Motorcycle Accidents In-Depth Study

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Content

Presentation of the study

- Introduction
- Main features
- Main figures

MAIDS highlights

Discussion / What does MAIDS tell us?

Time to Decide

- Improvements in MC safety are essential:
  - Riders
  - Future of motorcycling
  - Positive contribution that motorcycling brings to society

- But, not enough information was available to develop an **integrated safety policy** and **action plan**

- Need of in-depth accident study

Decision

- To provide the scientific basis for the discussion of MC accidents in Europe:
  - ACEM organised the Motorcycle Accident In-Depth Study (MAIDS);
  - Created a Consortium of partners, namely:
    - DG TREN of the European Commission, who co-financed the project.
    - Other partners: BMF, CEA, CIECA, FEMA, FIM.

Who and Where?

- For data collection

  - France — CEESAR
    Centre Européen d'Etudes de Sécurité et d'Analyse des Risques
  - Germany — MUH
    Medical University of Hanover
  - Italy — Uni Pavia
    University of Pavia
  - Netherlands — TNO
    Nederland's Organization for applied scientific research
  - Spain — REGES
    Investigación y reconstrucción de accidentes de tráfico

- For statistical analysis

  - Uni Pavia (Italy)

MAIDS Main Features

In-Depth investigation of motorcycle accidents

- OECD methodology
- Basic parameters of accidents
- In-depth data on human, vehicle and roadside factors (about 2000 variables per case)
- Data on collision dynamics
- Data on injury types and severity
- Data on accident causation

MAIDS Main Features

In-Depth investigation of motorcycle accidents

All 921 accident cases reconstructed

- Allowing MAIDS teams to identify

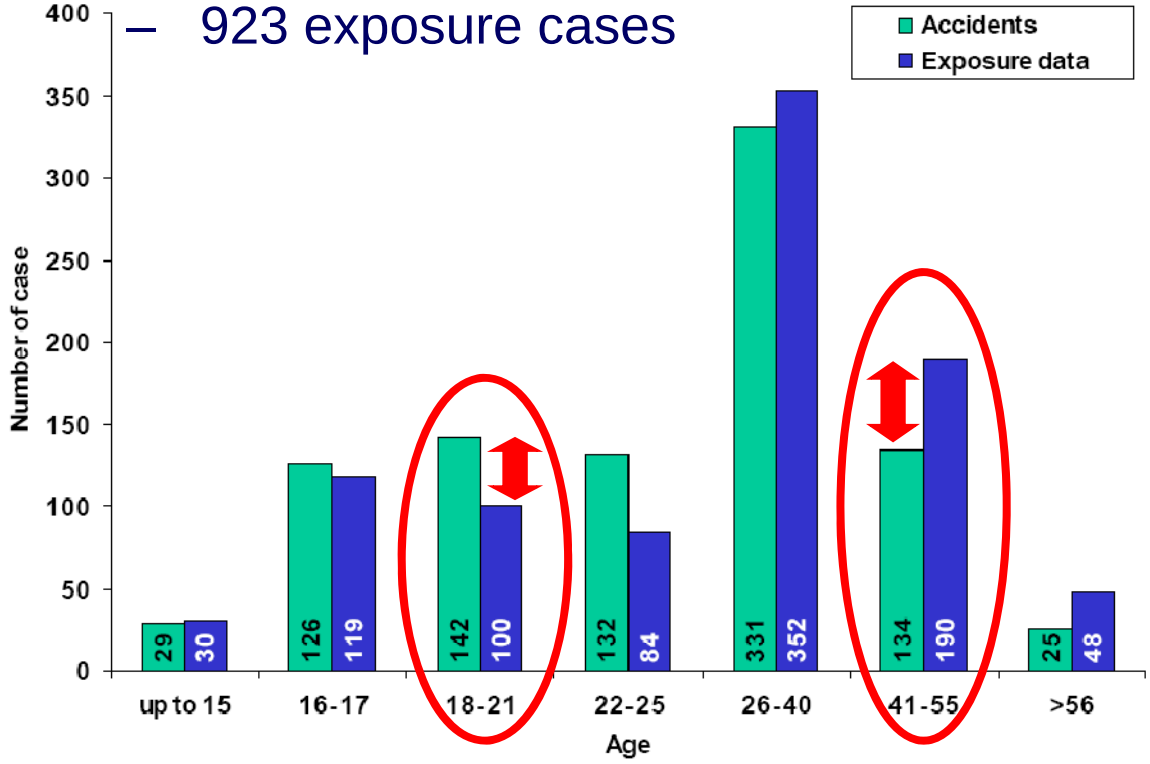
Accident contributing Factors

- For each case
  - One single **primary** accident contributing factor
  - Four **additional** accident contributing factors
  - Attributed to
    - Human
    - Vehicle
    - Environment

MAIDS Main Features

In-Depth investigation of motorcycle accidents

- Exposure data
  - Essential for comparison purpose and risk evaluation
  - 923 exposure cases



MAIDS Main Figures

In-Depth investigation of motorcycle accidents

- Distribution of cases and controls according to category
  - L1 mofas = 28
  - L1 mopeds = 370
  - L1 total = 398 L3 motorcycles = 523

MAIDS Main Figures

In-Depth investigation of motorcycle accidents

- Distribution of cases and controls according to category

Table 3.3: PTW legal category

	Accident data		Exposure data	
	Frequency	Percent	Frequency	Percent
L1 vehicle - mofa	28	3.0	49	5.3
L1 vehicle - other	370	40.2	324	35.1
L3 vehicle	523	56.8	550	59.6
Total	921	100.0	923	100.0

  - L1 = 40 %, over-represented (moped only)
  - L3 = 57 %, no over-representation

MAIDS Main Figures

In-Depth investigation of motorcycle accidents

- Distribution of fatal and non-fatal cases

Table 3.2: Number of fatal cases

	Fatal	Not fatal	Total
University of Pavia (Italy)	11	189	200
TNO (Netherlands)	15	185	200
REGES (Spain)	12	109	121
ARU-MUH (Germany)	49	201	250
CEESAR (France)	16	134	150
Total	103	818	921

  - Fatal 11 %
    - L1 = 24 %, under-represented
    - L3 = 76 %, over-represented
  - Non-fatal 89 %

Main Figures

- Distribution of single and multi-vehicles accidents

Table 3.5: Number of OVs involved in the accident

	Frequency	Percent
None (single vehicle accident)	143	15.5
One	738	80.2
Two	36	3.9
Three	4	0.4
Total	921	100.0

