FI-07-02

Frontal Impact Protection

German Accident Data Analysis II

Geneva 7.12.2009

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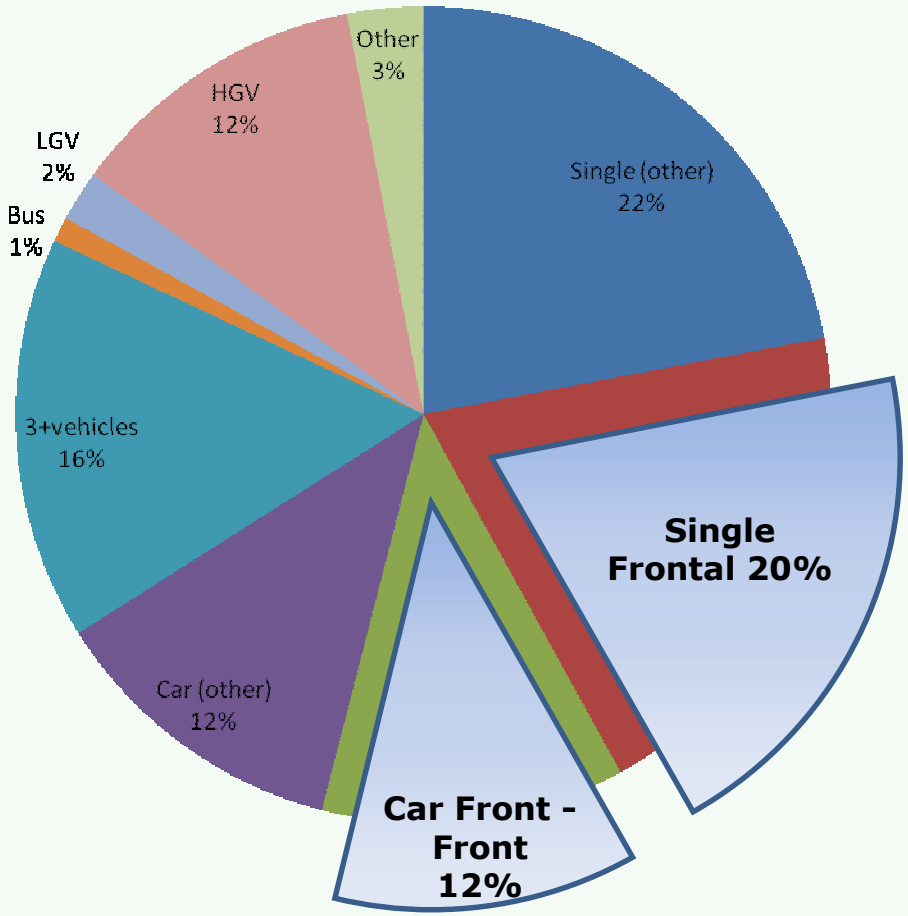
What are we talking about ....?

Car Occupant Fatalities 2008



What can we see....?

- ***Single Car*** is first (42%)

Single Frontal is a big subgroup (20%)

- ***Car to Car*** is second (24%)

Front – Front is a big subgroup (12%)

Last presentation Car to Car col.

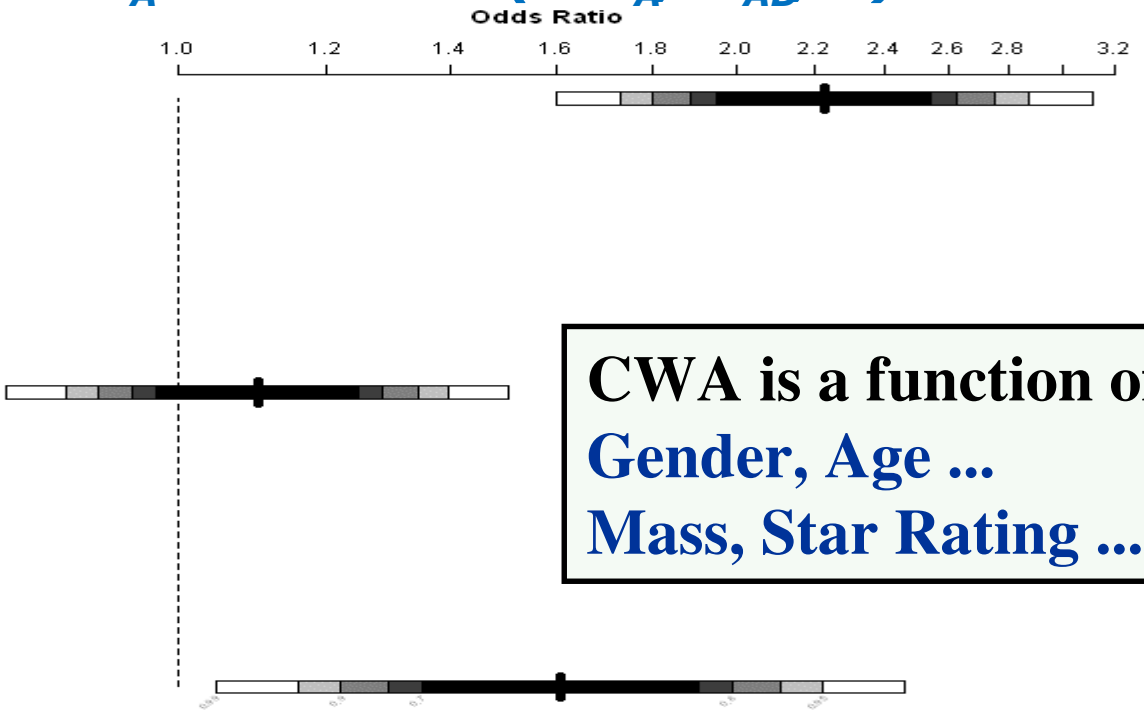
- It does not depend so much on what car you are sitting in
- It depends more on which car you are hitting

Injury Risk $_A$ = function (CW_A, D_{AB}, S)

Partner Prot. D_{AB}

Self Prot. CW_A

Accident Sev. S

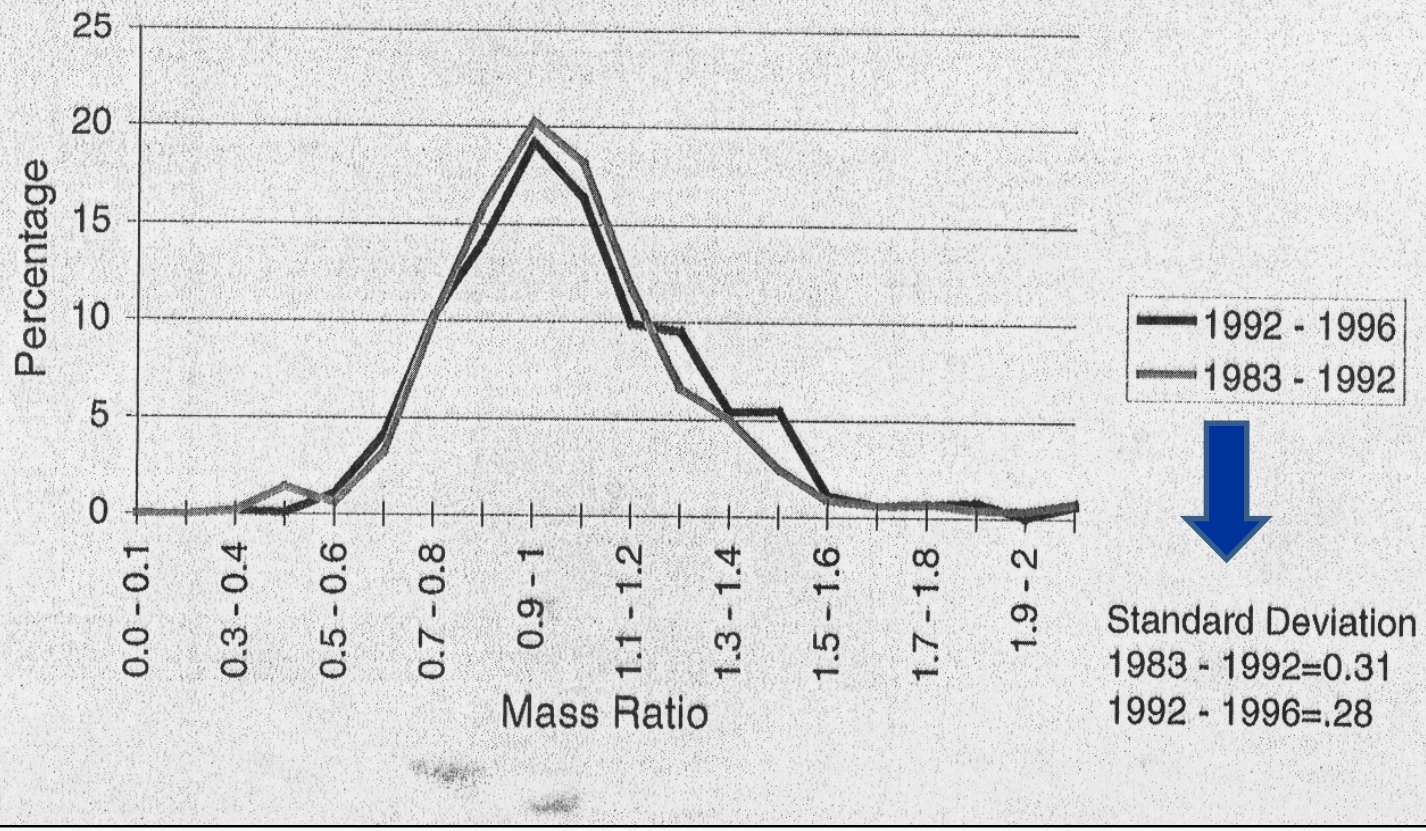


CWA is a function of
Gender, Age ...
Mass, Star Rating ...

So, what cars do we hit ?

