



# **SAFER CAR FRONTS FOR PEDESTRIANS AND CYCLISTS**

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# European Transport Safety Council

## Aims:

- **Provide impartial transport safety advice to policymakers and politicians in the EU**
- **Increase the awareness of transport accidents and their consequences**
- **Identify and promote research-based solutions with high safety potential**

# Reducing vulnerable road user injury

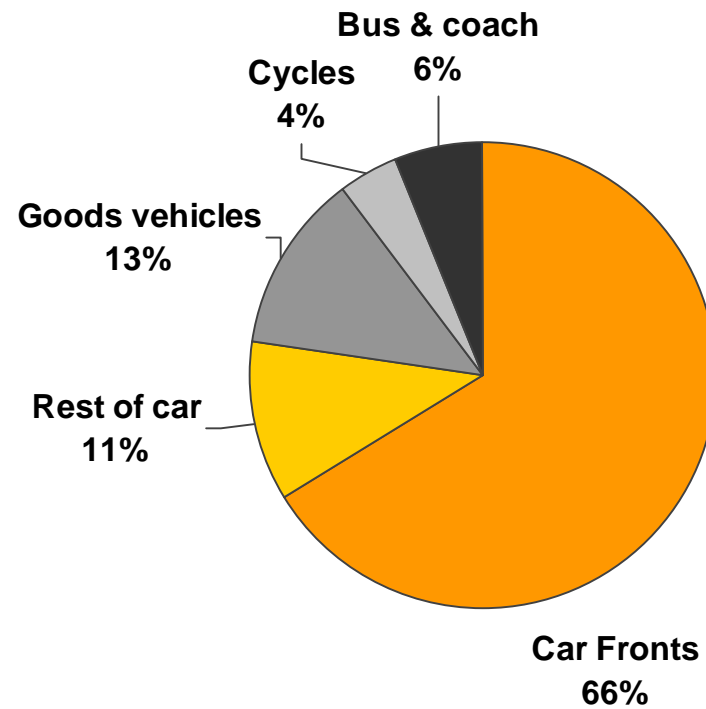
- **20% of all EU road user fatalities are pedestrians and cyclists**
- **The risk of road death is around 7-8 times higher for these users than for car occupants**
- **All parts of the traffic system safety need to be addressed, but changes in car design are the most important EU action**

# EU Pedestrian and Cyclist Casualties (1998)

	<b>Fatal</b>	<b>Serious*</b>
<b>Pedestrians</b>	<b>6618</b>	<b>91997</b>
<b>Cyclists</b>	<b>2289</b>	<b>90813</b>
<b>Total</b>	<b>8907</b>	<b>182810</b>