  - Single 16 %
  - Multi-vehicle 84 %

Content

Presentation of the study

MAIDS highlights

- **Vehicles factors**
  - Accident causation
  - Vehicle population

Primary Accident Contributing Factors

- Vehicle factors: 0,3% of all cases

	Frequency	Percent
Vehicle	3	0.3
Total	921	100.0

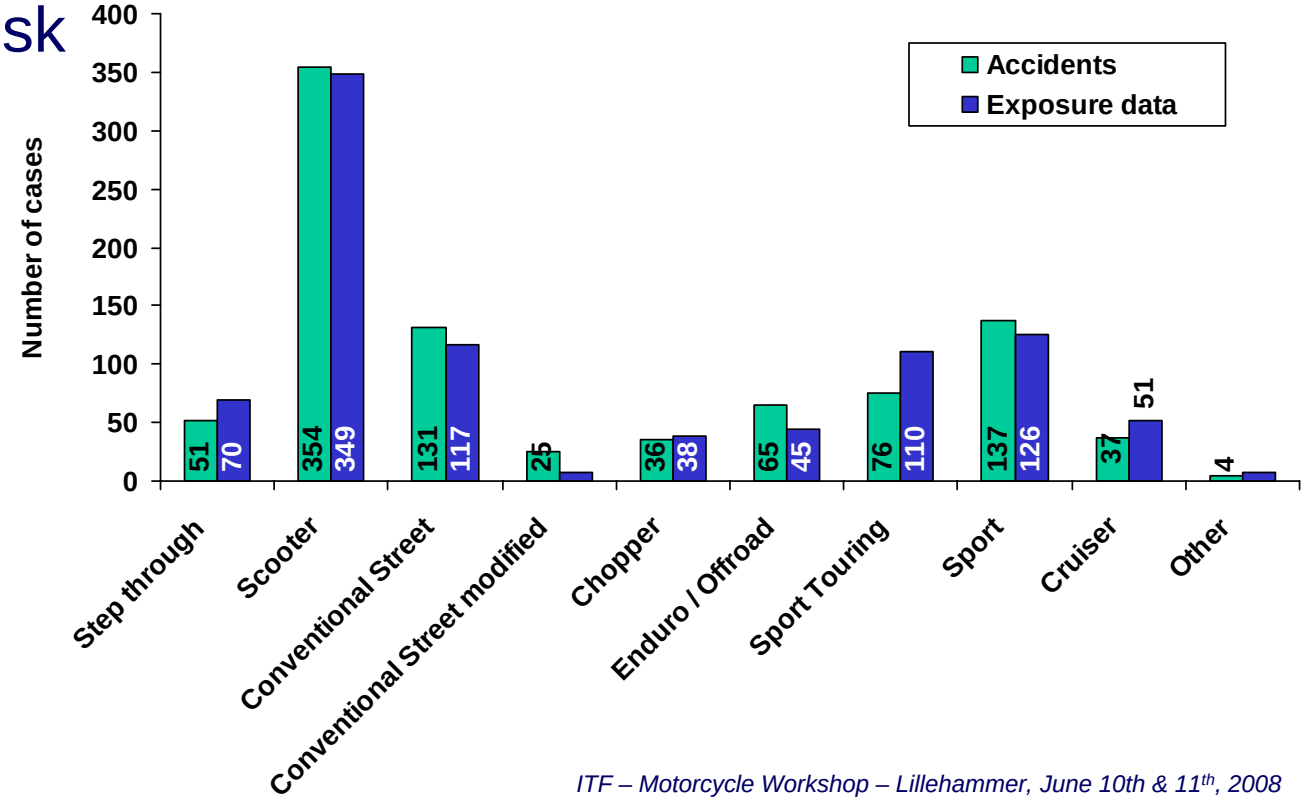
Additional Accident Contributing Factors

- Vehicle factors:
  - PTWs: 1,6 % of all cases
  - OVs: 0,5 %

	Frequency	Percent
PTW technical failure	32	1.6
OV technical failure	10	0.5
Total	2059	100.0

PTW Style

- Frequency
  - Scooters: 38 %
  - Conventional street: 14 %
- No associated risk



PTW Gross Mass

- Frequency
  - < 100 kg: 43 %
  - 151 – 200 kg: 21 %
- No associated risk
- Except for PTWs over 250 kg under-represented

PTW gross mass

	Accident data		Exposure data	
	Frequency	Percent	Frequency	Percent
under 100	393	42.7	355	38.5
101 – 150	97	10.5	85	9.2
151 – 200	193	20.9	183	19.8
201 – 250	153	16.6	195	21.1
over 250	43	4.7	105	11.4
Unknown	42	4.6	0	0.0
Total	921	100.0	923	100.0

PTW Engine Displacement

- Frequency
  - 50 cc: 43 %
  - 501 - 750 cc: 22 % of all cases
- No associated risk
- Except for the over 1001 cc category under-represented

Engine displacement

	Accident data		Exposure data	
	Frequency	Percent	Frequency	Percent
up to 50 cc	394	42.7	367	39.8
51 to 125 cc	89	9.7	86	9.3
126 to 250 cc	37	4.0	32	3.5
251 to 500 cc	56	6.1	50	5.4
501 to 750 cc	206	22.4	193	20.9
751 to 1000 cc	80	8.7	107	11.6
1001 or more	58	6.3	88	9.5
Unknown	1	0.1	0.0	0.0
Total	921	100.0	923	100.0

Content

Presentation of the study

MAIDS highlights

- Vehicle factors
- Environmental factors
  - Accident causation
  - Worsening factor

Primary accident causation factor

- Environmental factors: 8 %

	Frequency	Percent
Environmental	71	7.7
Total	921	100.0

  - Weather 2 %
  - Road maintenance defect 2 %
  - Road design defect 1 %
  - Traffic hazard 1 %

Additional Accident Contributing Factors

- From the road environment: 15%

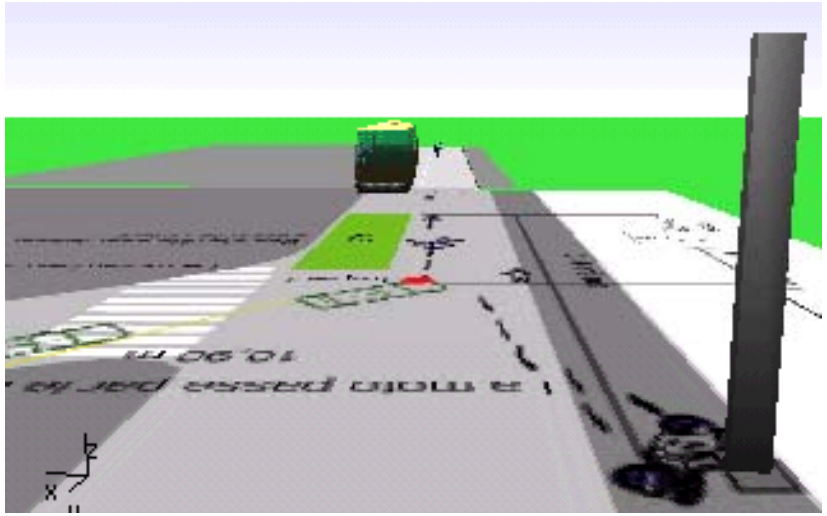
	Frequency	Percent
Environmental cause	300	14.6
Total	2059	100.0

  - Weather 5 %
  - Road Maintenance defect 1 %
  - Road design defect 2 %
  - Traffic hazard 2 %

Worsening Factors

- Roadway and fixed objects: second collision partner with 17 % of MAIDS cases
  - L1 = 9 %
  - L3 = 23 %
- (Directive on Road Safety Infrastructure Management)

Fixed object	74	8.0
Roadway	83	9.0



Content

Presentation of the study

MAIDS highlights

- Vehicle factors
- Environmental factors
- Human factors
  - Accident causation
  - Accident population
  - Collision dynamics
  - Injuries

Primary Accident Contributing Factors

- Human factors: 88 % of all cases

	Frequency	%
Human-PTW rider failure	344	37,4
Human-OV driver failure	465	50,5
Total	809	87,9

- OV drivers: largely responsible for PTW crashes
  - 50 % of all MAIDS cases (L1 = L3)
  - 61 % of the multi-vehicle accidents
- PTW riders: responsible of 37 % of PTW crashes
  - L1 = 39 %
  - L3 = 36 %

