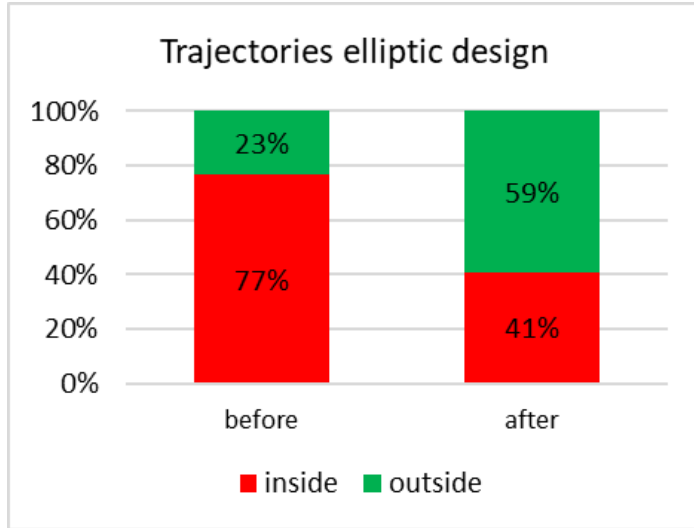
Riders don't like travelling over road markings



Paint the road, where you don't want them to go



First evaluation study, 2016, nine curves, two designs

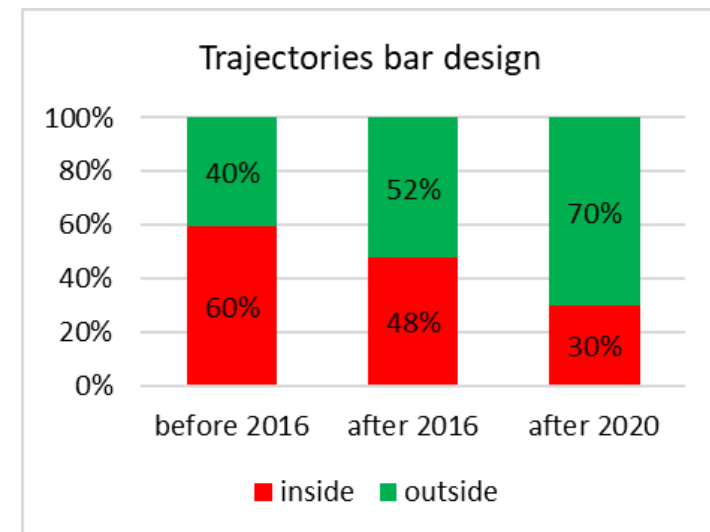
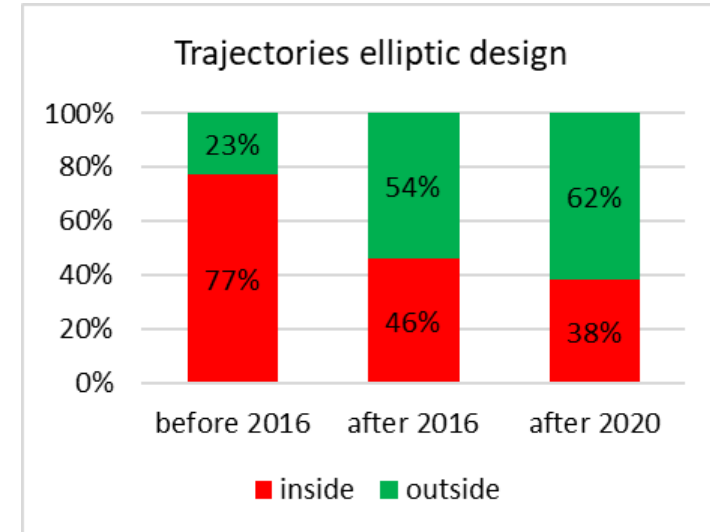


2nd evaluation study

- 7 curves
- elliptic design improves
- bar design catches up
- from 16 to 7 crashes



<https://www.google.at/maps/@47.8718896,16.534052,3a,51.5y,96.31h,79.91t/data=!3m6!1e1!3m4!1sA6bxzsGScZ-FaWLA0-9yOg!2e0!7i16384!8i8192>



