Protecting Our Children in Crashes…. Lessons from What Really Happened

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The Focus on Child Passenger Safety

The 10th Annual World Traffic Safety Symposium
and Industrial Design Students "Designs for Safety" Competition

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The Symposium's Important Theme:
Protecting Our Forgotten Children

Greetings to you all at the *10th Annual World Traffic Safety Symposium.* Some of you are government officials, automobile manufacturers, or members of the Greater New York Automobile Dealers Association. Some are vehicle safety specialists, journalists or teachers. Some are Industrial Design students or interested citizens. While there may be differences in our professions, backgrounds, and interests, we all share a common trait. We are all very concerned about the safety of our children, grandchildren, and our young brothers and sisters.

My own profession is automotive safety design and vehicle crashworthiness, the emphasis on how and why people are injured in vehicle crashes, and what to do to design safer vehicles. I'm a member of the Industrial Designers Society of America (IDSA) and the Society of Automotive Engineers (SAE). For more than 30 years, I've investigated and analyzed what happens in vehicle crashes, and from that experience drawn lessons and principles about safety and design.

I would like to particularly direct my remarks to the young Industrial Design students who are here today. These Industrial Design students are being educated and trained to soon plunge into the real world, and before long they will be out there designing the many products and motor vehicles that we all will use and drive… and many of those vehicles will one day be involved in collisions.

Whatever you design should take into account that children may use it, children may come in contact with it, children may ride in it, children may play in it. Children *trust* that you have designed a product, a motor vehicle, or a child safety seat that is safe for them. Is whatever you design truly safe for infants and children ? How do you know ?

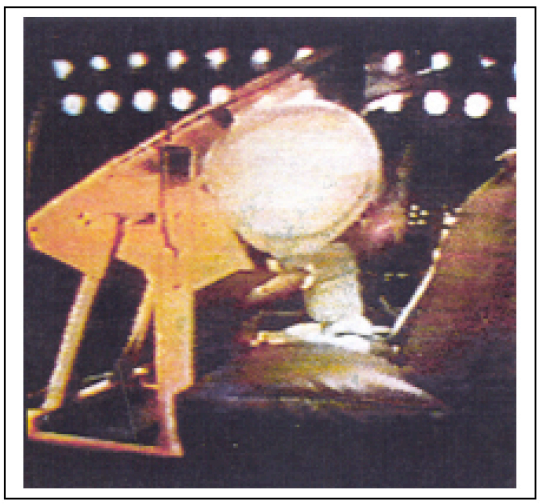
Learn From Case Examples:
Why Do Some Airbags Kill Children ?

The nation was stunned when we learned that airbags were killing children. Case after case made the news, and we were horrified. Then we were puzzled. How could the well-

proven life-saving technology of airbags *also* cause the death of some children. As the story unfolded after many months and years of concern and anguish, we learned what happened…. and why about 100 children so far have been killed by airbags.

Some airbags are triggered in very minor crashes. Some airbag systems have crash sensors that trigger in minor collisions as low as 7 to 15 miles per hour, when airbags aren't really needed. In some designs, the automakers decided to use fewer crash sensors to hopefully respond to a variety of crashes, so they made them especially sensitive, and used low-cost designs such as a magnet holding a small steel ball. The ball would release even if it was a minor impact, and complete the electrical signal that then led to airbag inflation.

Some airbags were aimed directly at the child. The lethal design airbags burst out from the *front face* of the instrument panel, and inflate *horizontally* right at the neck and head of a small child passenger. In some low-speed accidents, the child might move a bit forward during pre-crash braking, placing her too close to the force of the airbag as it "burst out" from the front of the dash. Safer designs stored the airbag in the *top* of the instrument panel, and the airbag's higher "burst out" pressure inflated it *initially upward* and then with less force toward the child. Published articles many years earlier had pointed out these safer airbag design principles, but some automakers apparently ignored those recommendations.



Too many automakers used a very high-pressure inflator. In most airbag systems, it is the ignition of a stored propellant called sodium azide (which looks like thousands of small aspirin tablets) that instantaneously generates a large volume of nitrogen gas causing the folded airbag to suddenly inflate and burst out of the steering wheel and instrument panel at high pressure and velocity, as much as 200 miles per hour. While the high-pressure would be suitable to protect an unbelted average-size man, about 5'10" and 170 pounds, it was *much*

too forceful when inflated into a small child or short-stature adult. In other words, it was poor design to use a *"one size fits all"* high inflation pressure, from large adult to small child. Even simple logic tells us so.

Learn From Past Experience:

What Did We Know About Airbags in the Early 1970's ?

Ironically, back in 1973, before many of you Industrial Design students were born... General Motors mass-produced one thousand 1973 Chevrolet Impala sedans with airbags for both the driver and front passengers. (By the way, I've owned one of these pioneering ***"Airbag Chevys"*** for many years, shown here.) The passenger airbag inflates *"softer"* in crashes from 12 to 18 miles per hour, and inflates *"firmer"* in crashes above 18 mph… in order, said GM, to reduce the airbag inflation hazard to children. That 1973 dual-pressure airbag system worked well, and was proven to be a safer design for children in GM crash tests and in actual highway accidents over the years.