Primary Accident Contributing Factors
Fatal Cases

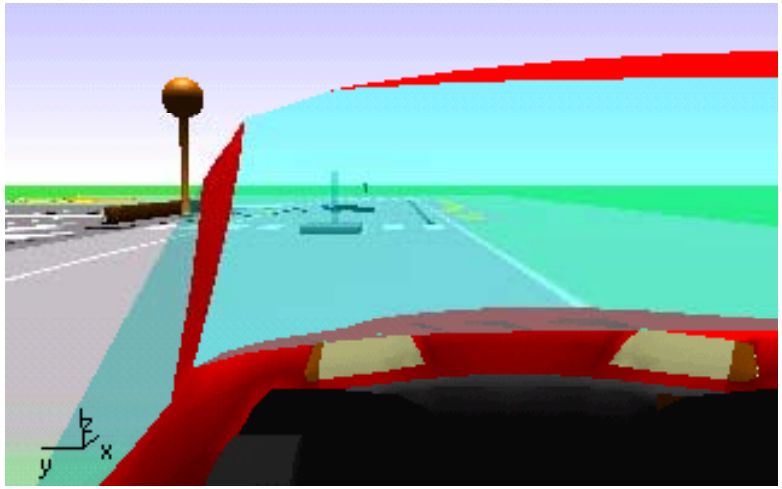
- Human factors: 86 % of all cases

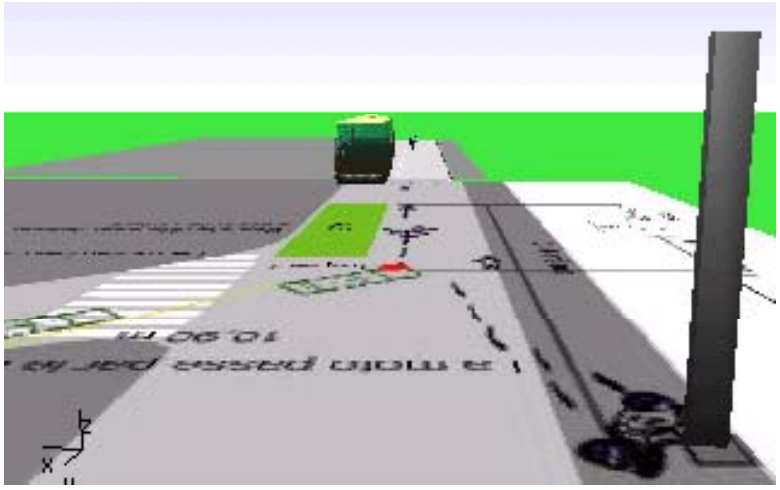
	Frequency	%
Human-PTW rider failure	54	52,4
Human-OV driver failure	34	33,3
Total	88	85,7

- PTW riders: largely responsible for PTW fatal accidents
  - 52 % of MAIDS fatal cases
- OV drivers: responsible of
  - 33 % of all MAIDS fatal cases
  - 44 % of the multi-vehicle fatal accidents

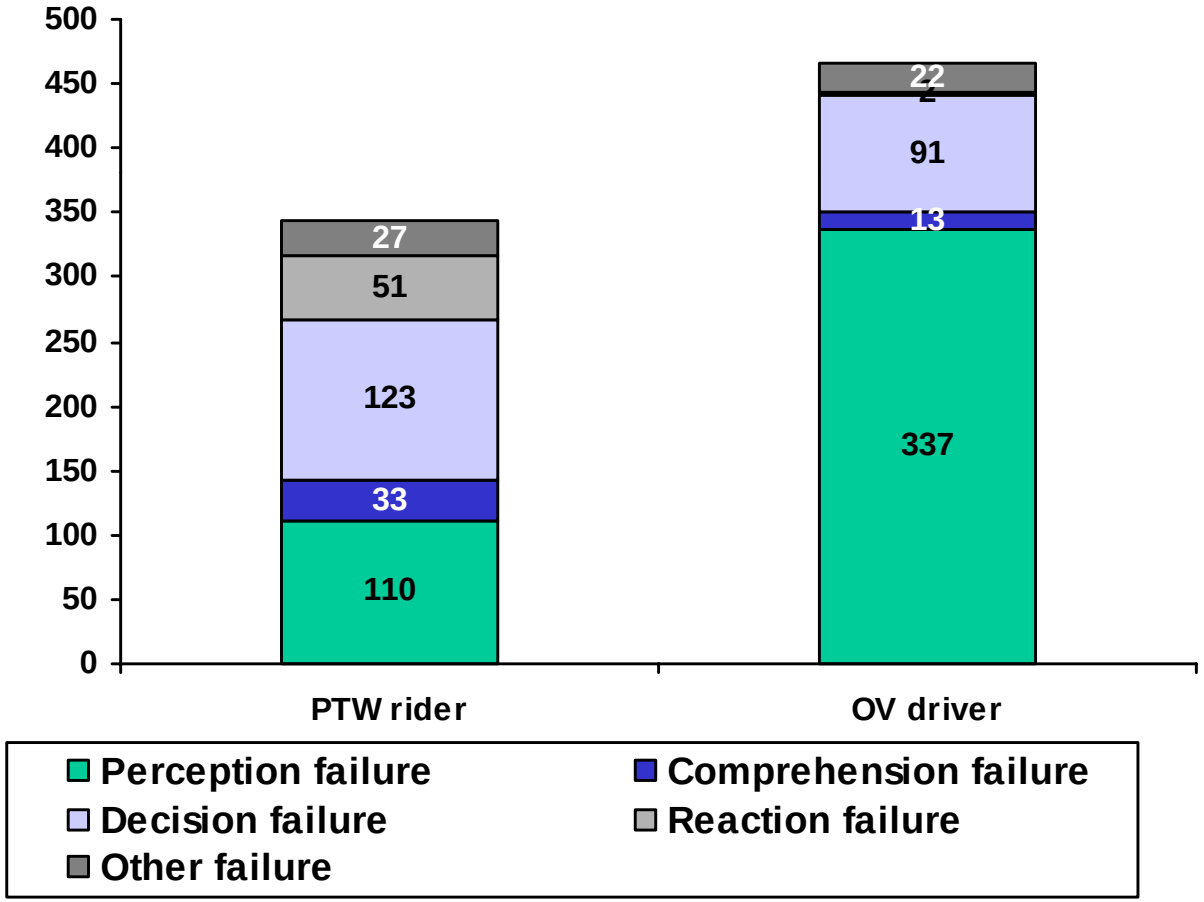
Primary Accident Contributing Factors

- 921 cases reconstructed
- Primary contributing factors classified
  - Perception
  - Comprehension
  - Decision
  - Reaction