Today around 50 curves equipped in the North of Luxembourg

2018: N25

2019: CR342

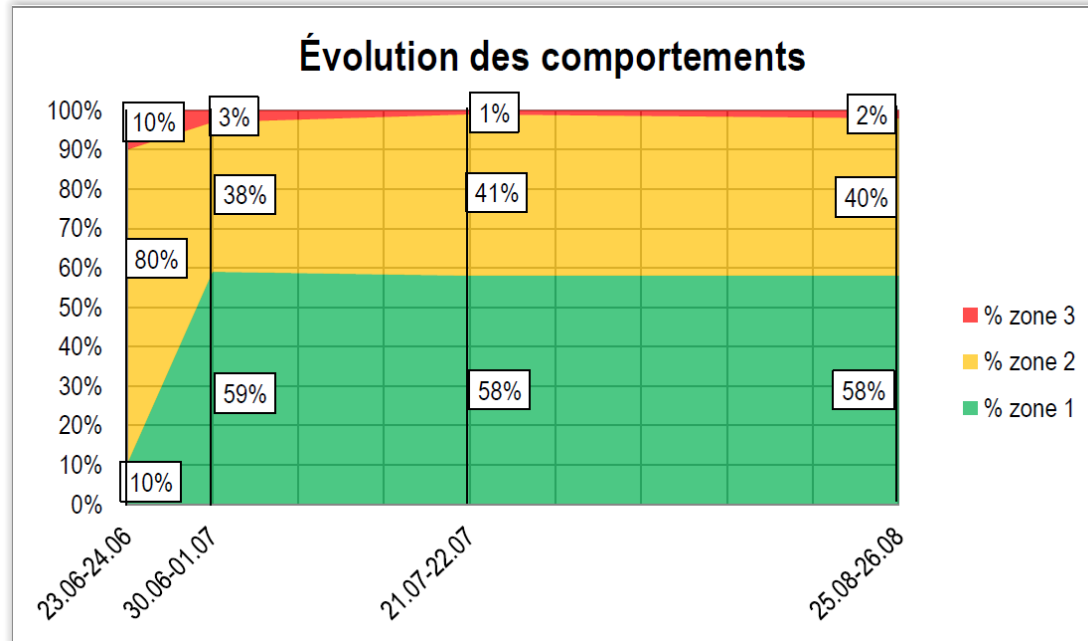
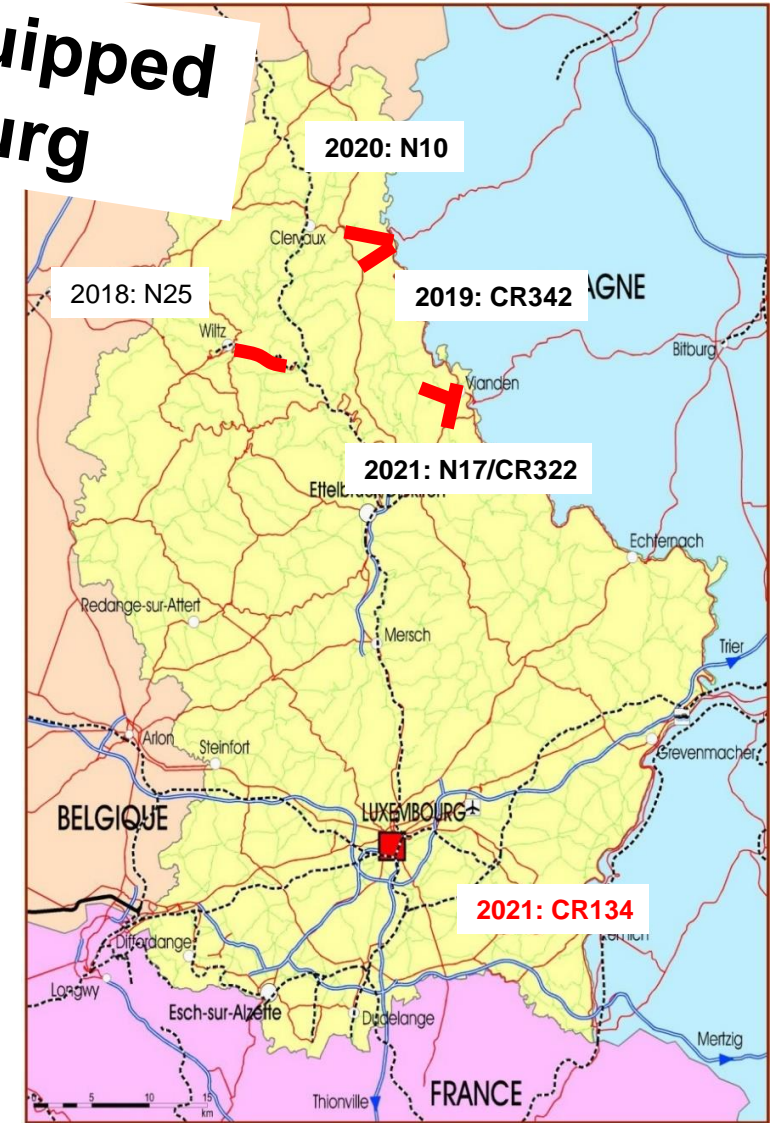
2020: N10