\*based on IRTAD data and including estimates for under-reporting

# Vehicles Involved in Pedestrian Deaths



UK data

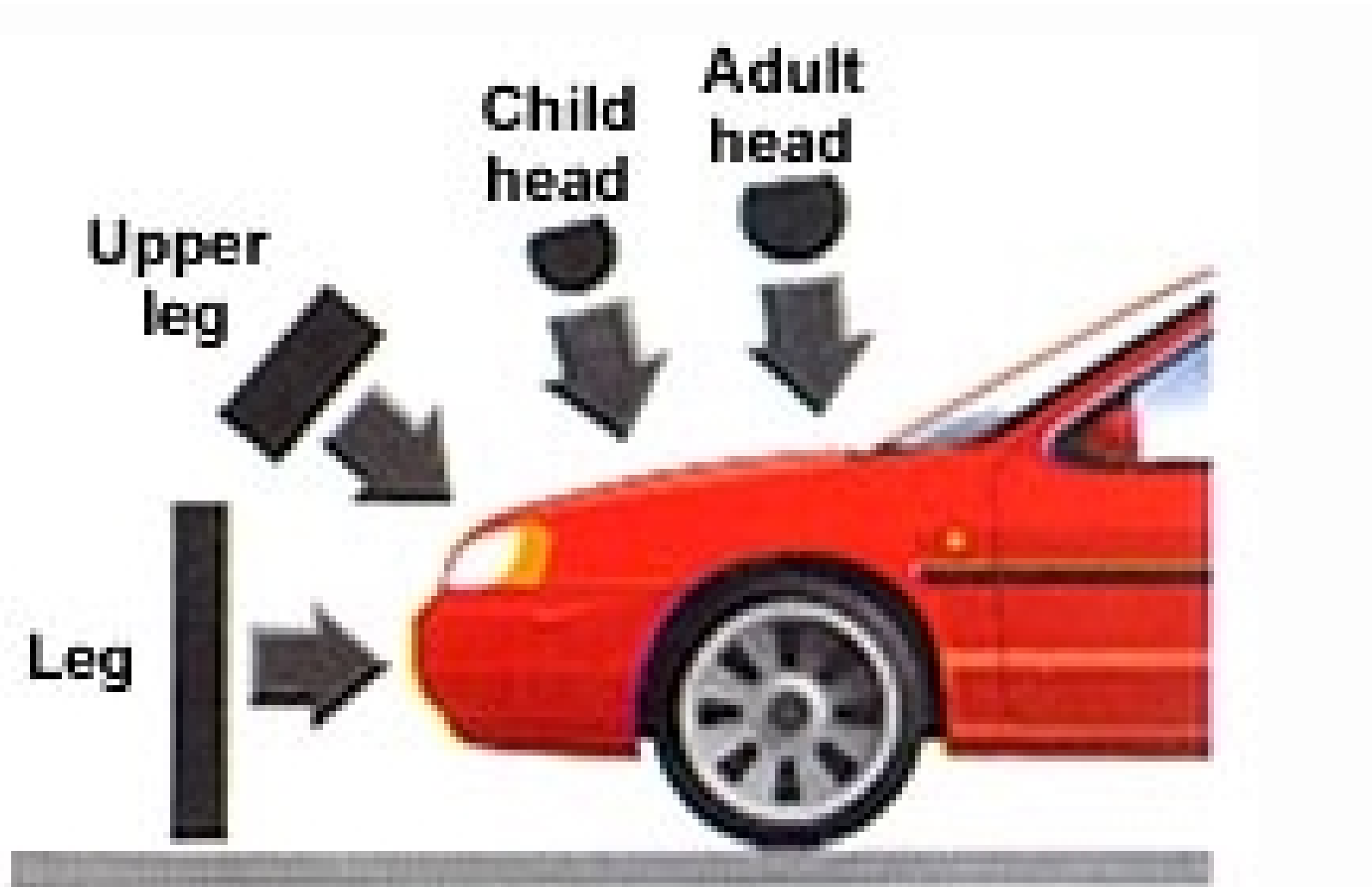
# Fatal Injuries

- **Accident statistics show the most frequent causes of fatal injuries are impacts between:**
- **The head and the bonnet top, scuttle and windscreen frame**
- **The bonnet edge and the pelvis or the abdomen of adults, or the chest or head for small children**

# **Serious Injuries**

**Accident statistics show the most frequent causes of serious injuries are impacts between:**

- The head and the bonnet top, scuttle and windscreen frame**
- The bumper and the legs**
- The bonnet edge and the upper leg or pelvis of adults, the abdomen or chest of children or the head of small children**



## EEVC Pedestrian Sub-System Tests

# Savings for the Big Five

Annual	Current % of Potential	
	EU Deaths	Lives Saved
Germany	19%	347
France	15.5%	324
Italy	14%	267
Spain	12.5%	302
UK	12.5%	290

# EEVC WG17 Test Procedures

**Potential Savings:**

**20% of Pedestrian and Cyclist  
Deaths and Serious Injuries**

**→ up to 2100 deaths**

**→ up to 18000 serious injuries**

# ACEA and JRC Proposals

- **Provide less than 50% of the savings obtained from the EEVC WG17 proposals**

# JRC Evaluation

**“...not previously involved in such work”**

- **Excessive reliance on “non-independent” ACEA data**  
**ACEA - four meetings + written comments**
- **Limited understanding of EEVC’s “independent” activities and data**  
**EEVC - one meeting + report**

**Most EEVC data appears to be ignored**



# Previous ACEA Positions

## Side Impact

CTP - almost ready and validated  
reduced barrier ground clearance  
Requirements impossible to meet

## Frontal Impact

30° ASD test - ready earlier and validated

## EuroNCAP

64km/h frontal test impossible to meet  
Will put many manufacturers out of business

**ALL PROVED TO BE WRONG**

## JRC - General Statement 2

“... neither ACEA nor EEVC performed a feasibility study...”



**ESV 1985 - Demonstration Pedestrian Safety  
Car**

## **JRC - Original General Statement 3**

**“... no extensive studies and data available in the EEVC WG17 work on the global kinetics of pedestrians.”**

**“... makes uncertain the level of protection ... secondary impact on the ground.”**

**EEVC accident analyses and cost/benefit analysis took account of injuries from ground contact**

## **JRC - General Statement 3**

**“... WG17 ... mandate ... sub-system tests as opposed to ... dummy based test methods.”**

**“... reflects the testing and especially numerical modelling capabilities existing in the eighties.”**

**“... current testing and numerical modelling developments should allow reconsidering this statement of the mandate in future work**

# Dummy Testing

- No pedestrian dummies
- Impossible to control head impact point  
Honda - Standing, Padded Hybrid III  
TRL - Standing OPAT (adult and child)



# Numerical Modelling

**Used for development by WG10 and WG17**

- **Lumped Parameter**
- **Finite Element**

**Problems in using modelling for legislation**

- **Information availability**
- **Validation**
- **Engineering judgement**

# Wrap Around Distance

“... assumption that the WAD is roughly equal to the height of the impacted pedestrian.”