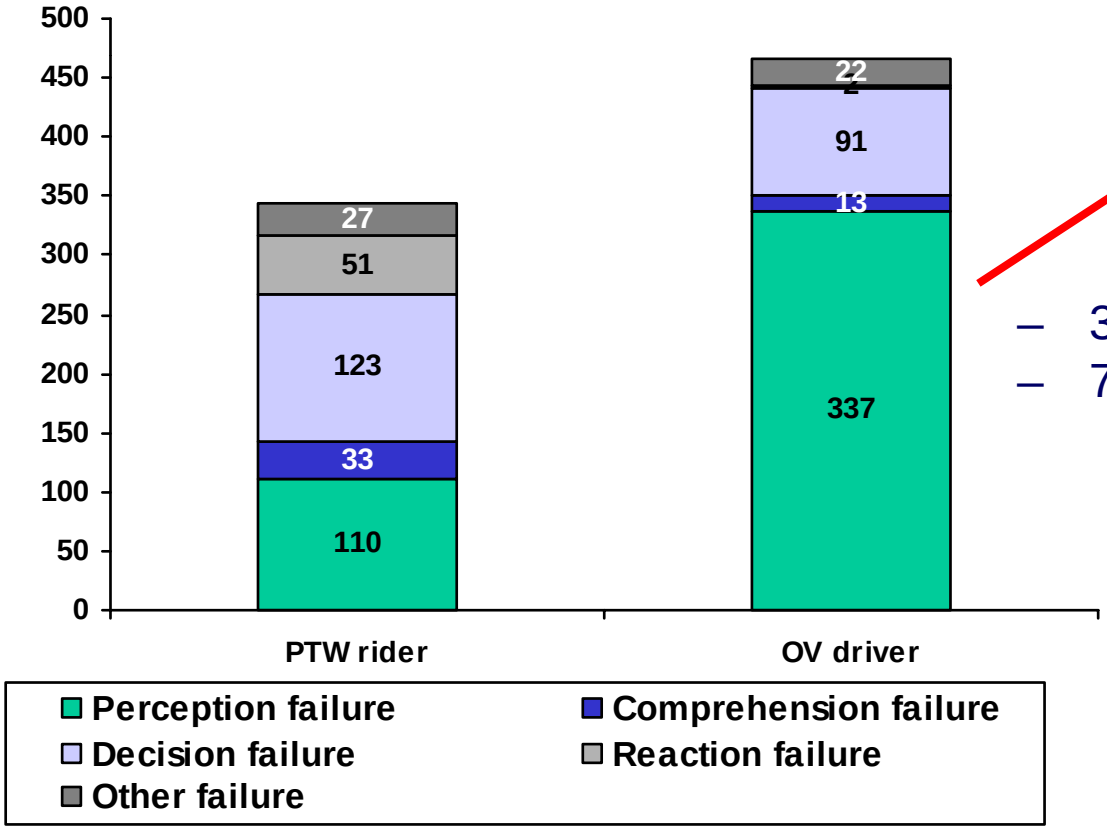


Primary Accident Contributing Factors



Primary Accident Contributing Factors

- The most frequent : perception failure by the OV drivers



Perception

- 37% of all MAIDS cases
- 72 % of the drivers' failures
  - L1 = 77%
  - L3 = 69%

