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New auto safety research evaluates impact of size and weight on accidents.

Lighter/large vehicles can decrease fatalities, contrary to common belief

plastics & autos

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- In 1997, Dr. Charles Kahane of the U.S. National Highway Transportation and Safety Administration published a study concluding that lighter, smaller vehicles can cause additional fatalities. Kahane neglected, however, to separate the combined effects of size and weight (mass) on safety, and instead described MY (Model Years) 1985-93 vehicles he studied on the basis of weight alone.[1,2]

- In 2002, the National Academy of Sciences (NAS) conducted a study of the Effectiveness and Impact of CAFE Standards (based on Kahane). The NAS found that adverse safety impacts from down-weighting or producing/selling smaller cars as suggested by CAFE (Corporate Average Fuel Efficiency, a national fuel efficiency standard), "could be minimized or even reversed if weight and size reductions were limited to heavier vehicles (particularly those over 4,000 lb.)." As a result, the NAS found Kahane's conclusions "overly simplistic," and recommended that NHTSA undertake additional research to clarify the relationship between fuel economy and safety.[3]

Size and weight are distinctly different characteristics. An automobile can be lightweighted without compromising safety.

- Kahane updated his 1997 study in 2003, using data from cars MY1991-99. However, size and weight again were not evaluated separately, causing a repeat of similar results as in his 1997 study.[4,1]

- In further research regarding the impact of CAFE standards on the safety of 'size,' well-known expert in automotive safety engineer Dr. Leonard Evans conducted a study to determine the separate causative effects of mass and size on risk, which he presented to the Society of Automotive Engineers (SAE) in 2004.

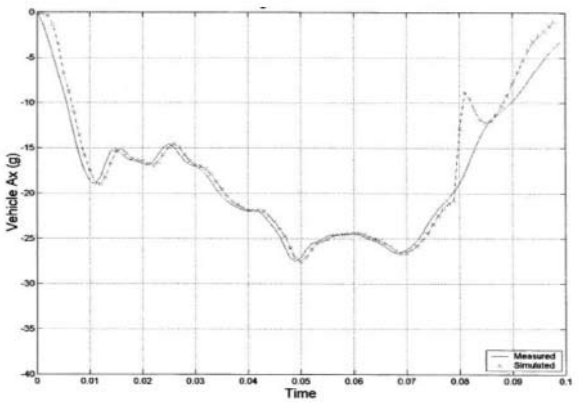
- Dr. Evans concluded when separate effects of size and weight are considered, a reduction in wheelbase and track (size) could increase the overall number of fatalities, as NHTSA had predicted. But, a weight (mass) reduction could be expected to decrease the overall number of fatalities, largely by reducing the aggressiveness of bigger/heavier vehicles when crashing into small/lighter vehicles. For the first time, size and weight implications were separated.

- It is important to note that combining the separate weight and size results in Dr. Evans' study produces the same results as Kahane's studies.[3] Therefore, not only can size and mass effects be separately delineated, but they are also consistent with previous Kahane (NTSHA) data while making the point that fatalities are not related to 'size' exclusively.

- As a part of his study, Dr. Evans also found that use of lightweight materials in a vehicle can lead to lighter, larger vehicles with reduced risk to occupants in two vehicle crashes; reduced risk to the occupants of the other vehicle into which it crashes; and reduced risk to occupants in single-vehicle crashes, in addition to reduced fuel consumption and CO2 emissions.[3]

- Also in 2004, Dynamic Research, Inc. (DRI) performed a simulation using data from 500 crash events in the US National Automotive Sampling System/Crashworthiness Data System (NASS/CDS) database. DRI modeled the 500 selected collisions using virtual versions of a typical passenger vehicle and a typical SUV.[3,5]

- The simulated crashes involved either an SUV that rolled over, hit a fixed object, hit a passenger car, or hit another SUV. All 500 crashes were first simulated using the baseline production vehicle weight, and then using a 20% lighter weight SUV. Researchers found that lightening the SUV, even without extending its front and rear crash zones, reduced overall injuries by about 15%, and injuries to the other driver by more than half.[3,5] When crush zones were extended without increasing weight (through the use of lightweight materials), a 26% improvement in ELU (expected life units) for all drivers resulted.



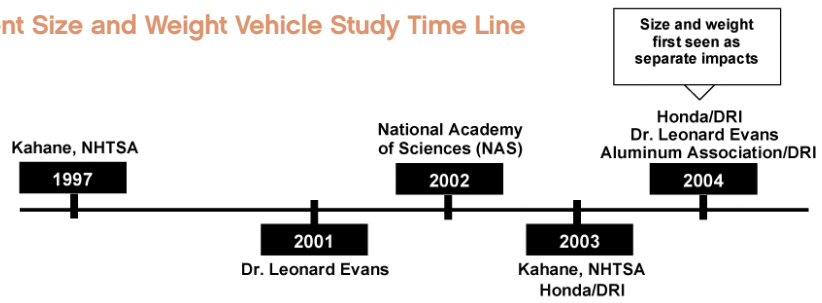
Model Calibration graph taken from Aluminum Association meeting with NHTSA on May 26, 2004.

This illustration shows computer simulated frontal vehicle acceleration versus actual measured acceleration over time. Note that modeling is accurate enough to make the two graph lines closely parallel. With a correctly calibrated model, computer simulated changes in weight and size configurations can reasonably predict vehicle and occupant performance.

Additional Information

- By using lightweight materials, Jaguar was able to make its 2004 XJ8 longer, taller, and wider, but 400 lbs. lighter than the outgoing model (see size and weight illustration, p.1). Even with the reduction in weight, the 2004 XJ8 jointly received the top safety rating in the luxury class in "Which?" Magazine [editor's note: this is literally the name of the UK consumer magazine].[3,6]
- The Jaguar X-type from 2002-2005 was rated by the Insurance Institute for Highway Safety as a "Best Pick Frontal" impact vehicle.[7]
- Computational models allow researchers to predict with strong, plausible credibility the outcomes of manipulating vehicle weight, size, and other variants.
- In creating a computational model, researchers:
  - Select and closely examine a car make and model that is representative of the vehicle model year
  - Research detailed state accident reports for the selected make and model, which break down minute details including rollover, speed, frontal/side/rear crash, what the car hit or was hit by, etc.
  - Gather overall injury and fatality data for the selected vehicle model year
  - Compile this information to triangulate the circumstantial data of the accidents of the vehicle group to create a computer model that simulates the effects of a given type of crash
- The detailed information required to design a computational model results in a model that so closely simulates the effects of a crash that crash force and energy impact diagrams run almost exactly parallel to each other. This gives researchers confidence that the model will predict outcomes correctly when certain variant factors are entered into the computational model (i.e., add four inches of length; reduce weight by 400 pounds, etc.).
- A computational model renders what researchers call "expected life-units," or "ELUs," a way of calculating major injury levels and fatalities in an across-the-board fashion.

Recent Size and Weight Vehicle Study Time Line



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Pictures

Ruler and Scale: Microsoft Word Clipart

Timeline: Designed by Lindsay Pack

2004 Jaguar XJ8: http://cars.about.com/cs/newcarprofiles/p/04__jaguar__xj8.htm

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