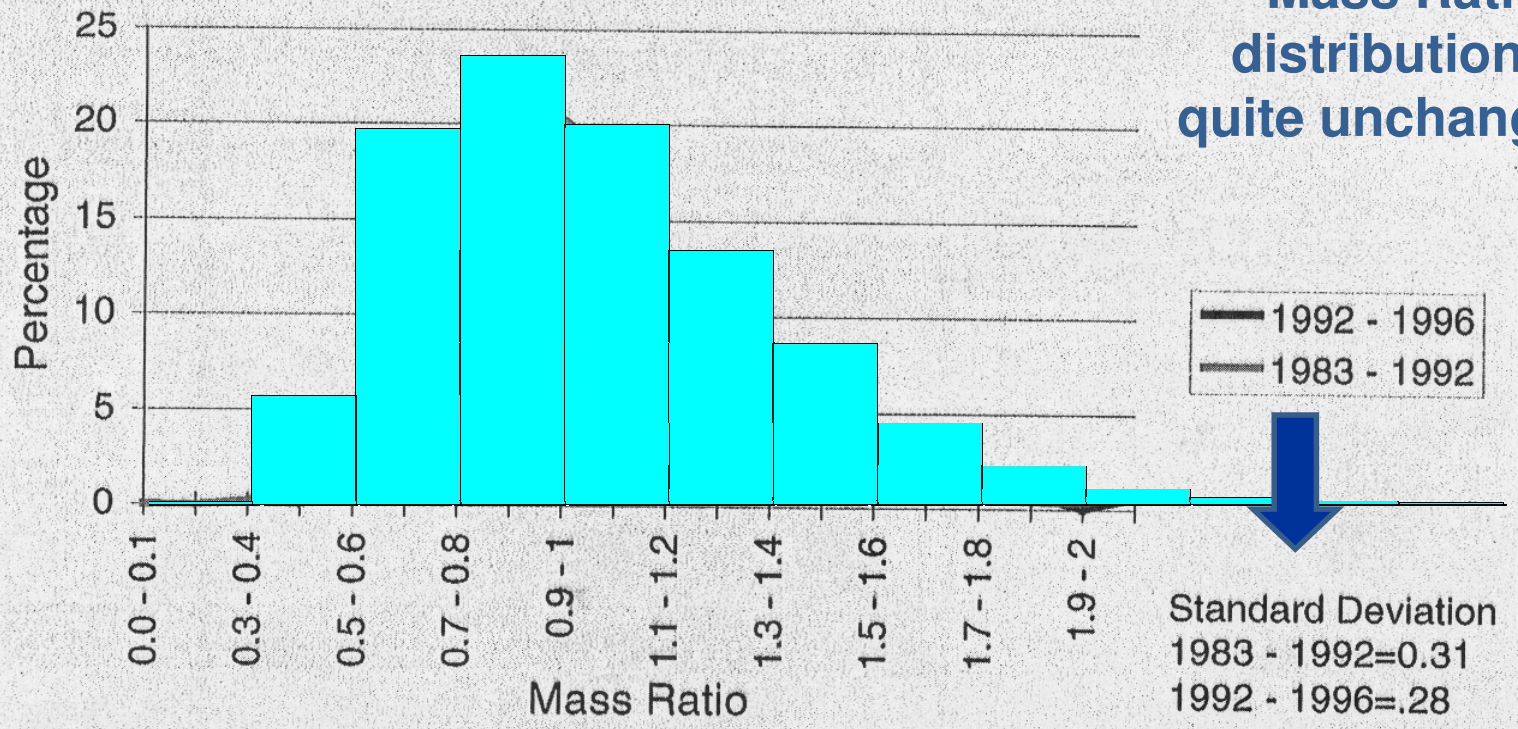
Mass Ratio Distribution in Crashes

1983 -1996



Mass Ratio Distribution in Crashes 1983 -1996

P. Thomas, R. Frampton
1998 / Dearborn

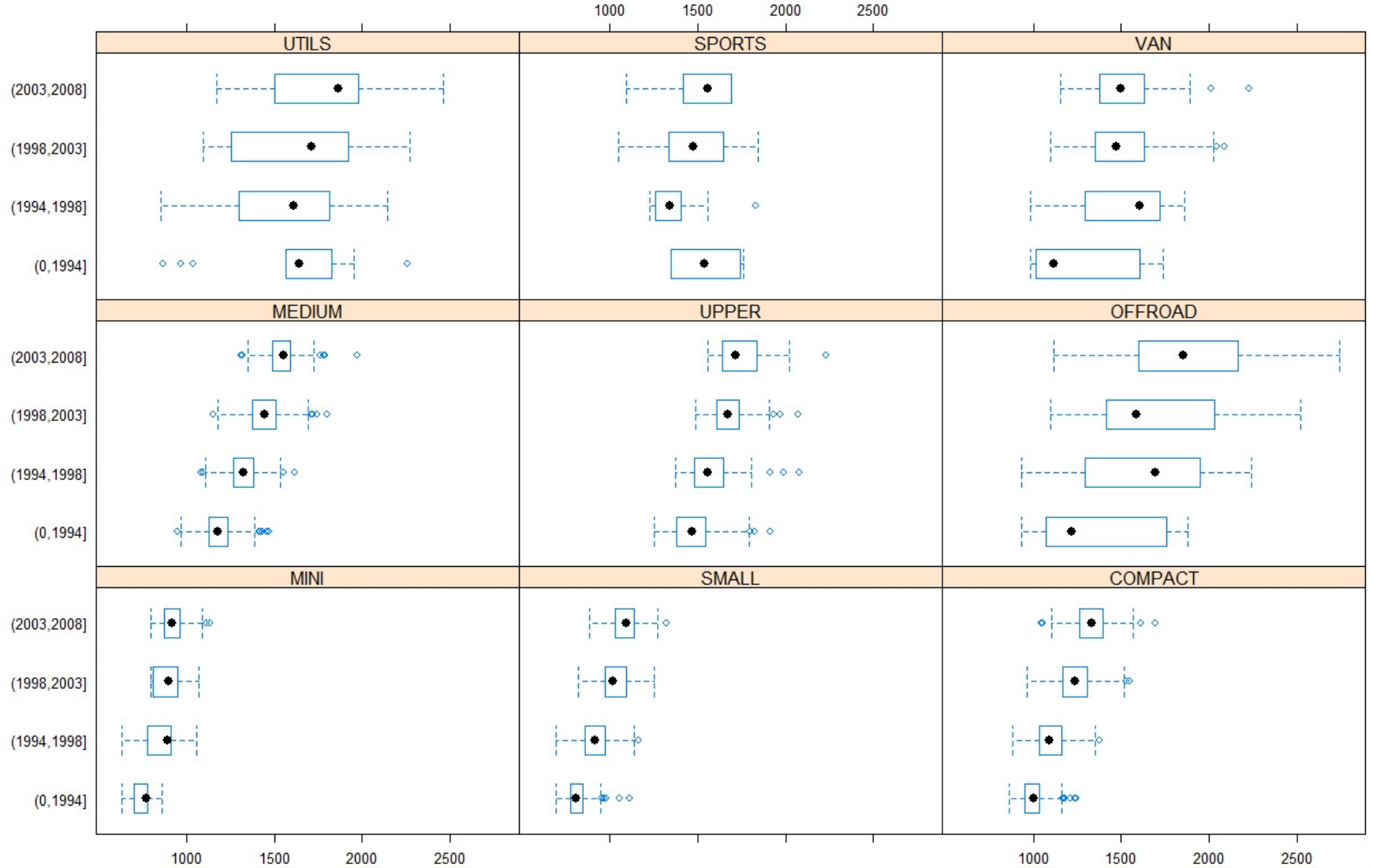


Mass Ratio distribution is quite unchanged !