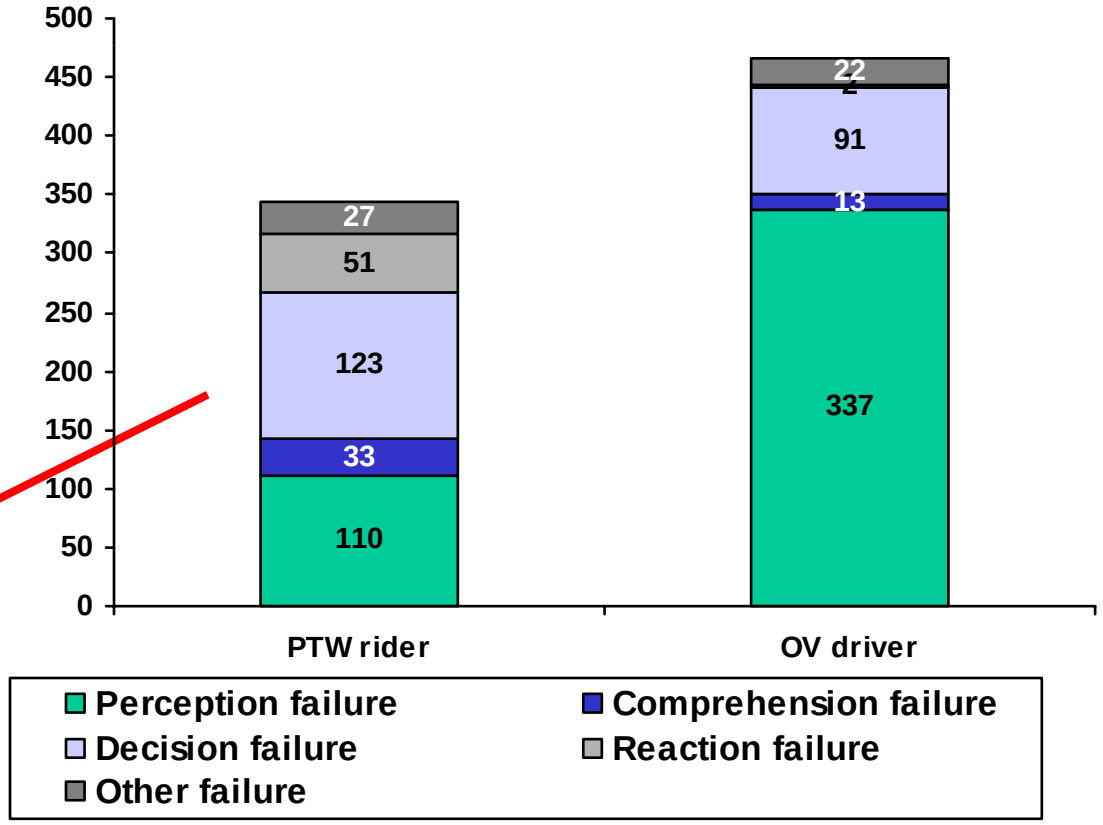
Primary Accident Contributing Factors

- The second most frequent attributable to PTW riders
  - Decision failure

    13% of all MAIDS cases
    35 % of riders' failures

    - L1 = L3

Decision



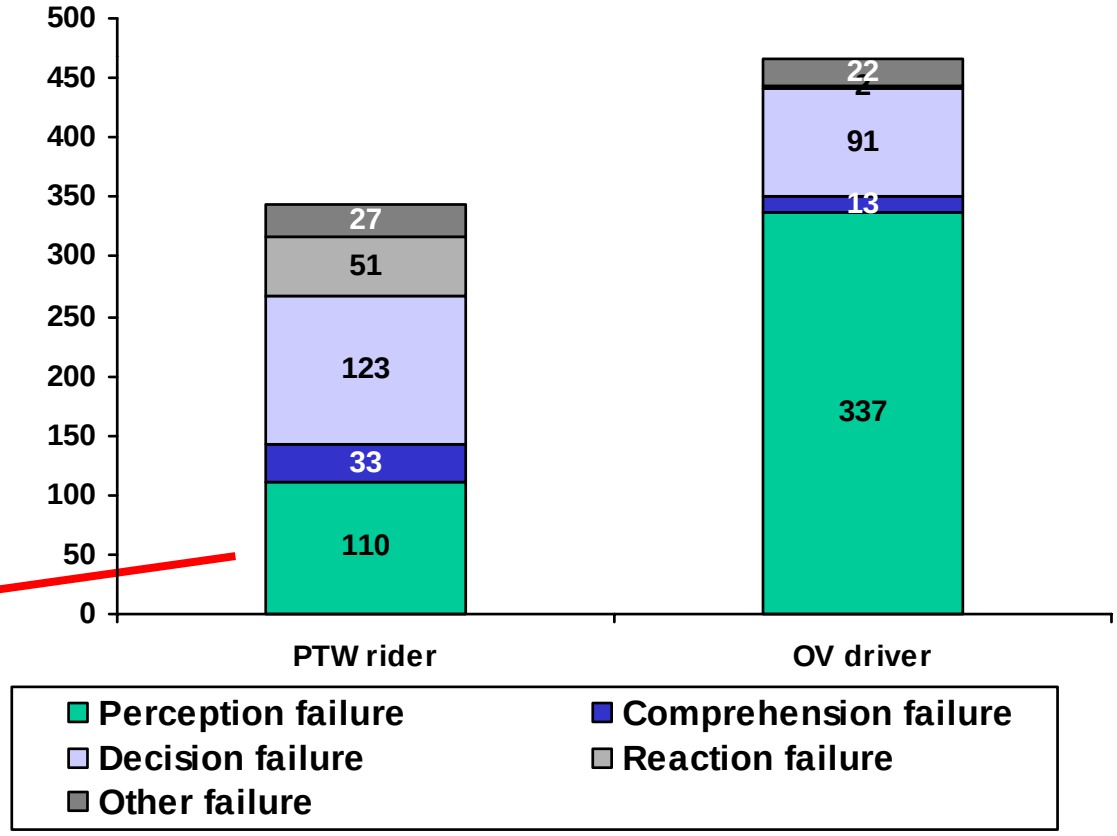
Primary Accident Contributing Factors

- The third most frequent attributable to PTW riders
  - Perception failure

    12% of all MAIDS cases
    32 % of riders' failures

    - L1 = 17 %
    - L3 = 8 %

Perception



Additional Accident Contributing Factors

- Human factors: 72% of all cases

	Frequency	Percent
PTW rider	900	43.7
OV driver	589	28.6
Total	2059	100.0

- PTW riders: major contributors to crashes
  - 44% of all additional contributing factors
    - L1 = 47 %
    - L3 = 31 %

Content

Presentation of the study

MAIDS highlights

- Vehicle factors
- Environmental factors
- **Human factors**
  - Accident causation
  - **Accident population**
  - Collision dynamics
  - Injuries

Alcohol and Drug

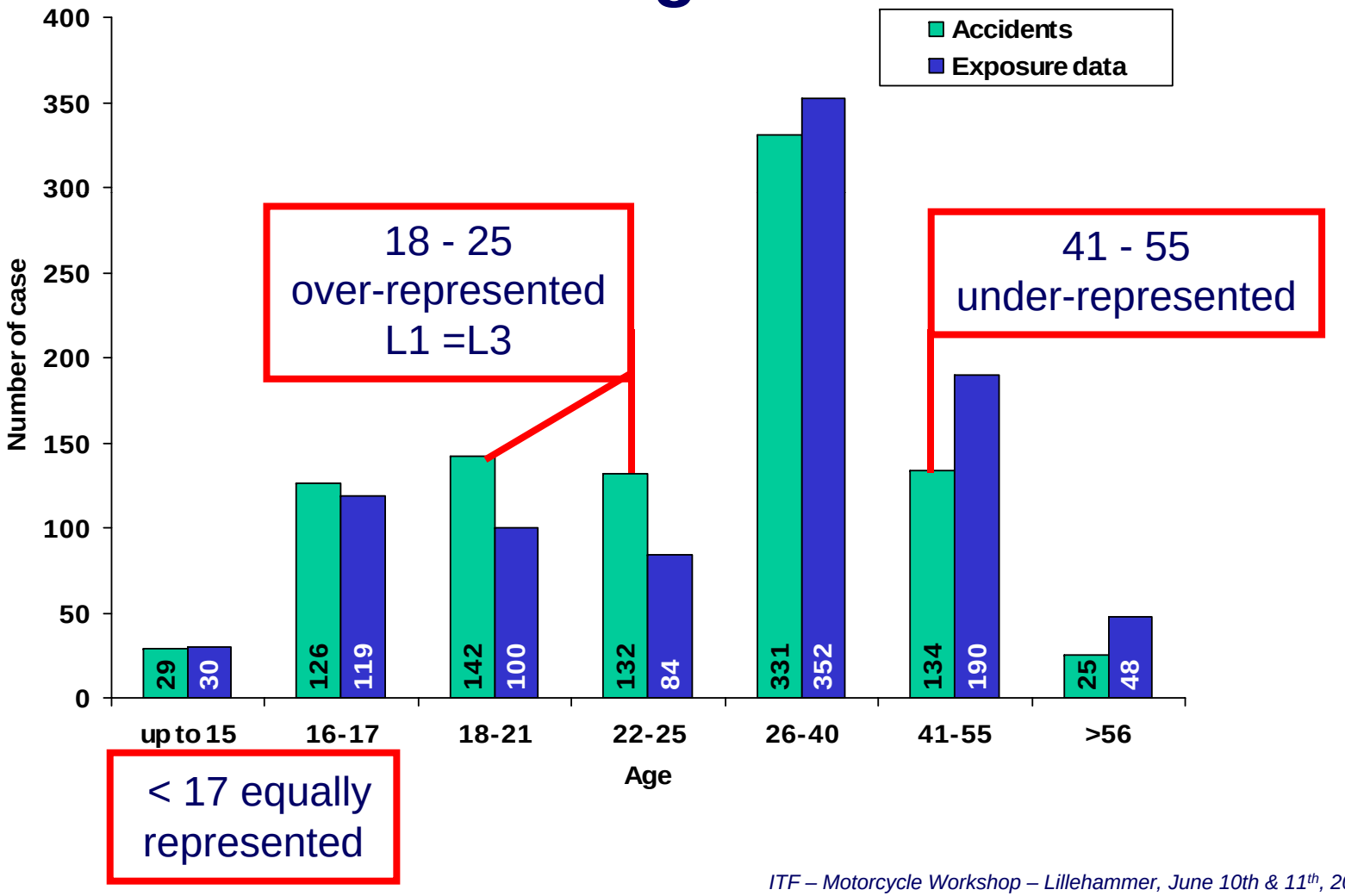
- Alcohol use by the PTW rider: 4% of all cases
  - L1 = 7 %
  - L3 = 3 %

Table 7.9: Alcohol/ drug use by PTW rider

	Accident data		Exposure data	
	Frequency	Percent	Frequency	Percent
None	853	92.6	902	97.8
Alcohol	36	3.9	14	1.5
Drug	5	0.5	2	0.2
Alcohol+drug	2	0.2	2	0.2
Unknown	25	2.7	3	0.3
Total	921	100.0	923	100.0

Note: drug use is defined as the use of illegal, non-prescription drugs (e.g., cocaine).

Rider Age


Accidents
Exposure data
Number of case
400
350
300
250
200
150
100
50
0
29
30
126
119
142
100
132
84
331
352
134
190
25
48
up to 15
16-17
18-21
22-25
26-40
41-55
>56
Age
18 - 25
over-represented
L1 =L3
41 - 55
under-represented
< 17 equally
represented