2021: N17 / CR322

2021: CR134 Not retained,

- because the road is too small

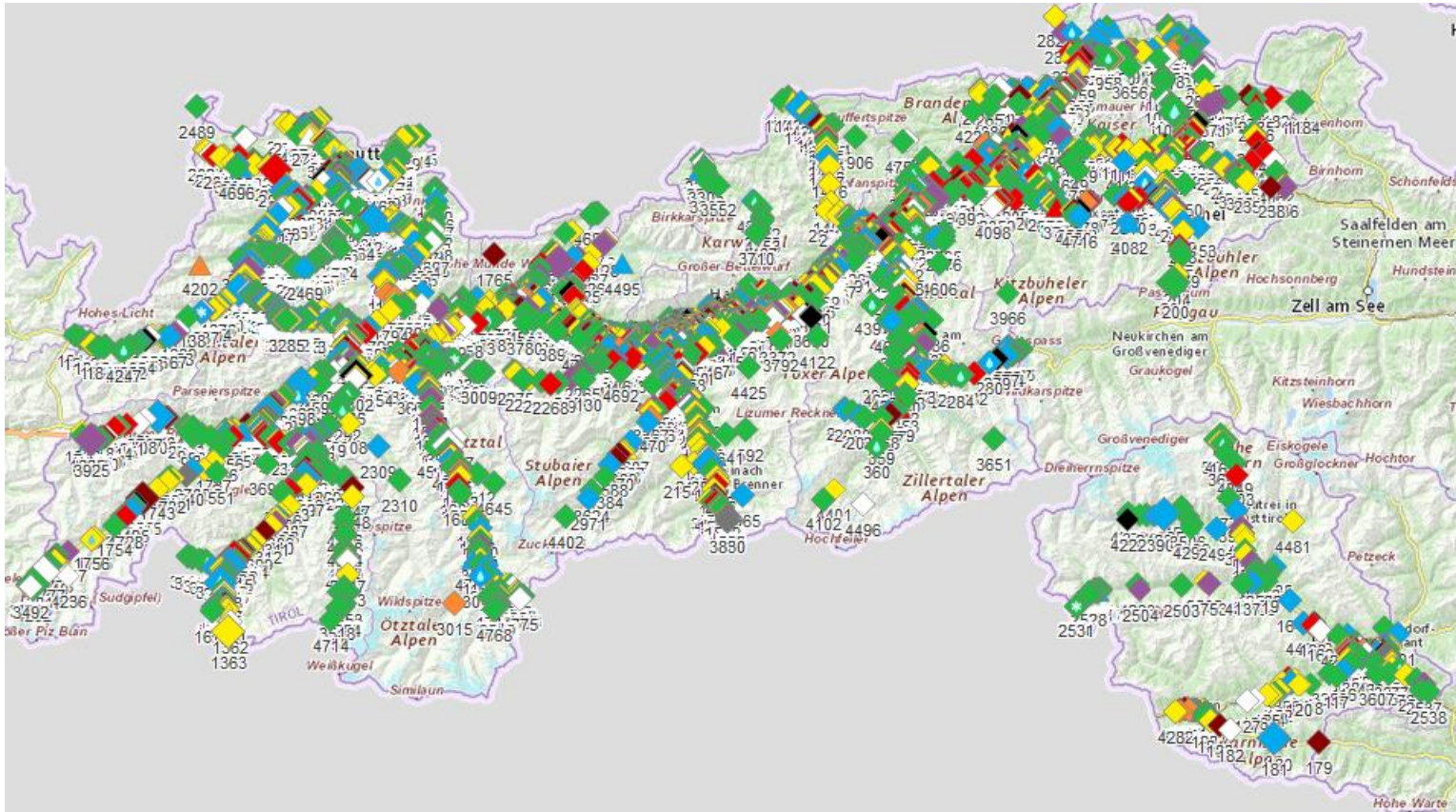
- only "danger" signposting in 2022



Rakitna, Slovenia



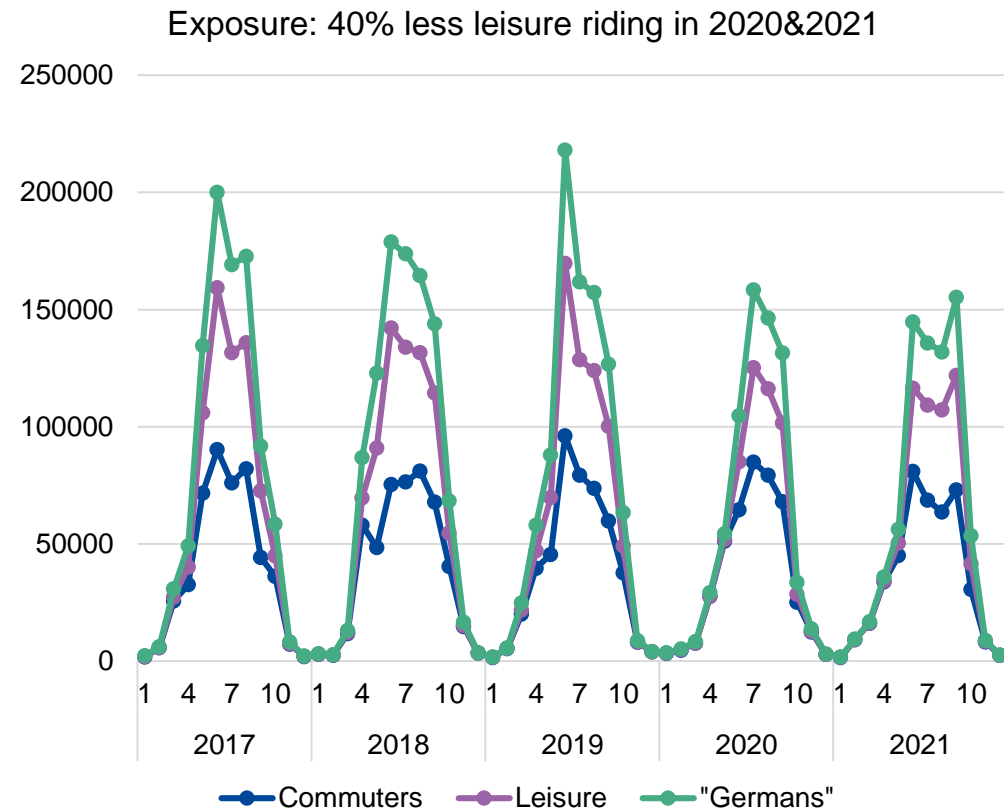
Tyrol, 2019, 19 curves



2022 Tyrol Update

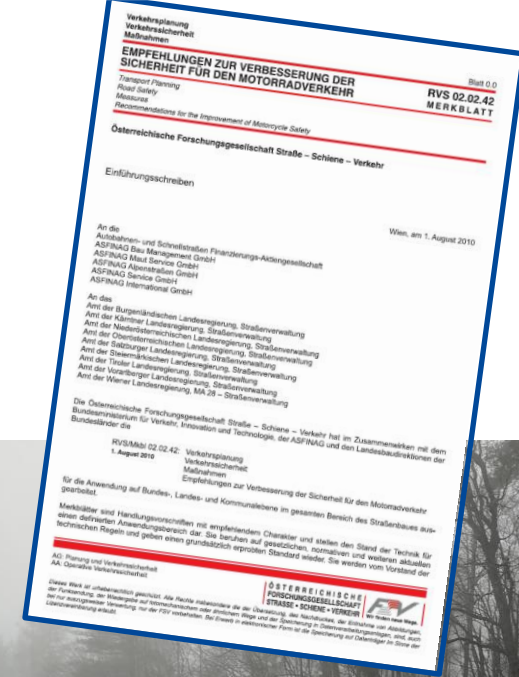
**Elliptic road markings
Riders, danger for you!**

- **19 Curves**
- **Before (2012-6/2019)**
 - 6,3 slight injuries p.a.
 - 6,4 severe injuries p.a.
 - 0,57 fatalities p.a.
- **After (7/2019-2021)**
 - 2 slight injuries
 - 2 severe injuries
 - Control for corona pandemic
- **80% fewer crashes**



Infrastructure

- Predictable alignment
- Predictable friction
- Forgiving roadsides
 - Chevrons on steel poles?
- Guardrails
 - Retrofitting
 - New installation
 - Removal where not needed
- Infrastructure Guidelines for motorcycle-safe road design





Thanks for listening!

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