Standard Deviation
1983 - 1992=0.31
1992 - 1996=.28

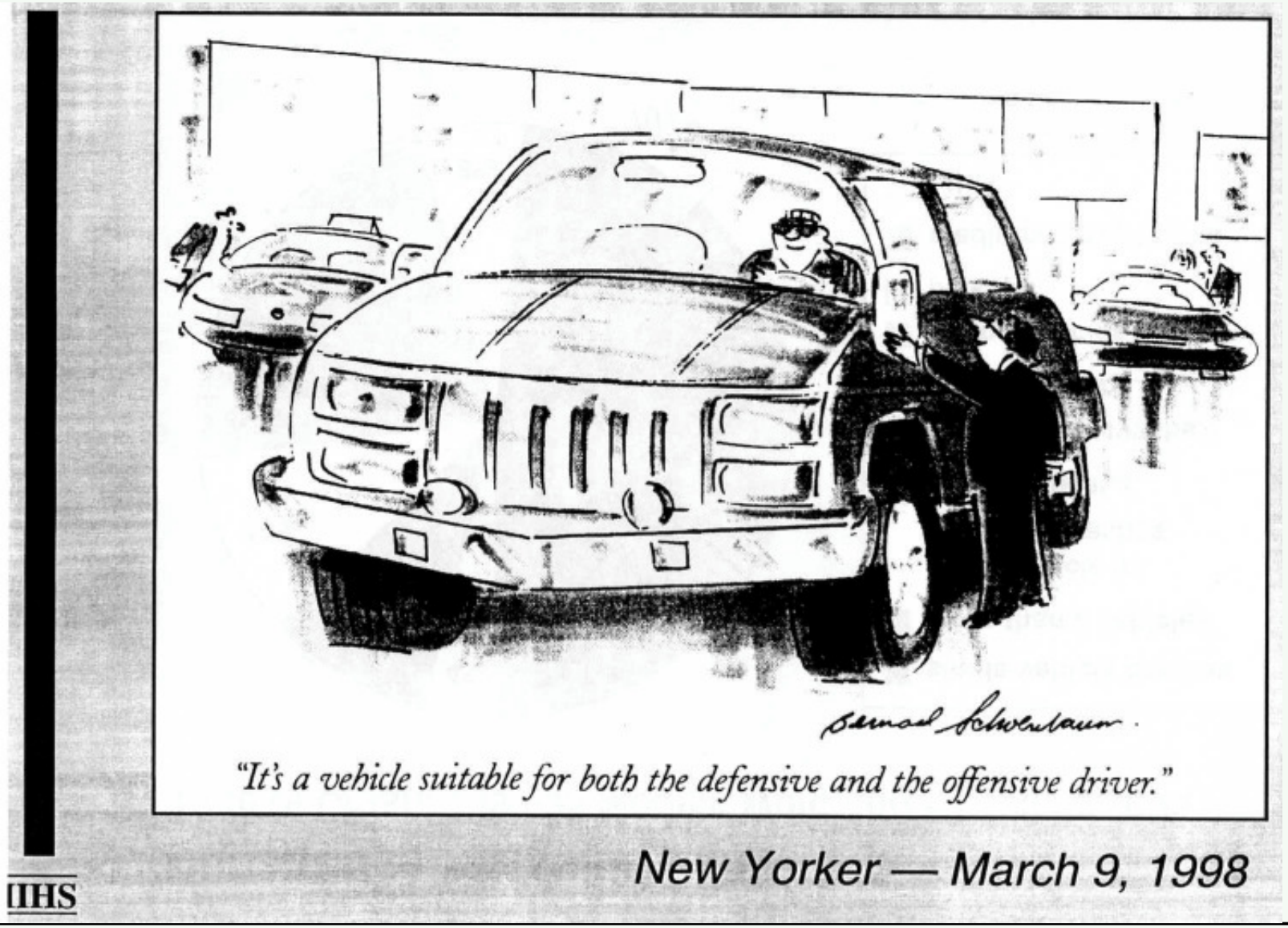
2005 – 2008 = 0.36

Masses of crashed vehicles

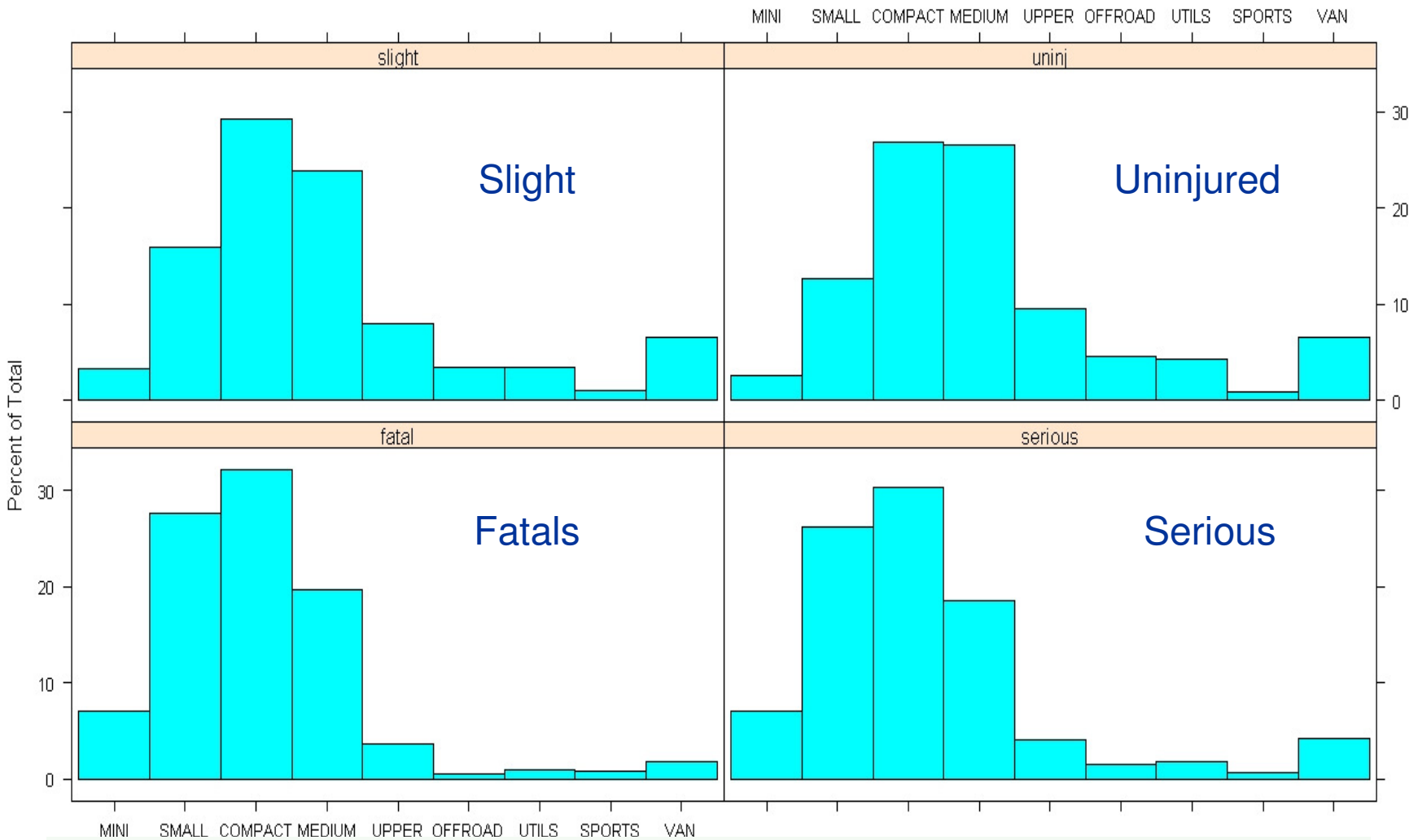


All Segments became more massive, keeping geometric size similar

Do we have a problem with big cars?

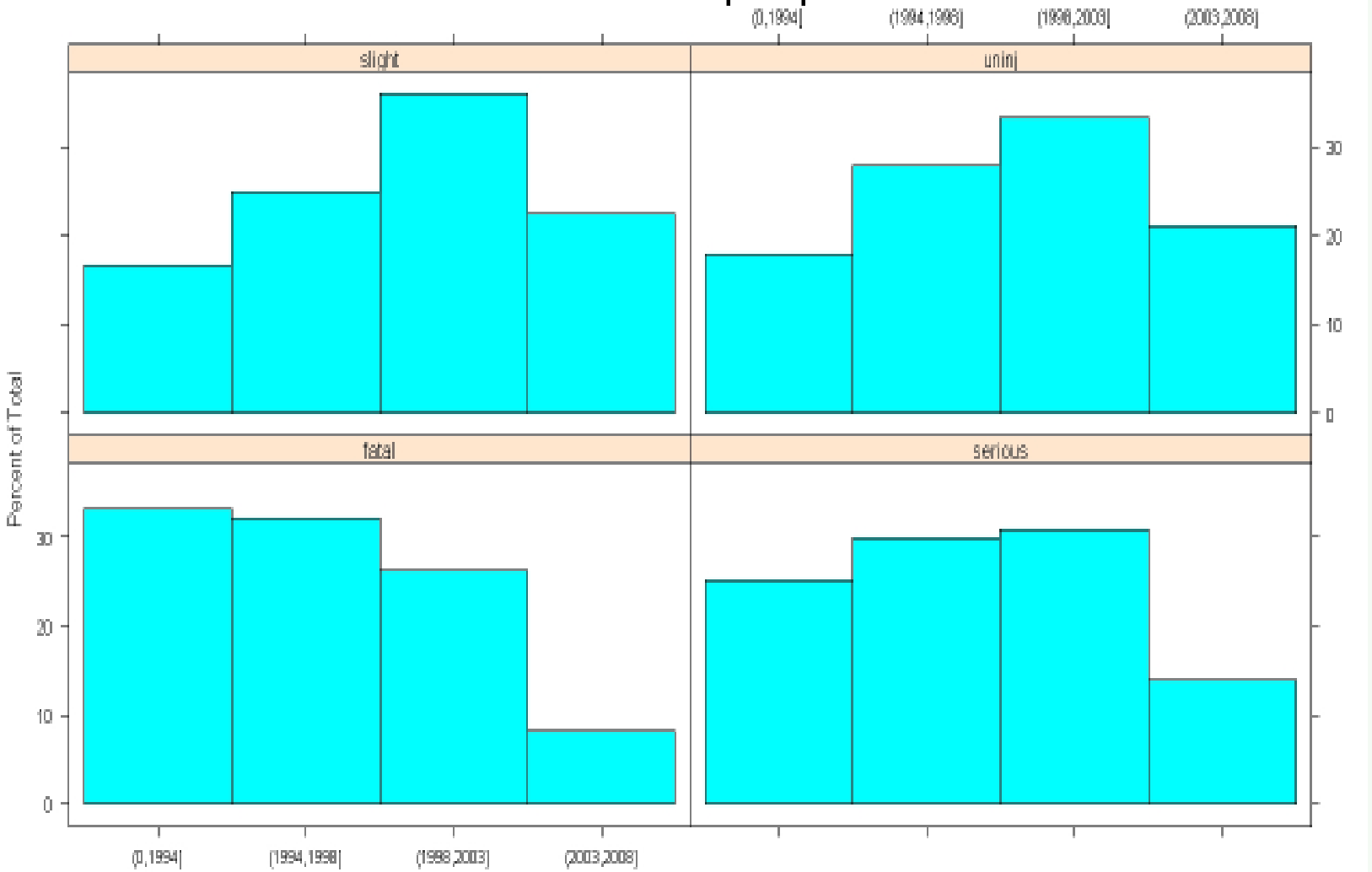


In which cars do people die?



We have a problem with Compact, Small and Mini Cars!

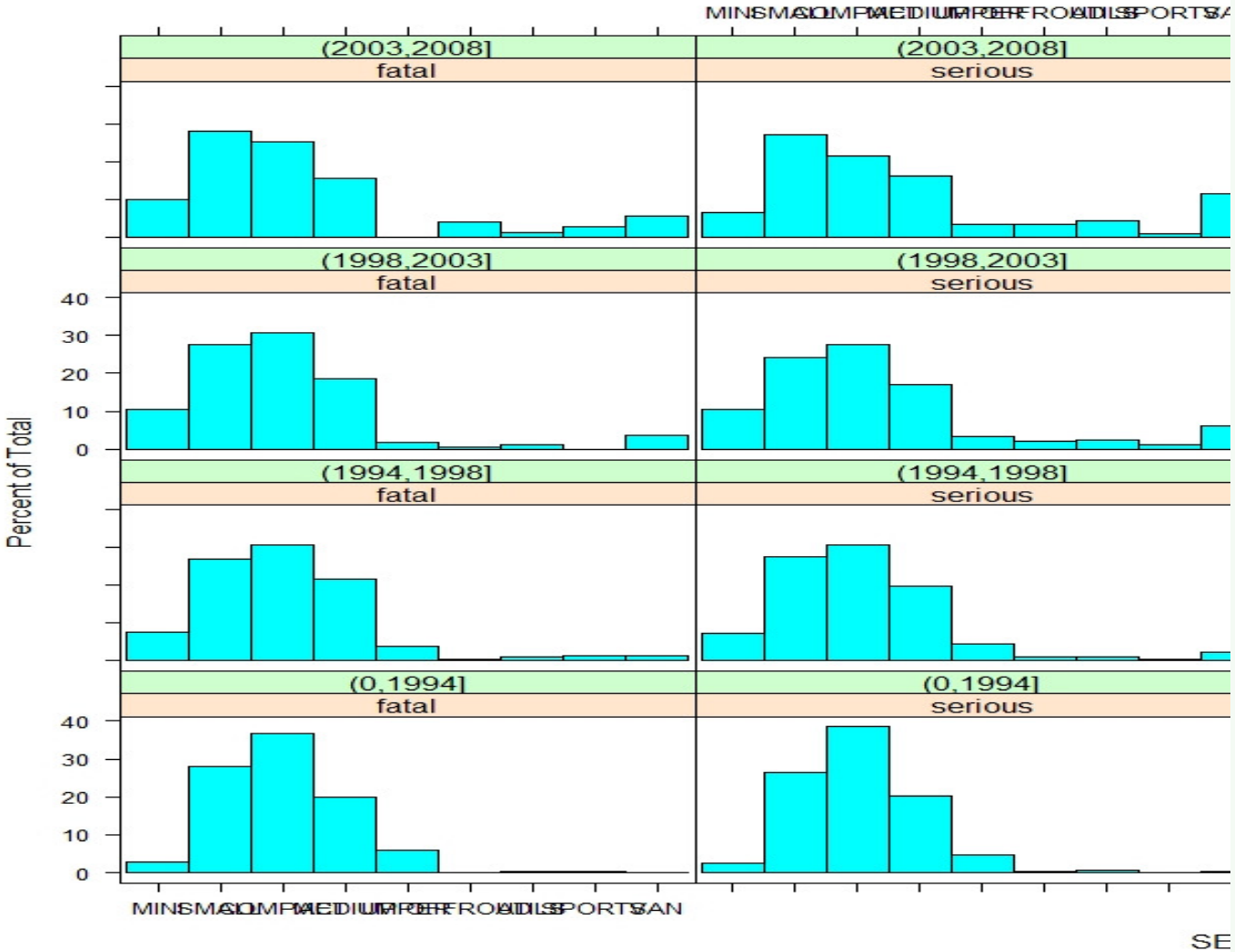
In which cars do people die?