PTW Rider Licence

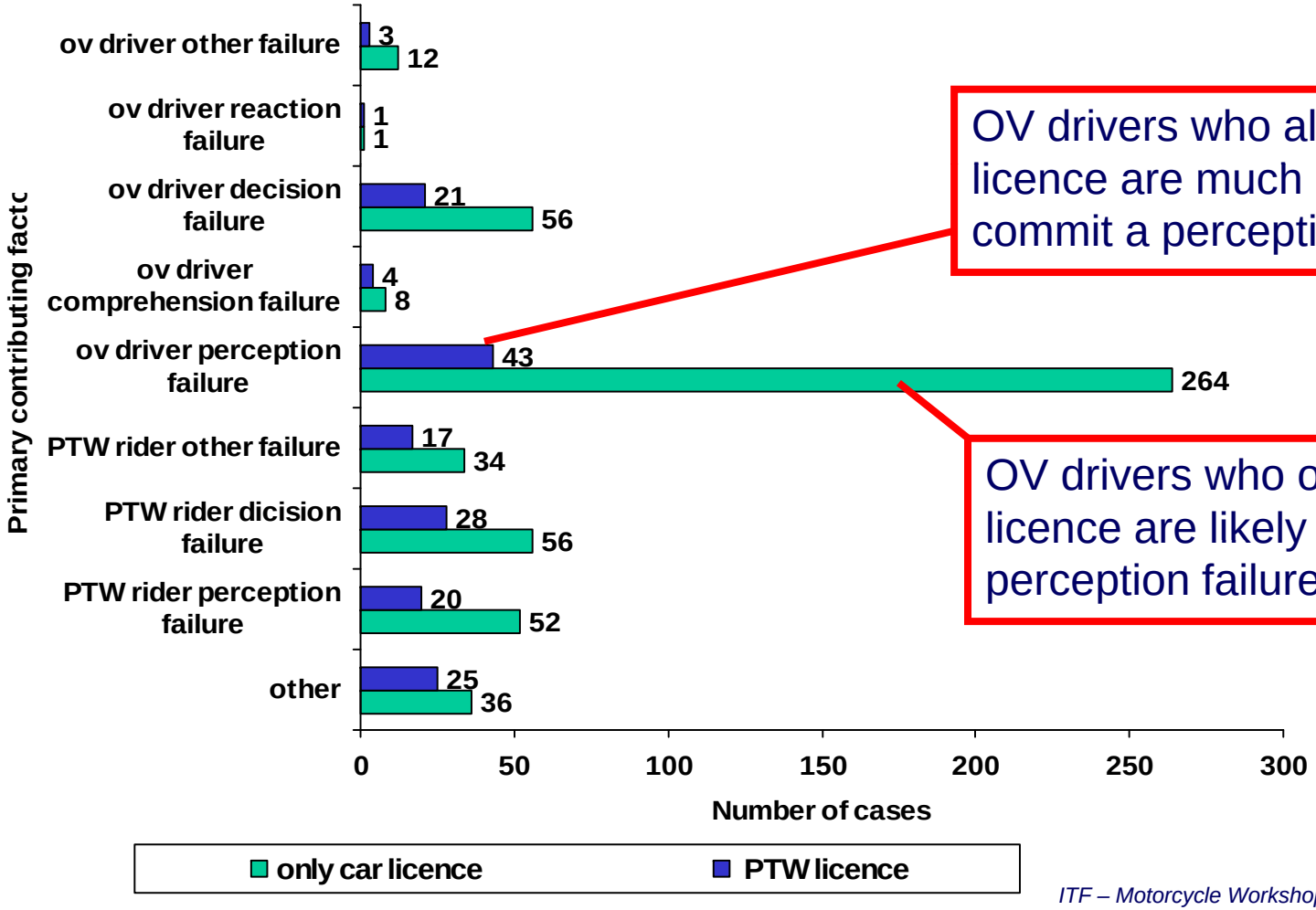
- 5 % without licence (required)!
- 13% with a licence, but for vehicles other than a PTW (equivalence)
- 11 % licence was not required to operate the vehicle (mopeds)

Riders without licence are over-represented

PTW licence qualification

	Accident data		Exposure data	
	Frequency	Percent	Frequency	Percent
None, but licence was required	47	5.1	13	1.4
Learner's permit only	4	0.4	1	0.1
PTW licence	608	66.0	697	75.6
Only licence for OVs other than PTW	125	13.6	125	13.5
Not required	104	11.3	86	9.3
Unknown	33	3.6	1	0.1
Total	921	100.0	923	100.0

Other Vehicle Licence



OV drivers who also have a PTW licence are much less likely to commit a perception failure

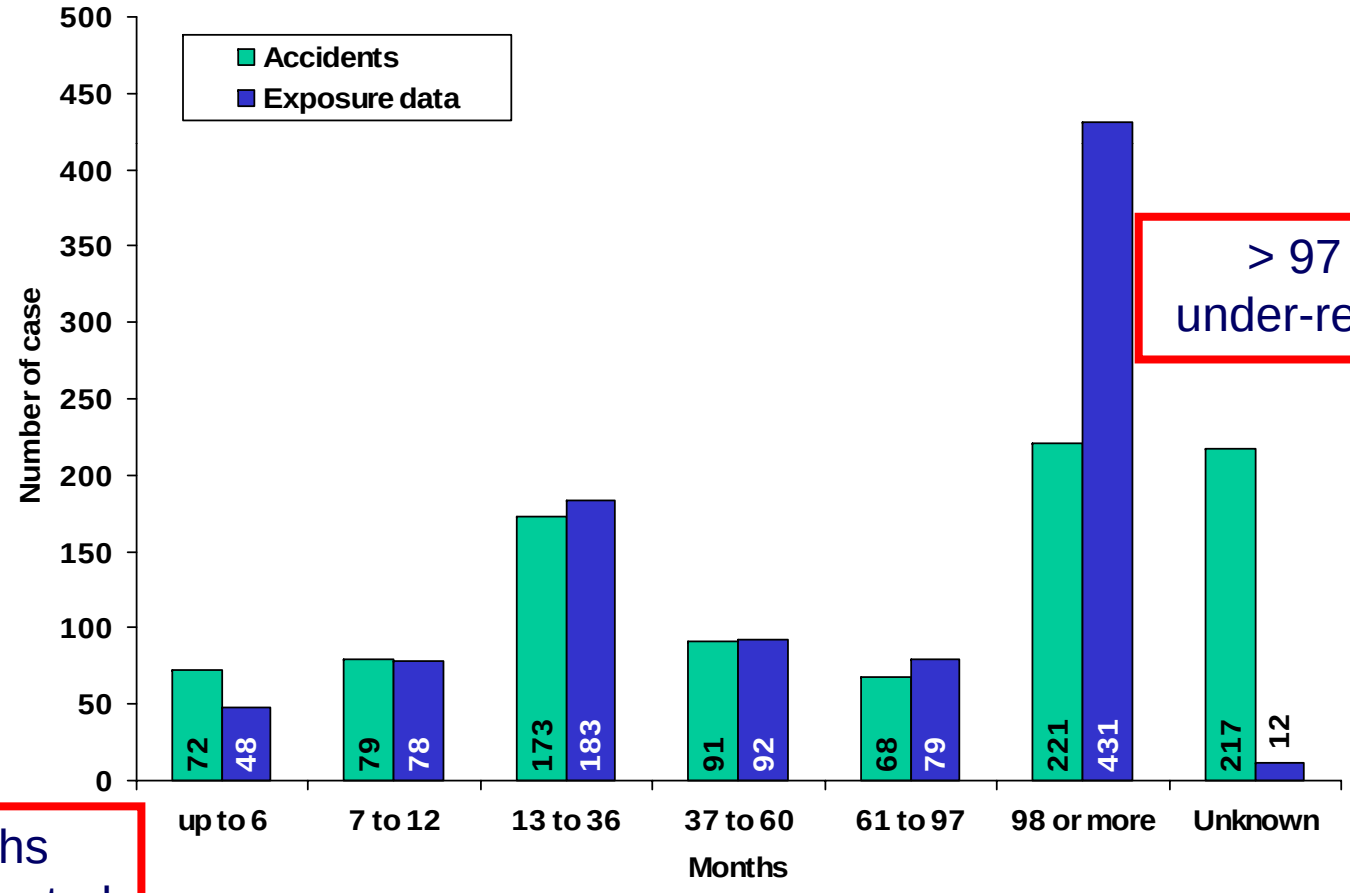
OV drivers who only have a car licence are likely to commit a perception failure

PTW Rider Training

- L1 = 75 % no training
- L3 = 77 % have some pre-license training
  13 % no training