EEVC took into account of pedestrian slip up the bonnet

Based on ACEA supplied data:

“ a pedestrian of a height of 1500 mm ... obtains a WAD equal to 1815 mm.”

EEVC child pedestrian - 1500 mm WAD

# Head Impact Test Speed

**“... limited material made available to the evaluation team by ACEA tends to prove ... impact speed of the head ...remains lower than the vehicle velocity.”**

- **JRC proposal**
  - **35 km/h test speed**
- **ACEA would like a lower test speed**

# Head Impact Test Speed

**EEVC Research**

**Impact speed in range 0.8-1.4 times car speed**

**Due to support of cadaver arm on bonnet**



**Dummy testing gave ~ 40 km/h head impact speed**

# Child Head Mass

**“... the difference between real and effective masses is not well established . ... a mass of 3.5 kg can be considered as acceptable since it is in accordance with similar ISO recommendations.”**

## **EEVC Proposal**

- **Mass adjusted from 3.5 kg to 2.5 Kg**
  - **Reduced due to forces on body from the bonnet leading edge**

# Effect of Head Mass Change

## Increased Child Head Mass

- Increases bonnet deflection
- Reduces brain acceleration

## Reduced Adult Head Mass

- Reduces bonnet deflection
- Reduces 'bottoming out' on stiff underlying structures

# Child Head Performance

**JRC / ACEA arbitrarily propose :**

- **2/3 of the area @ HIC 1000**
- **1/3 of the area @ HIC 2000**

**Free choice of area**

**ie Strips around hard stops**

**Risk of life-threatening brain injury (Mertz)**

- **HIC 1000 < 20 %**
- **HIC 2000 ~ 90 %**

# Adult Head Test

## JRC Proposal

- ‘monitoring test’ against windscreen
  - Windscreen poses little risk
  - Windscreen pillars very stiff

## EEVC Proposal

- Adult tests on bonnet based on Wrap Around Distance

# Lower Leg v Bumper

**Two main injury types**

**Knee Joint Injury - Severe - Long term disability**

- **Knee bending**
- **Knee shear**
- **Tibia / Fibula fracture - Moderate - Reversible**
  - **Tibia acceleration**

# Knee Bending Angle

## JRC Proposal

- 21°

## EEVC Proposal

- 15° @ 460 Nm

## Biomechanical data (Kaizer et al)

Ligament failure first 14.6° (SD 0.2°) @ 284 Nm

Fracture first 16.4° (SD 4.4°) @ 351 Nm

All bending angles < 21° except one

# **Acceleration - Influence on Knee**

**Current cars generate high tibia acceleration**

- **Tibia / Fibula fracture**
- **Low knee bending**

**Reducing Tibia Acceleration with inadequate control of knee bending**

- **Reduce Tibia / Fibula fractures**
- **Increase knee joint injuries**

**INCREASE IN SEVERE IRREVERSIBLE INJURIES**

# Bonnet Leading Edge Test

## JRC View

**“... relevance and necessity ... not yet fully asserted.”**

**“ ... the impactor is guided seems to affect the physical representativeness of the test.”**

## JRC Proposal

**Simply monitor and record**

# Bonnet Leading Edge Test

- Important source of fatal and serious injuries
- Future styling may lead to more aggressive BLE
- BLE forces reduce knee bending in the bumper test
- Manufacturers take advantage of un-instrumented load paths eg. side impact experiences



# Active Safety - Accident Avoidance

**Pedestrian detection and vehicle braking ?**

- **Hijack danger**
- **Children playing “chicken”**

# Conclusions

## EEVC WG17 Proposals

- **Best research proposals available**
- **Following > 25 years research**
- **Integrated - all tests are necessary**
- **Developed by independent researchers**
- **Car industry input**

# Conclusion

## ACEA Proposals

- **ALL less demanding**
- **ALL provide reduced safety**

## Repeat of history

- **Frontal impact**
- **Side impact**
- **EuroNCAP**

# Conclusions

## JRC Proposals

- **Too reliant on industry advice**
- **Limited understanding of background**
- **Selective use of data**
- **Unscientific**

# **Voluntary Agreement v Legislation**

- **ACEA and JRC proposals are far from providing for an acceptable level of protection**
- **Some proposals may guide car design in a dangerous way**
- **ACEA has probably too far to move to make their voluntary agreement proposal acceptable**
- **Agreement necessary with all non-ACEA manufacturers**
- **Legislation can be as soon as voluntary agreement**

# Production Honda Civic



Pedestrian-friendly cars nearly here