... and currently we still have a problem with older cars!

Less than 10% of fatalities happen in new cars!

In which cars do people die?

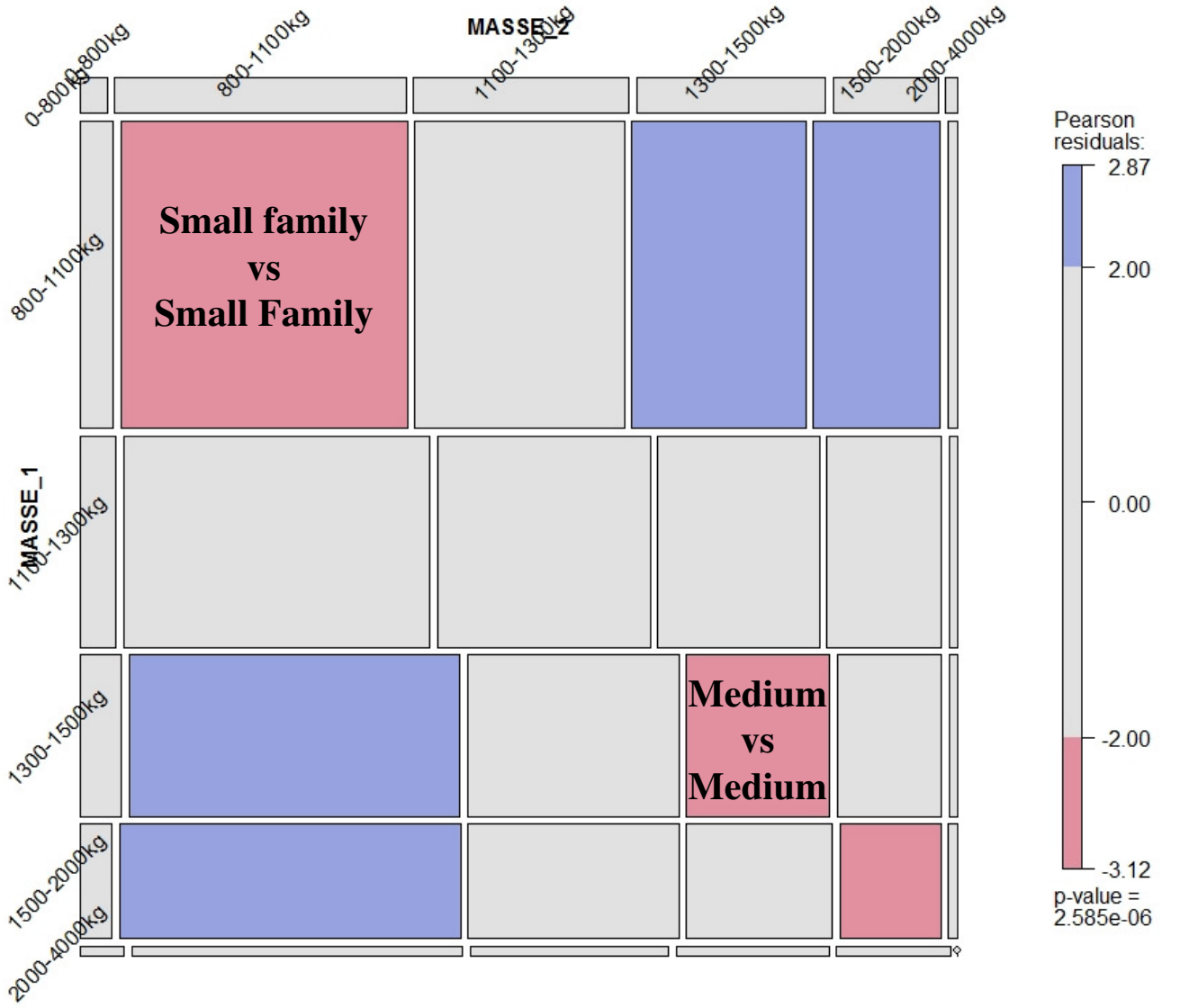


Fatalities in new vehicles happen again in small cars

- We have a problem with Compact, Small and Mini Cars!
- ... and currently we still have a problem with older cars!
- For new cars fatalities happen again in small cars

Whom do they collide with?