	L1 vehicles		L3 vehicles		Total	
	Frequency	Percent of L1	Frequency	Percent of L3	Frequency	Percent
None	298	74.9	71	13.6	369	40.1
Pre-licence training	35	8.8	404	77.2	439	47.7
Additional training	8	2.0	8	1.5	16	1.7
Other	0.0	0.0	4	0.8	4	0.4
Unknown	57	14.3	36	6.9	93	10.1
Total	398	100.0	523	100.0	921	100.0

Rider Experience on any PTW



> 97 months
under-represented

< 6 months
over-represented

Traffic Control Violation

- PTW riders: 24 % of cases when traffic control present

Traffic control violated by PTW rider	Frequency	Percent
No	235	25.6
Yes	73	7.9
Unknown if traffic control was present or if traffic control was violated	17	1.8
Not applicable, no traffic control present	596	64.7
Total	921	100.0

- OV drivers: 41 % of cases when traffic control was present

Content

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  - Collision dynamics
  - Injuries

Collision Avoidance

- No manoeuvre: 27 %
- Braking and swerving 65 % (Directive 2000/56)
  - L1 = 52 %
  - L3 = 70 %

Collision avoidance performed by PTW rider	Frequency	Percent
No collision avoidance attempted	362	26.9
Braking	664	49.3
Swerve	218	16.2
Accelerating	17	1.3
Use of horn, flashing headlamp	18	1.3
Drag feet, jump from PTW	9	0.7
Other	32	2.4
Unknown	26	1.9
Total	1346	100.0

Loss of Control

- No loss of control: 68 % of all cases
- Loss of control: 31 %
  - L1 = 16 %
  - L3 = 44 %

- Loss of control mostly related to braking 13 % of all cases (41 % of all cases involving loss of control)

- Single accidents
  - The most frequent: running off the roadway : 23%

Reason for failed Collision Avoidance Action

- Inadequate time available
  - PTW: 32 %
  - OV: 21 %

Reason for failed collision avoidance	PTW rider		OV driver	
	Frequency	Percent	Frequency	Percent
Decision failure, wrong choice of evasive action	69	7.5	26	3.4
Reaction failure, poor execution of evasive action	41	4.5	9	1.2
Inadequate time available to complete avoidance action	297	32.2	164	21.1
Loss of control in attempting collision avoidance	129	14.0	3	0.4
Other	6	0.7	6	0.8
Not applicable, no OV or no evasive action taken	362	39.3	545	70.1
Unknown	17	1.8	25	3.2
Total	921	100.0	778	100.0

Unusual Travelling Speed

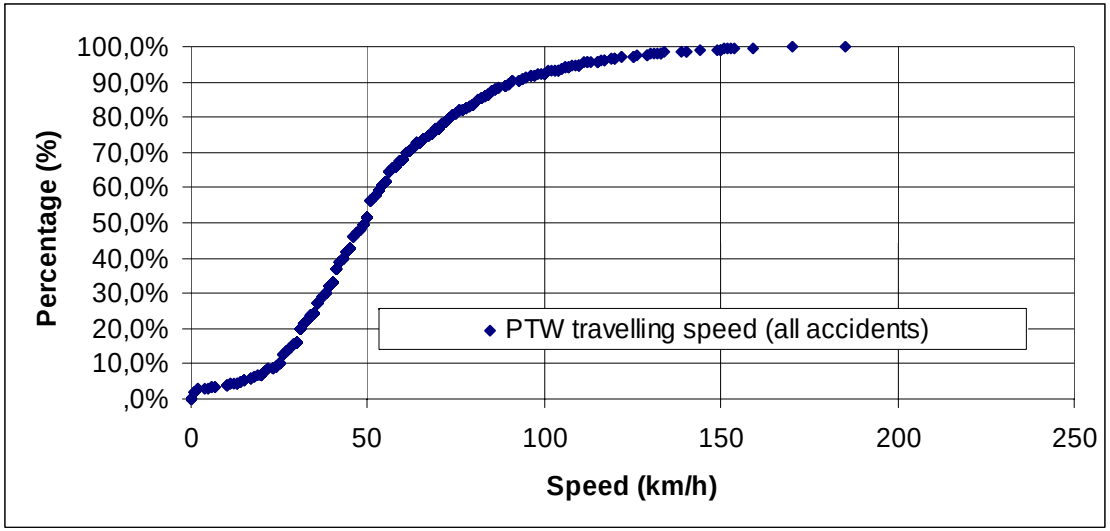
- PTW 18 %
  - L1 = 14 %
  - L3 = 21 %
- OV 5 %

Speed compared to surrounding traffic (PTW)

	L1 vehicles		L3 vehicles		Total	
	Frequency	Percent of L1	Frequency	Percent of L3	Frequency	Percent
Speed unusual but no contribution	35	8.8	39	7.5	74	8.1
Speed difference contributed to accident	57	14.3	109	20.8	166	18.0
No unusual speed or no other traffic (not applicable)	305	76.6	375	71.7	680	73.8
Unknown	1	0.3	0	0.0	1	0.1
Total	398	100.0	523	100.0	921	100.0

PTW Travelling Speed

- Median travelling speed: 49 km/h
- Fatal cases: 70 % with travelling speed >60 km/h
- Speed range: between 0 km/h and 185 km/h



PTW Impact Speed

- 75% of PTW crashes occurred below 51 km/h
  - L1 = 95 % below 50 km/h
  - L3 = 62 % below 50 km/h
- 5% of impacts over 99 km/h
- Fatal cases
  - 32 % between 30 – 50 km/h
  - 50 % > 60 km/h

PTW impact speed (all accidents)

	Frequency	Percent
0 km/h	14	1.5
10 km/h	44	4.8
20 km/h	124	13.4
30 km/h	194	21.1
40 km/h	185	20.1
50 km/h	128	13.9
60 km/h	70	7.6
70 km/h	45	4.9
80 km/h	40	4.3
90 km/h	25	2.7
100 km/h or higher	50	5.4
Unknown	2	0.2
Total	921	100.0