Masses of vehicles colliding in **serious** front-front accidents



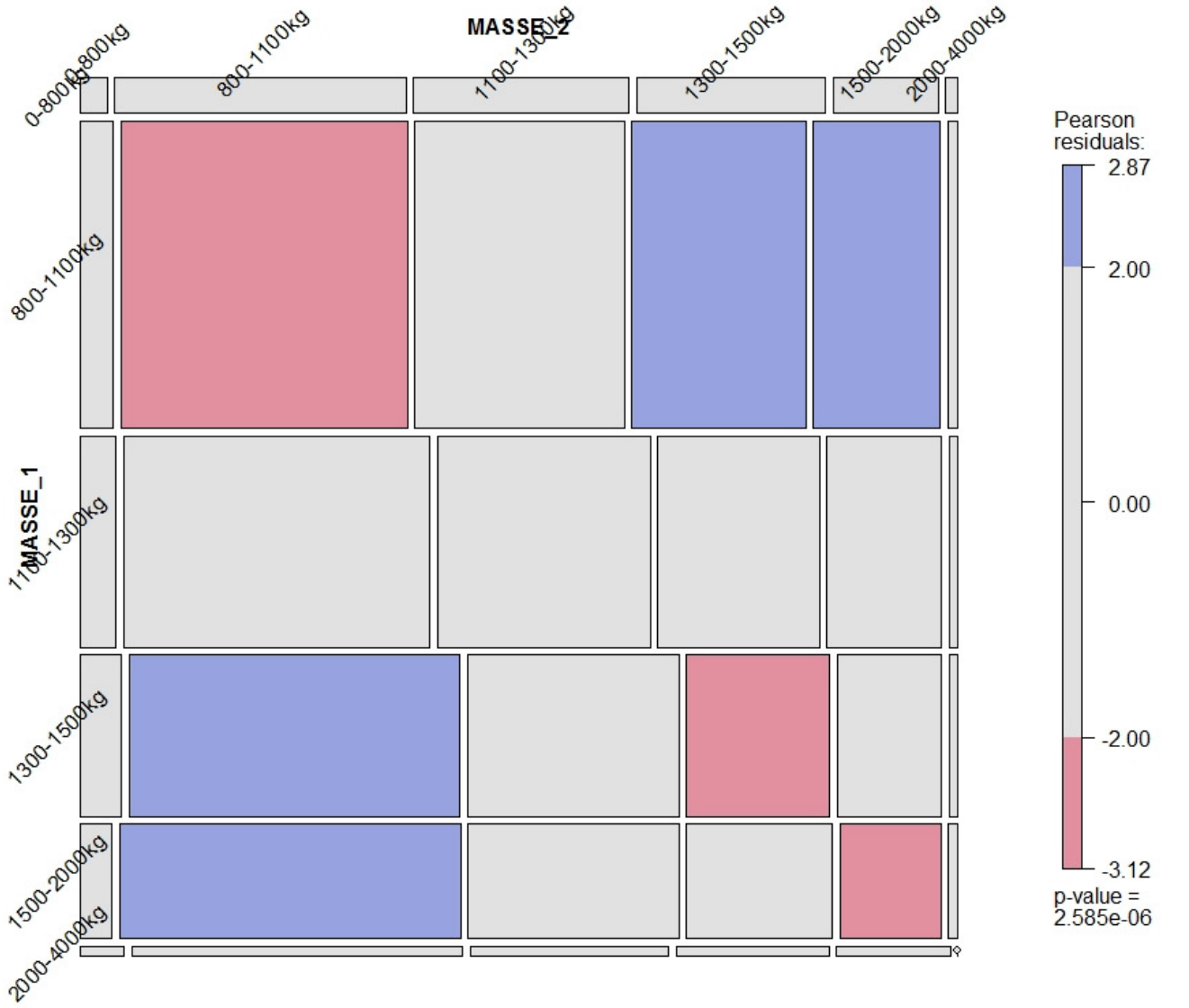
Mosaic Plot

Visualisation of a contingency table

Area ~ Count

Color ~ „unusual value“

Masses of vehicles colliding in **serious** front-front accidents



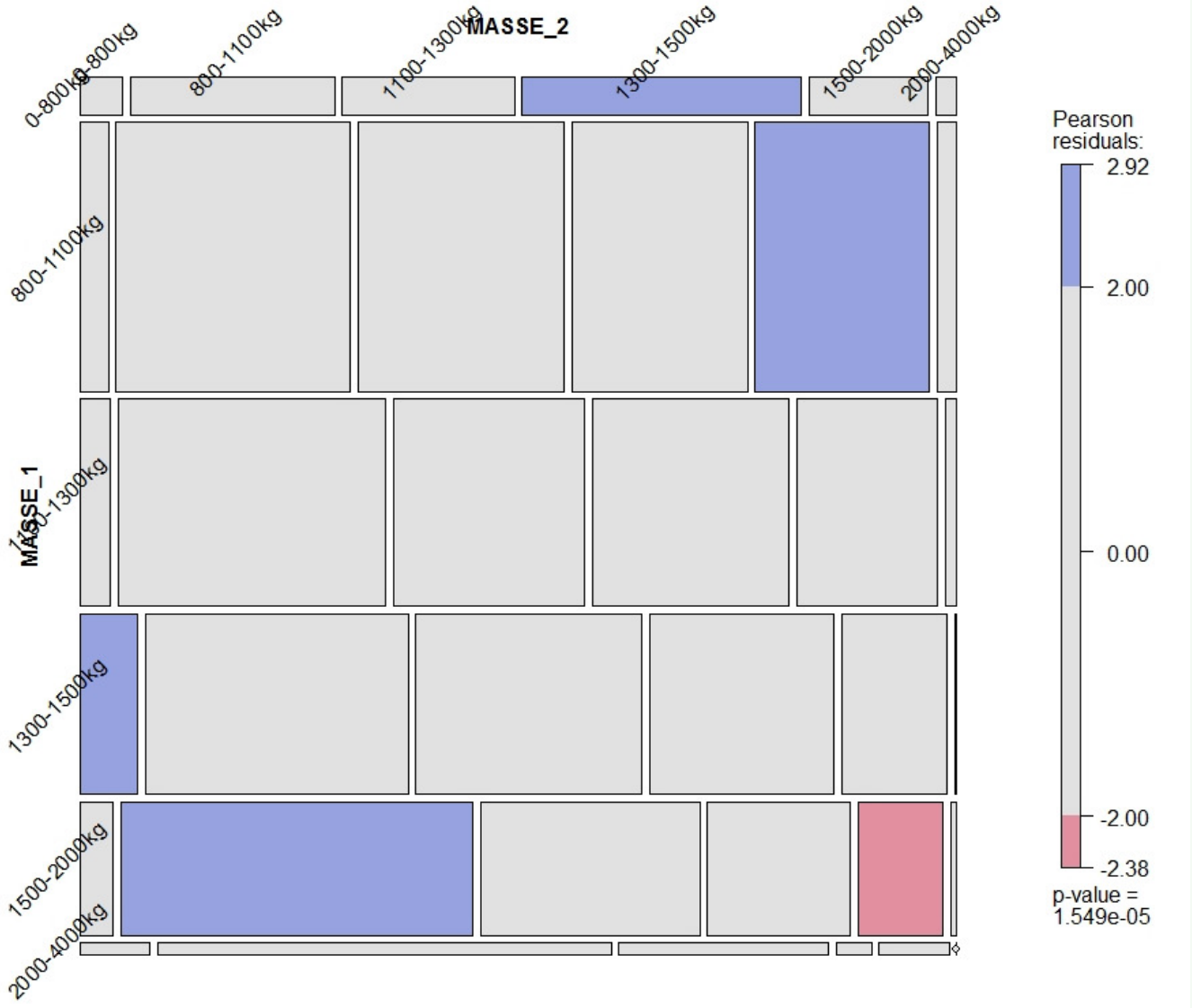
It is clear that
Mass Differences are a potential thread;
thus it is clear that:

High/Low Mass Ratios are overly represented
(blue areas)

where as

Mass Ratios of 1 are underrepresented
(red areas)

Masses of vehicles colliding in **fatal** front-front accidents



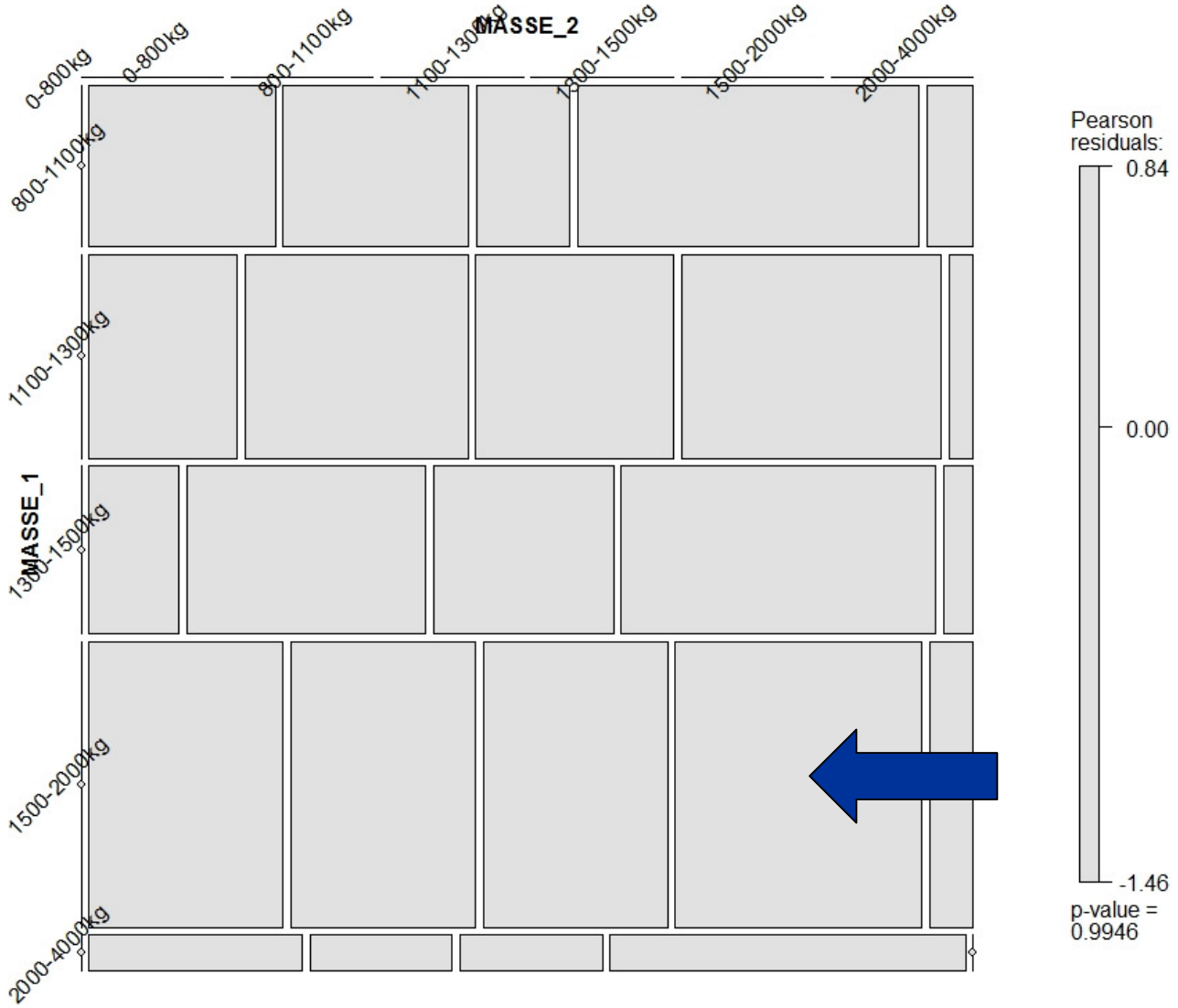
High Mass Differences are especially a

reason for fatal crashes

although
High Mass Differences

do not represent the highest share

Masses of **new vehicles** colliding in **serious** front-front accidents

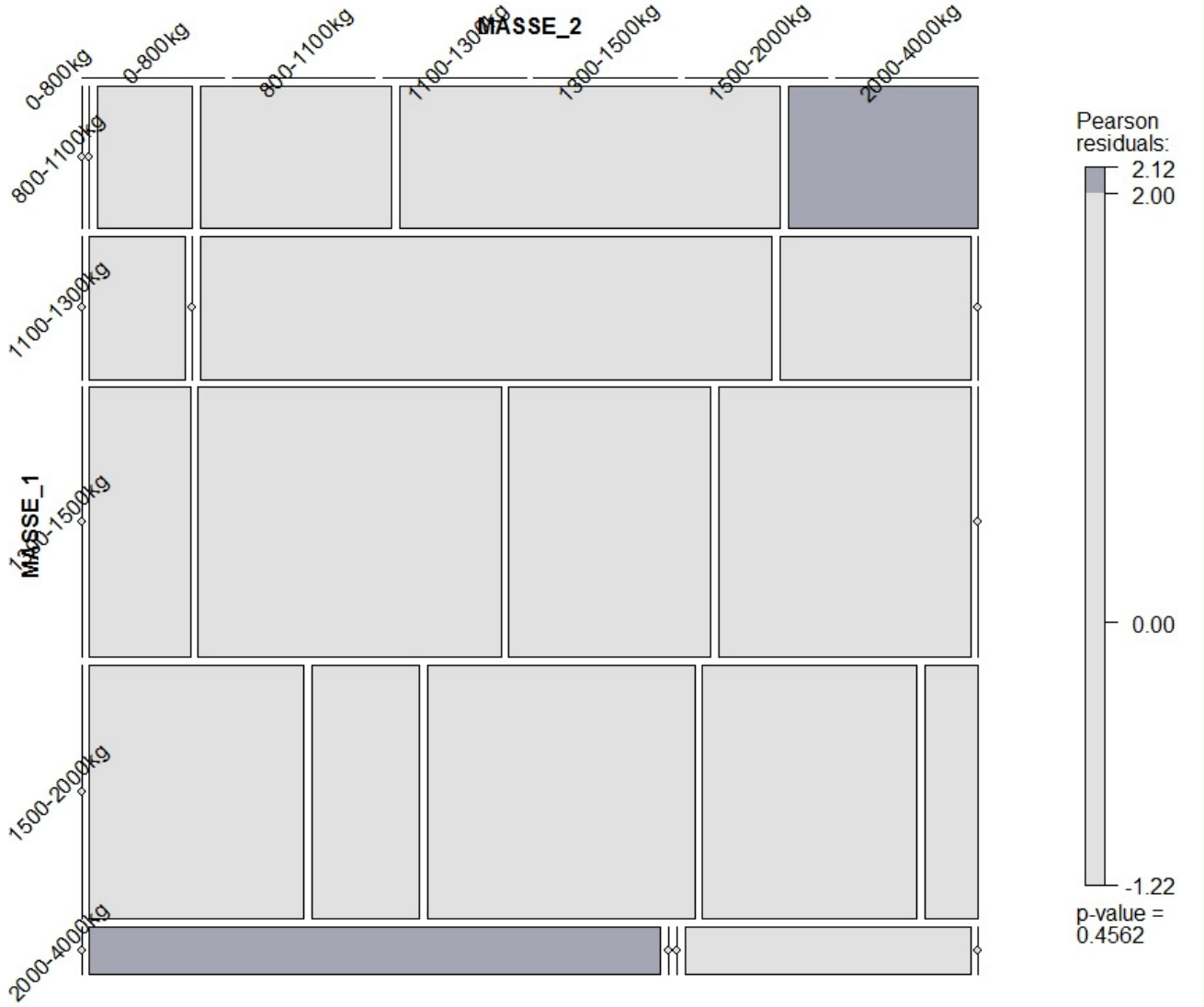


For new cars no combination is generally overrepresented

New Cars are heavier propably keeping the same relative speed

For new cars there is **more kinetic enery in the crash.**

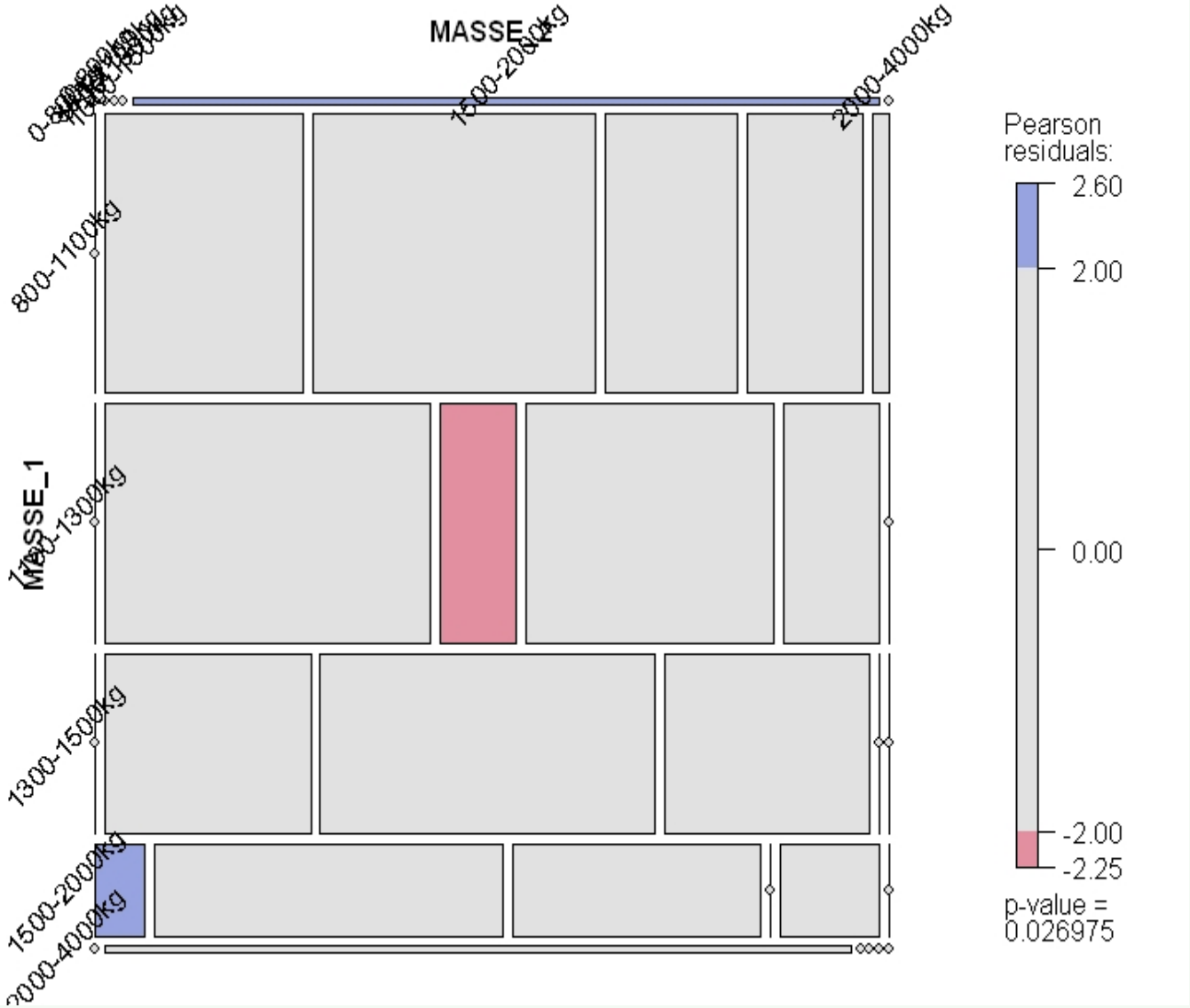
Masses of **new vehicles** colliding in **fatal** front-front accidents



High Mass Differences are slightly overrepresented for fatal new cars

Older fleet showed higher mass incompatibility,

Masses of (**1994-1998] vehicles** colliding in **fatal** front-front accidents



High Mass Differences are slightly overrepresented for fatal new cars

Older fleet showed higher mass incompatibility,
...
probably because of lower self protection level.

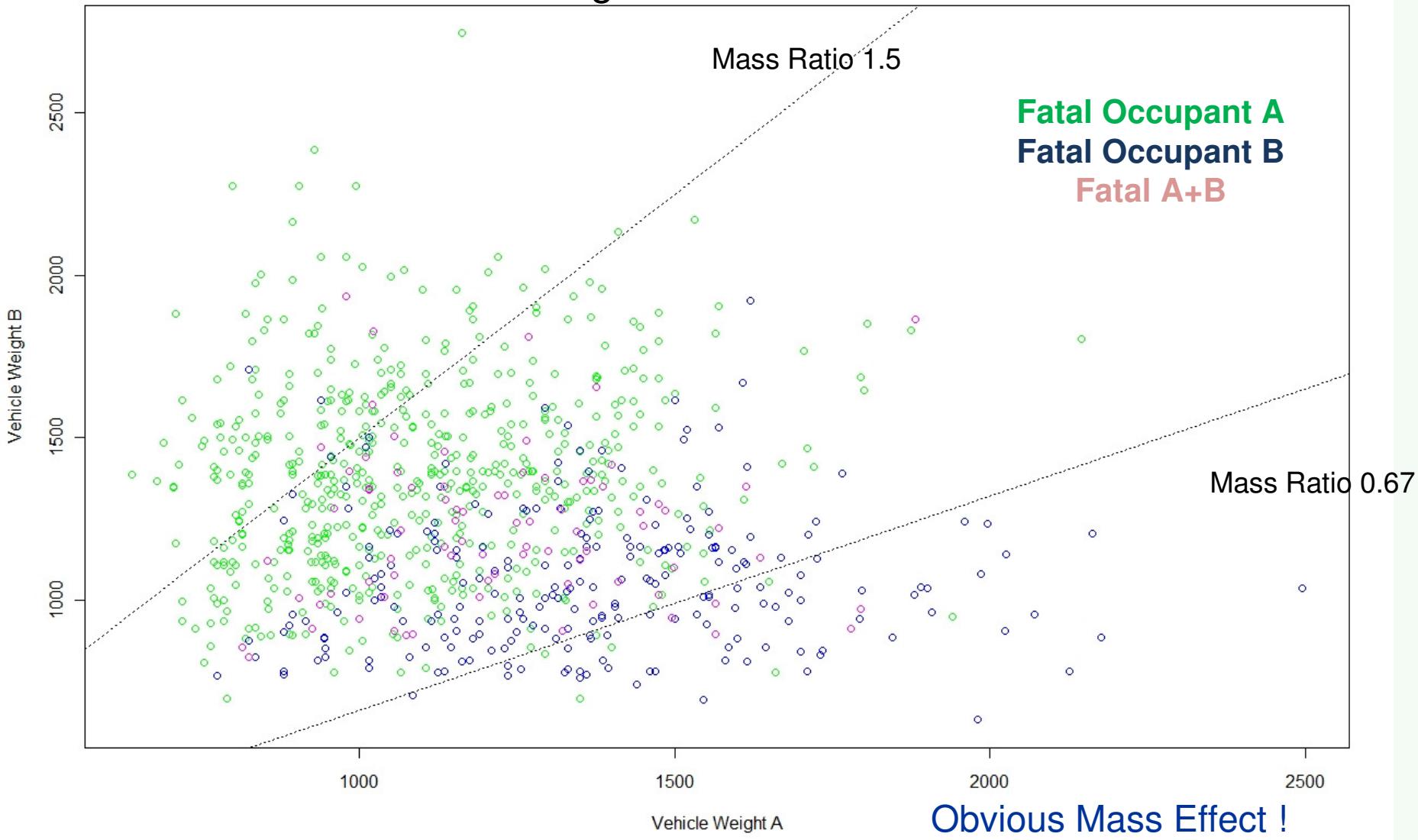
Whom do they collide with?

- Small cars have an overly proportional number of accidents with big cars

but

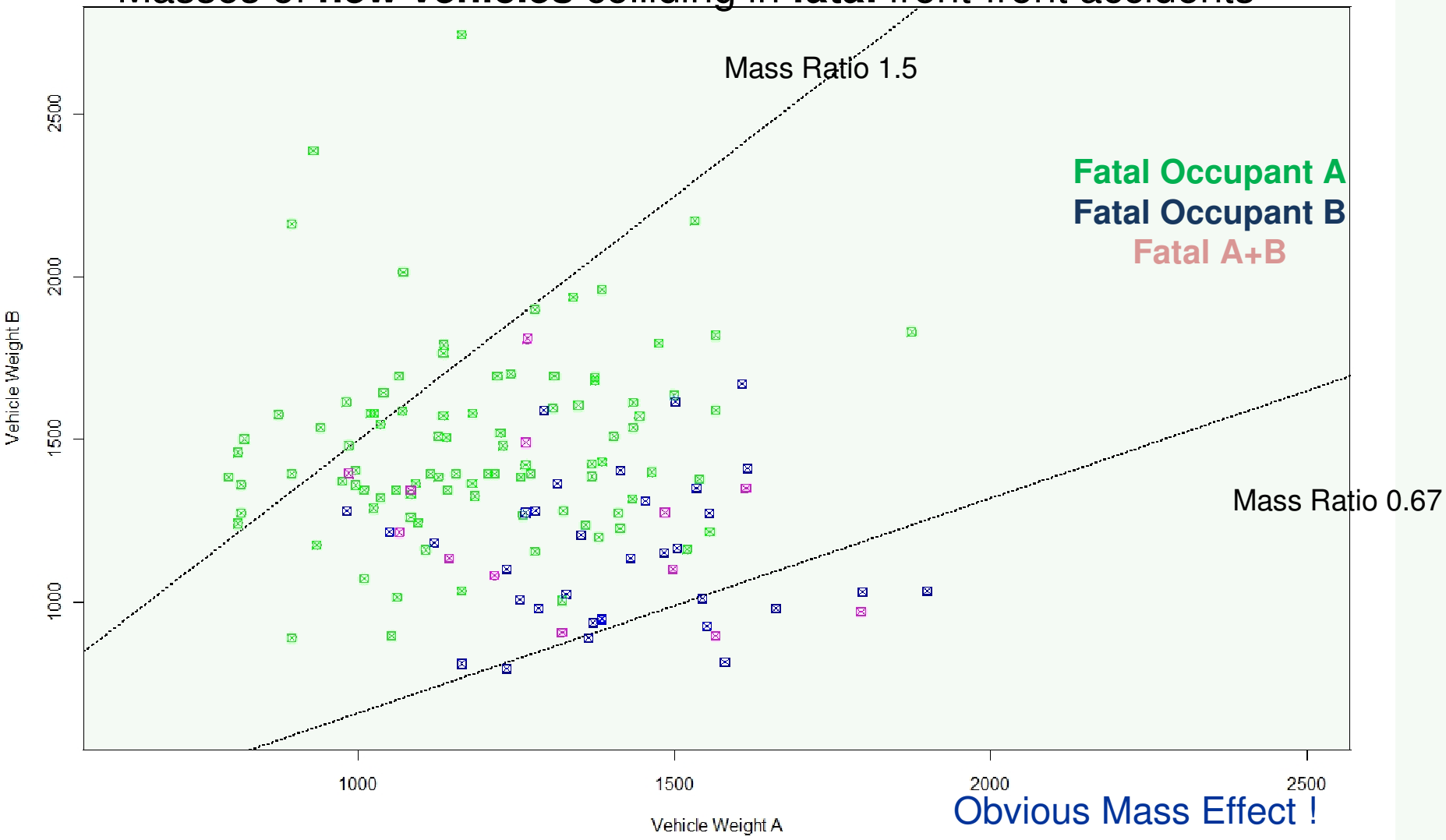
- Most of small cars accidents happen in a moderate Mass Ratio Range

Masses of vehicles colliding in **fatal** front-front accidents



Obvious Mass Effect !