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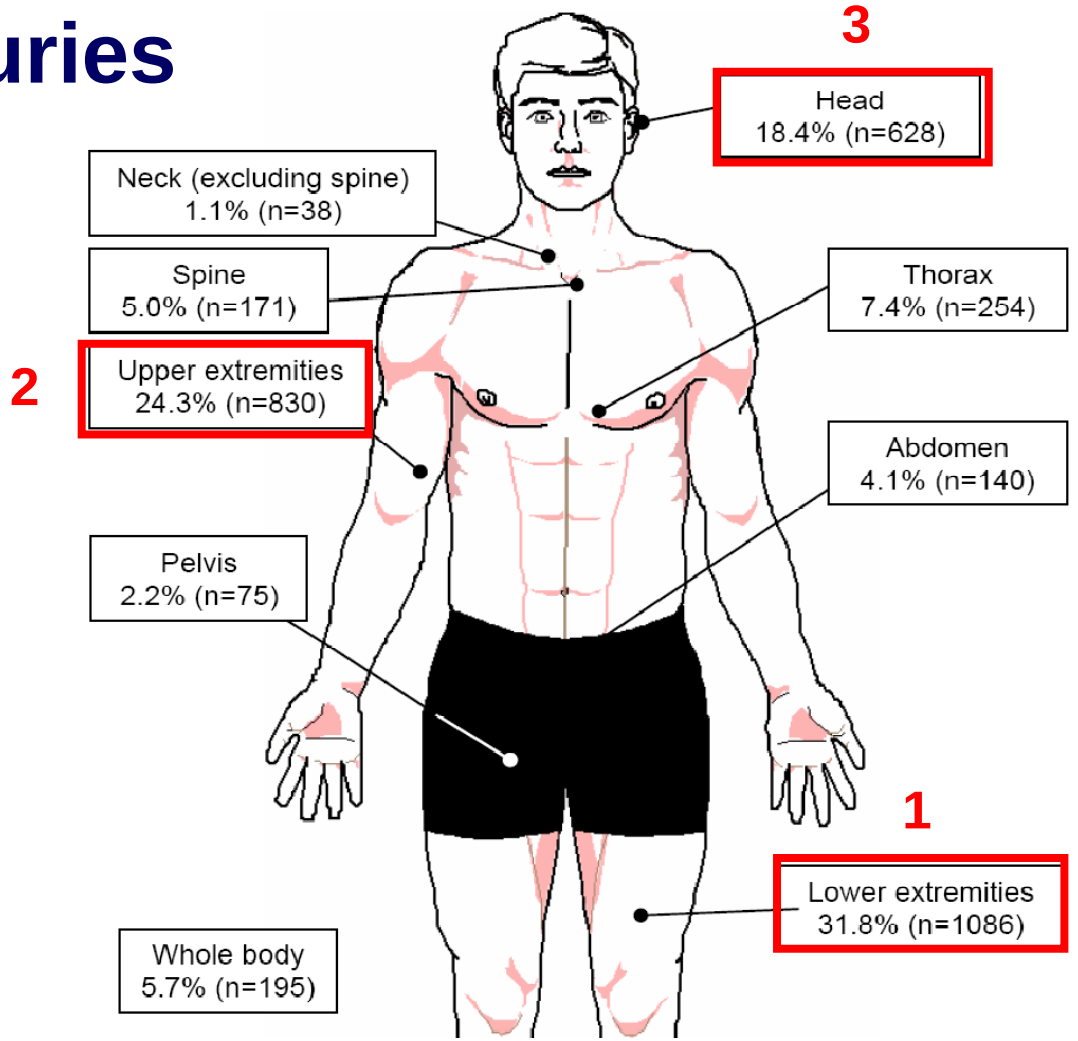
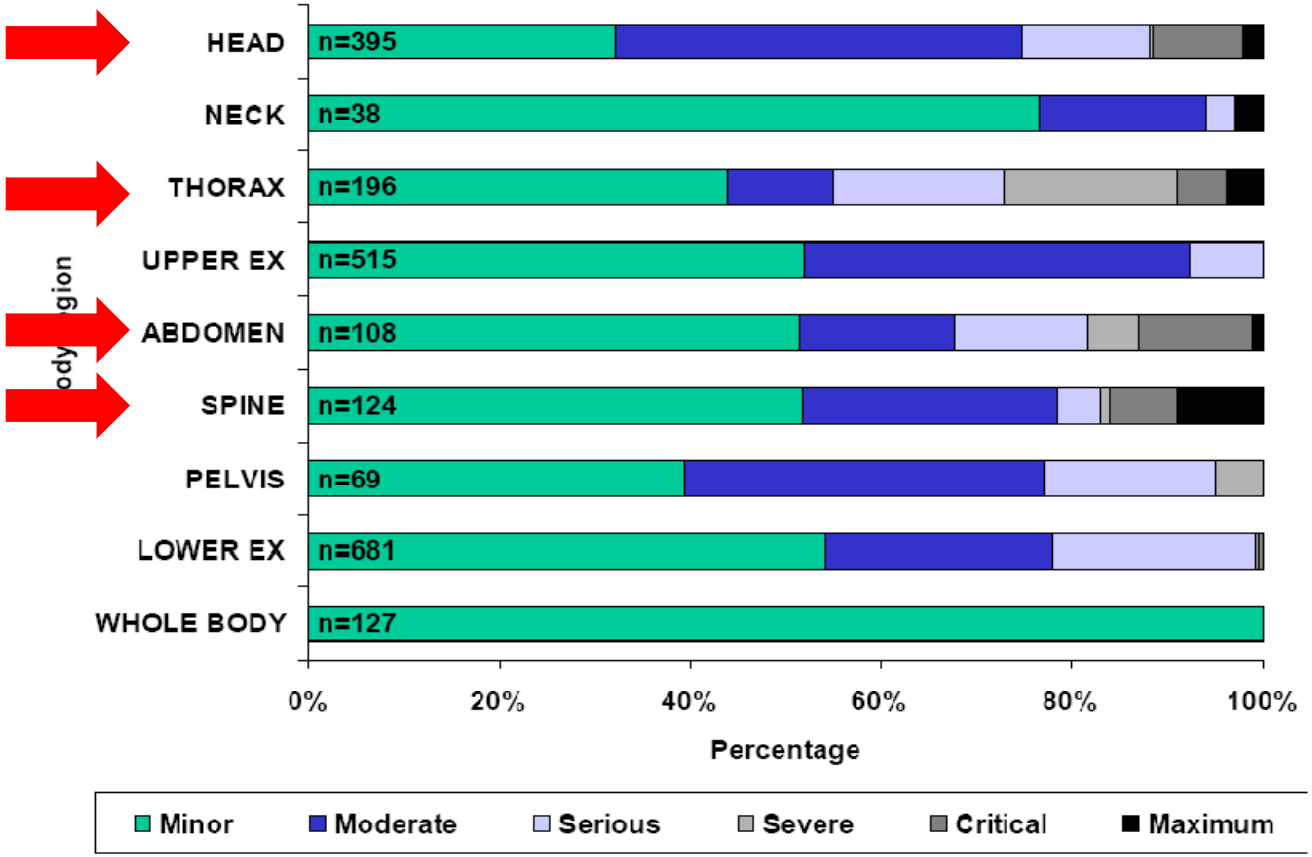
Injuries

- 921 accidents
- 3417 injuries



Relative Injury Severity per Body Region

- Body regions affected by the most severe injuries



Helmet Wearing

- L1 = 80 % (Evolving regulation in IT)
- L3 = 99 %

	L1 vehicles		L3 vehicles		Total	
	Frequency	Percent of L1	Frequency	Percent of L3	Frequency	Percent
No	69	17.3	4	0.8	73	7.9
Yes	317	79.7	516	98.6	833	90.5
Unknown	12	3.0	3	0.6	15	1.6
Total	398	100.0	523	100.0	921	100.0

Helmet Effect

- Positive 69 % (95 % / helmet worn and contact in region)
- No effect 4 %

	Frequency	Percent
No helmet present, injury to head occurred	62	6.7
Helmet worn, but no effect on head injury	33	3.6
Yes, coverage present and reduced injury	306	33.2
Yes, coverage present and prevented injury	327	35.5
No injury producing contact in region	152	16.5
Other	4	0.4
Unknown	37	4.1
Total	921	100.0

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- Main features
- Main figures

MAIDS highlights

Discussion / What does MAIDS tell us?

Discussion / What does MAIDS tell us?

- Human factors are predominant in accident causations
  - Perception failures from OV drivers
  - Decision and perception failures from PTW riders
  - Additional accident contributing factors from PTW riders

- Environmental factors
  - Are more worsening than contributing factors (excluding weather cond.)
  - An entry to engage with national/local authorities in PTW integration
  - Can potentially help riders and drivers (better decision, better perception)

- Vehicles factors
  - Marginal accident causation linked to maintenance defect
  - Can potentially help drivers to better perceive
  - Can potentially help riders (avoidance)


Thank you!
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MAIDS
In-Depth investigation of motorcycle accidents