Masses of **new vehicles** colliding in **fatal** front-front accidents



Obvious Mass Effect !

And now... ??

- To estimate influences correctly a paired comparison calculation shall be done
- Both cars in one accident must be looked at simultaneously
- Year of Initial Registration has been added
- German data from 2008 have been added

Paired Comparison (**including all Mass Ratio**)

	Estimate	Std	p-value	sign
AGEGROUP25.44y	-0.268942	0.181390	0.140246777	
AGEGROUP45.64y	-0.495306	0.203575	0.016344989	*
AGEGROUP65.	-1.139878	0.298463	0.000221091	***
geschlfemale	-0.640749	0.161242	0.000123600	***
MASSE.800.1.1e.03.	0.399616	0.389592	0.306031965	
MASSE.1.1e.03.1.3e.03.	0.910661	0.457876	0.047853838	*
MASSE.1.3e.03.1.5e.03.	1.327472	0.555923	0.018208526	*
MASSE.1.5e.03.2e.03.	2.241655	0.656793	0.000876800	***
MASSE.2e.03.4e.03.	5.009999	155.651108	0.974322632	
SEGMENTSMALL	0.353356	0.338260	0.297793526	
SEGMENTCOMPACT	0.860956	0.380049	0.024895255	*
SEGMENTMEDIUM	0.901251	0.453651	0.048623872	*
SEGMENTUPPER	0.896067	0.573682	0.120206491	
SEGMENTOFFROAD	1.400356	0.619731	0.024596457	*
SEGMENTUTILS	1.093652	0.685198	0.112879511	
SEGMENTSPORTS	1.151773	0.919353	0.211764368	
SEGMENTVAN	0.703663	0.575569	0.223881472	
IR.1994.1998.	0.449541	0.195077	0.022194762	*
IR.1998.2003.	0.766682	0.234136	0.001294839	**
IR.2003.2008.	1.042645	0.290726	0.000427537	***

Based on 4393 serious Front-Front collisions;
Bradley Terry Model (R), Random Sampling, Rubin Formula

SAVE

- Bigger Mass
- Offroad Car | Compact | Medium
- New car -> (R94 / NCAP)

DANGEROUS

- Being old
- Being female

Paired Comparison (**Mass Ratio in [0.9:1.1]**)

	Estimate	Std. Error	Pr(>|z|)	
AGEGROUP25.44y	-0.2637	0.1458	0.07055	.
AGEGROUP45.64y	-0.4386	0.1474	0.00292	**
AGEGROUP65.	-1.1609	0.2183	1.0e-07	***
geschlfemale	-0.6282	0.1254	5.4e-07	***
MASSE.800.1.1e.03.	-0.8696	0.7323	0.23502	
MASSE.1.1e.03.1.3e.03.	-0.5286	0.7840	0.50012	
MASSE.1.3e.03.1.5e.03.	-0.5808	0.8286	0.48335	
MASSE.1.5e.03.2e.03.	0.2642	0.9237	0.77486	
SEGMENTSMALL	-0.0253	0.3072	0.93440	
SEGMENTCOMPACT	0.4915	0.3514	0.16192	
SEGMENTMEDIUM	0.6415	0.4167	0.12373	
SEGMENTUPPER	0.1808	0.5446	0.73981	
SEGMENTOFFROAD	0.4728	0.6022	0.43239	
SEGMENTUTILS	0.4439	0.6124	0.46857	
SEGMENTSPORTS	1.3901	0.9313	0.13552	
SEGMENTVAN	0.2397	0.4741	0.61321	
IR.1994.1998.	0.4713	0.1698	0.00550	**
IR.1998.2003.	0.7803	0.2054	0.00015	***
IR.2003.2008.	1.1176	0.2611	1.9e-05	***

SAVE

- New car -> (R94)

DANGEROUS

- Being old
- Being female

Based on 848 serious Front-Front collisions;
Bradley Terry Model (R), Random Sampling, Rubin Formula

- Effect of gender remains constant irrelevant of mass

  ...women drive not only smaller cars

-> In a direct comparison women are less protected than men ✯

- Effect of age remains constant irrelevant of mass

-> In a direct comparison older drivers are less protected than younger ✯

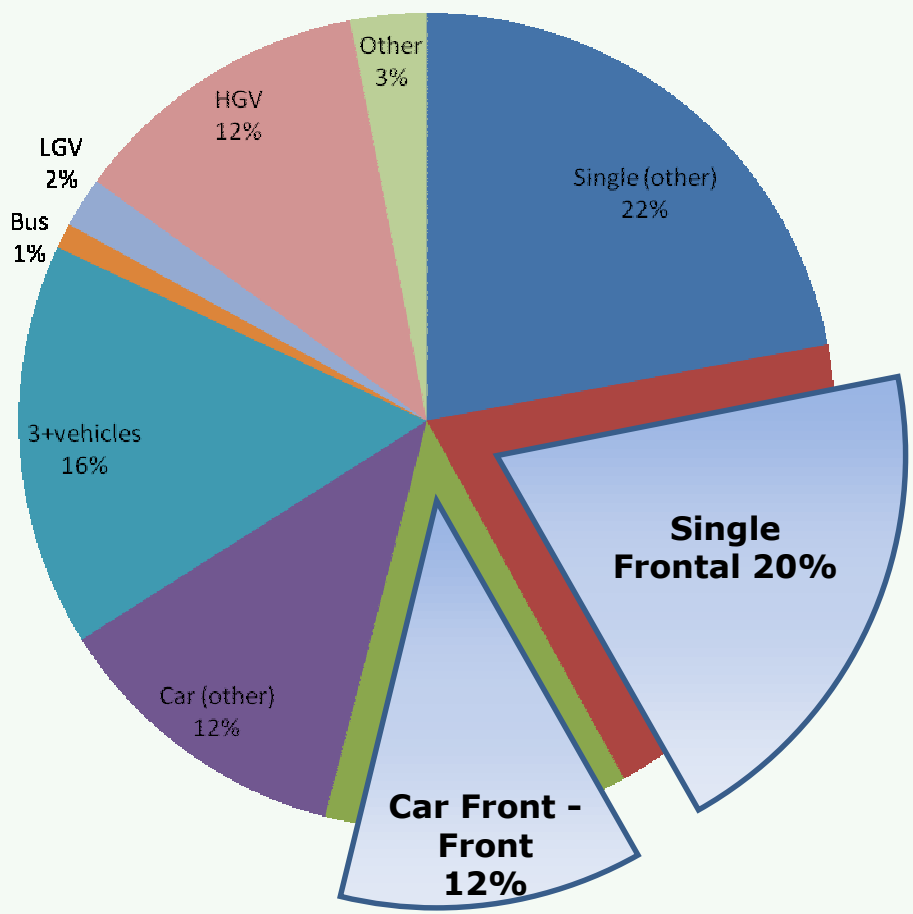
- Effect of „Year of Initial Registration“ remains constant

-> In a direct comparison newer cars are saver than older cars √

- Tackling Mass Problems will only solve a smaller part (high Mass Ratios) of todays safety problem

- Tackling the Gender Issue will cover a wider range and will therefore reveal the higher cost benefit rel.

Single Car Accidents

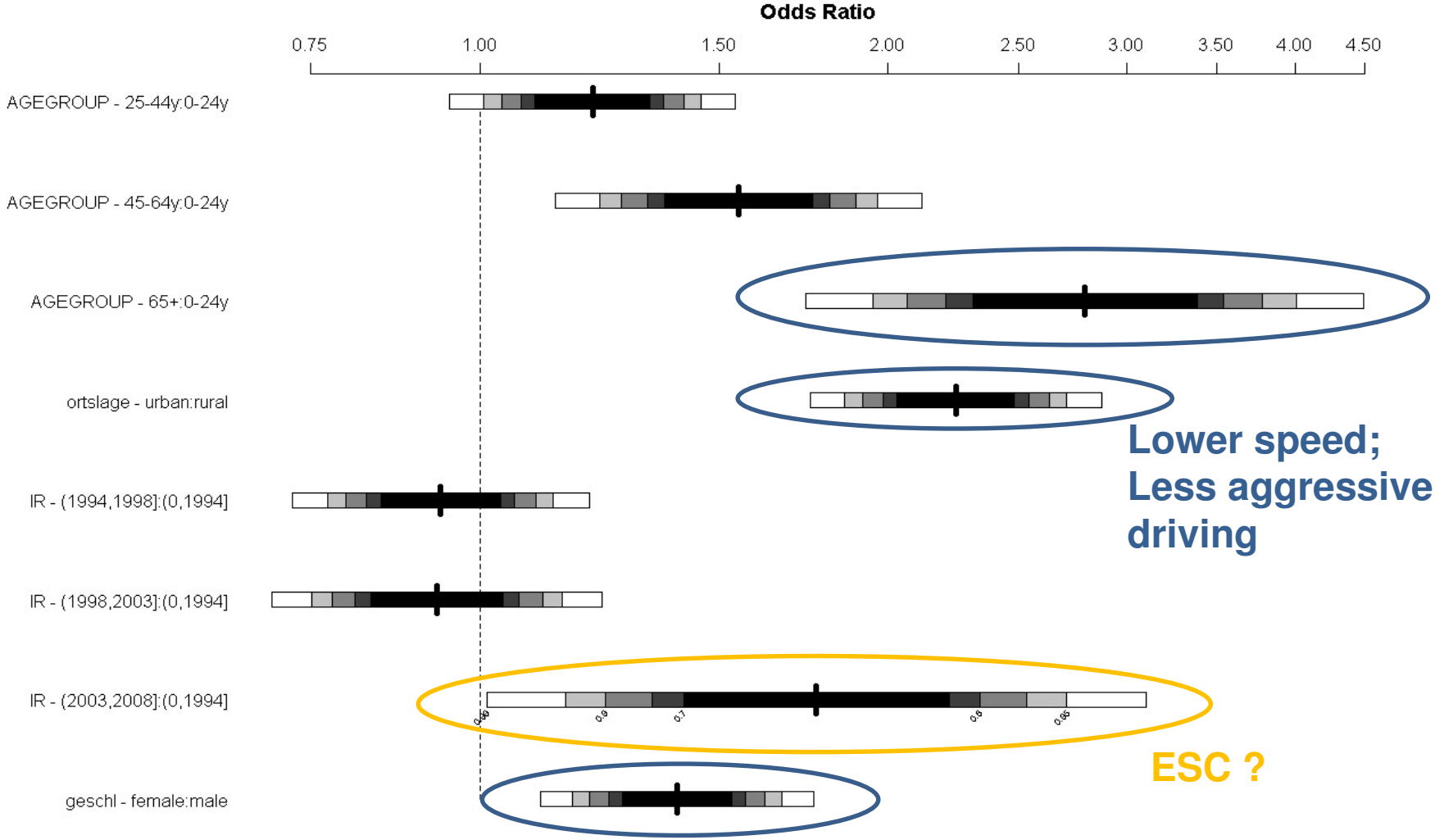


In Depth Data shows that:

<u>Single Car Frontal impacts</u> are more probable for:

- **Elderly drivers**
- **Female drivers**
- **Urban accidents**
- **New cars**

Factors influencing the probability of having a frontal single car impact

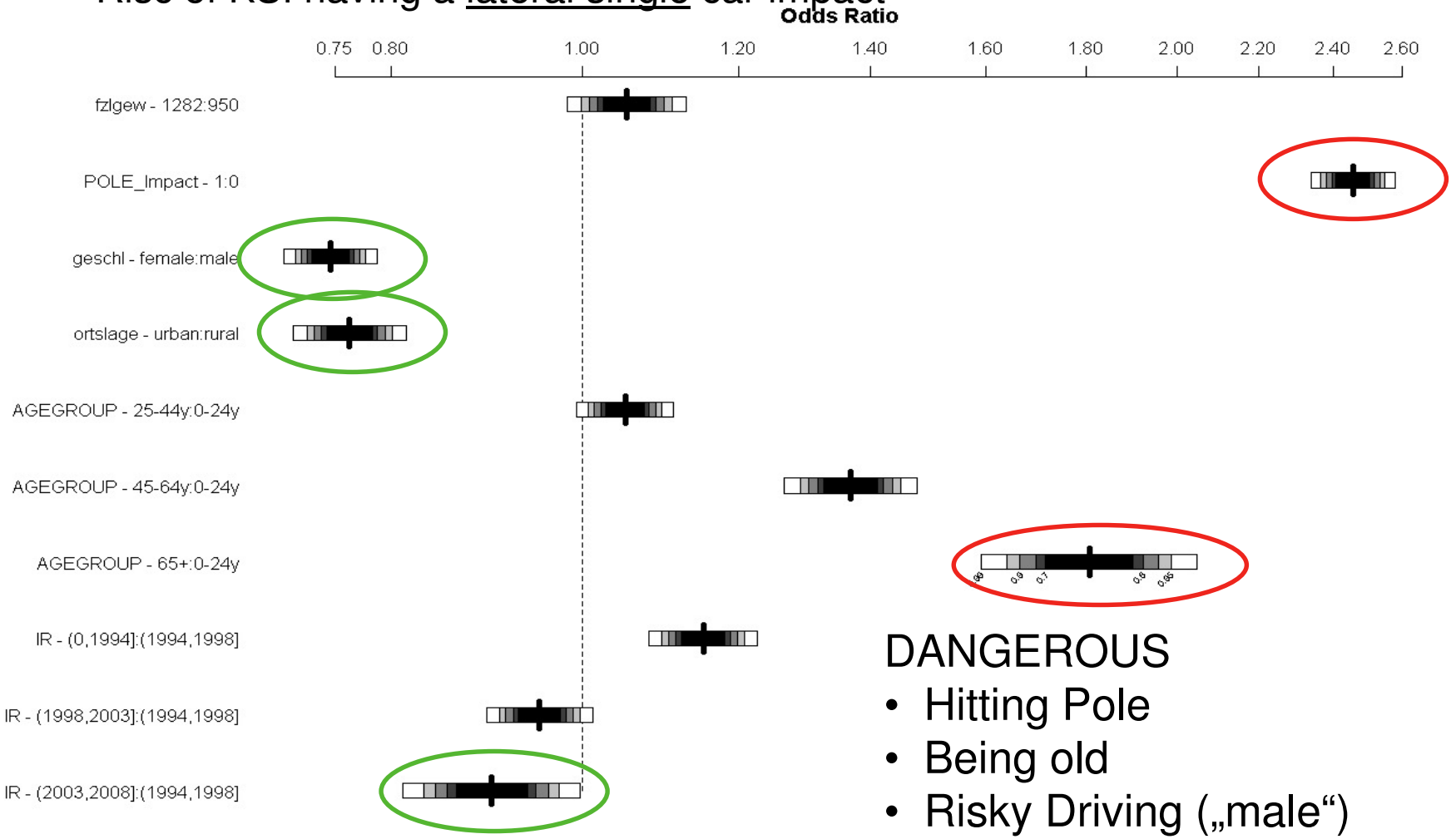


Risc of KSI having a frontal single car impact

DANGEROUS

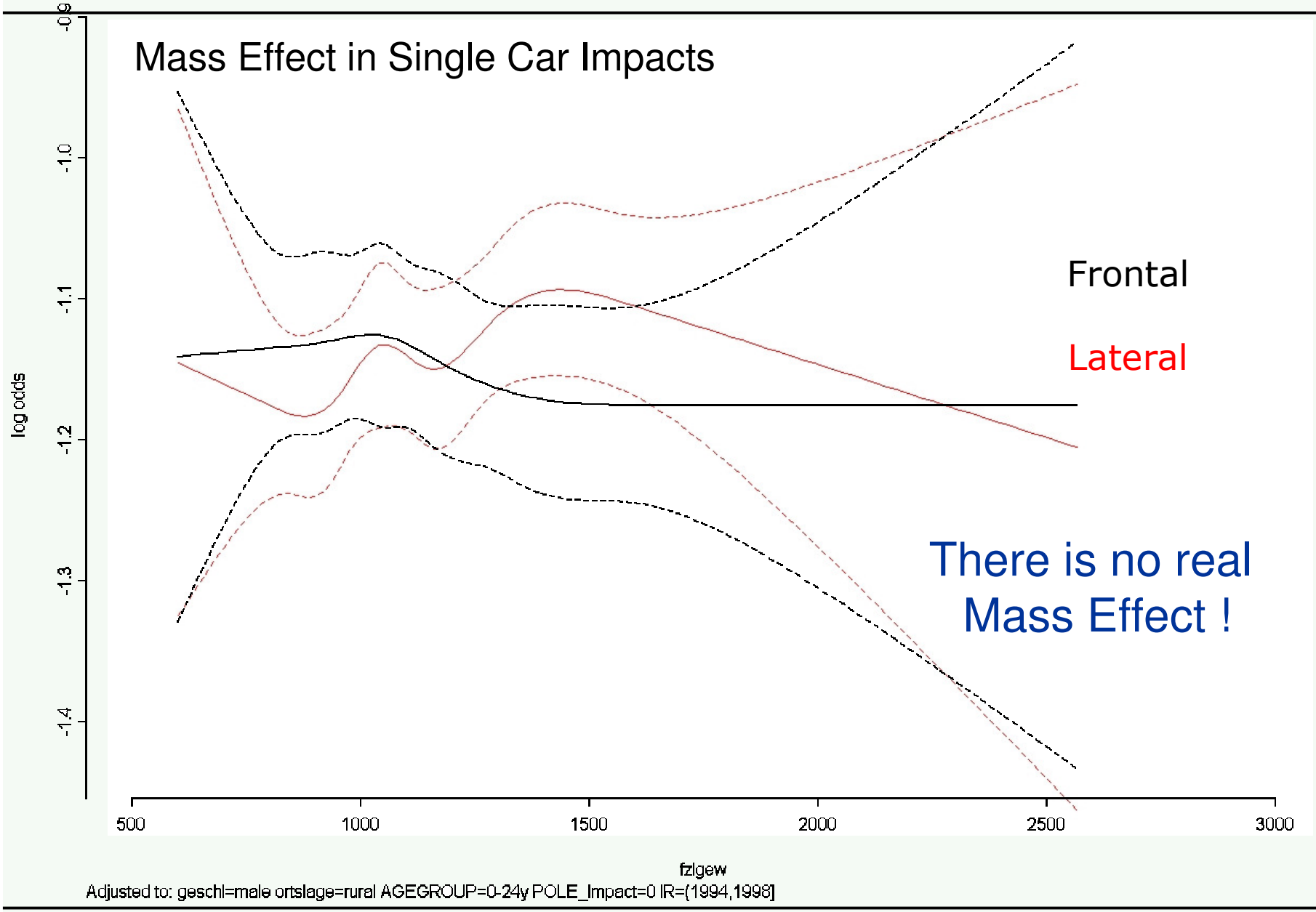
- Hitting Pole
- Being old
- Risky Driving („male“)
- Driving an (very) old car
- Driving rural

Risc of KSI having a lateral single car impact



DANGEROUS

- Hitting Pole
- Being old
- Risky Driving („male“)
- Driving an older car
- Driving rural


Mass Effect in Single Car Impacts
Frontal
Lateral
There is no real
Mass Effect !
log odds
-0.9
-1.0
-1.1
-1.2
-1.3
-1.4
500
1000
1500
2000
2500
3000
fzlgew
Adjusted to: geschl=male ortslage=rural AGEGROUP=0-24y POLE_Impact=0 IR=(1994,1998]

Conclusions

- No problem in particular for small cars
- Gender Issue, but „male“ stands for risky driving.
  Real Gender Issue need to be investigated In-Depth
- Age Issue,

[difficult - but important (demographic development) - to deal with]
-> Dynamic Demographics: Difficult to estimate benefit accurately

- Frontal impact regulation has been more effective for car to car collisions
- Side Impact regulation + NCAP seemed to have been more effective in (lateral) single vehicle collisions

Merci de votre attention !

Thanks for your attention!

Danke für Ihre Aufmerksamkeit!