But when airbags finally were phased into most cars starting in the late-1980's, many automakers, including GM, somehow forgot about that child safety issue and the safer dual-pressure airbag system. Some automakers didn't even conduct any crash tests to see what would happen to small passengers. Why didn't automakers and airbag companies learn from past experience ? Did they decide that a lower-cost design that would just comply with the *minimum* federal safety standards was enough ? If you were the chief safety designer or the company president, what would *you* do ?

There are valuable lessons here for you Industrial Design students. While airbag systems are marvelous and well-proven life-saving technology, especially in higher-speed crashes, and preferably in conjunction with seatbelt usage, *not all airbag systems are alike.* The crash sensors shouldn't trigger the airbag when it's not needed in a minor crash. The inflator should not be a single high-pressure *"one size fits all"* design, but should instead be a

multi-stage inflator. The passenger airbag should inflate initially upward from the top of the dash, and not horizontally directly at the neck and head of a child passenger.

What about crash testing and the federal safety standards ? The federal safety standard, Number 208, is a *minimum* standard that only required crash testing with an average size male test dummy. It was up to the automakers whether or not to use the full range of crash test dummies, including infants and children. Change the words *"federal safety standard"* to *"bargain-basement minimum requirement"* and you'll have the correct perspective that many so-called safety standards are far too minimal and unrealistic to what actually happens in collision accidents. Our vehicles should be safe and crashworthy to protect children and adult passengers in 50 and 60 mph crashes… front, side, rear, rollover, and underride… and we shouldn't settle for the bargain basement minimum of 25 or even 30 miles per hour. The technology is readily available to make our vehicles much safer in all kinds of crashes.

And what about the recommendation to put your child on the rear seat, away from the airbag ? There's a potential danger in a *rear impact* accident, because too many cars have front seats that are so weak they'll collapse rearward… causing the front seat adult to slam into the child sitting behind him on the supposedly safer rear seat, and possibly injure or kill their own child. And that's happened. The federal safety standard, after a 30 year delay, urgently needs to finally adopt a rear-impact crash test requirement with dummies… to help ensure stronger, safer seats. But automakers should design safer seats without waiting for regulations to force the issue. Notice how airbag safety and stronger seats and upgraded standards *all interrelate*… thus the vehicle *must* be designed as an *integrated safety totality*.

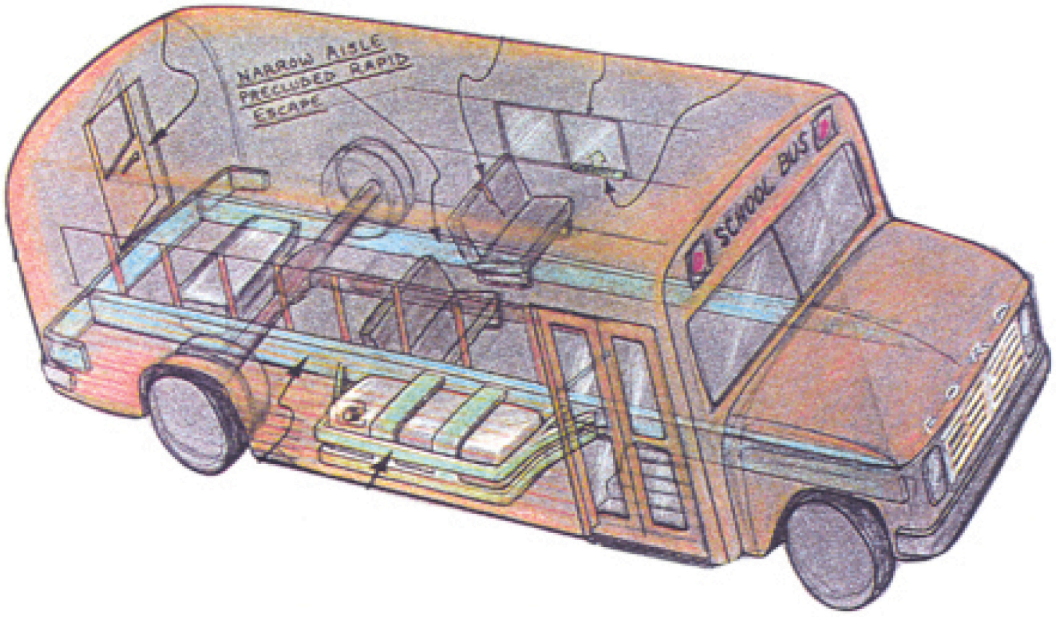
Learn From Case Examples:

The Worst School Bus Tragedy in History

There's another case example involving children, and it involves the worst schoolbus death toll in America's history. The accident occurred on May 14th, 1988, in Carrollton, Kentucky, when a drunk driver in a small Toyota pickup hit a 1977 school bus head-on. The schoolbus fuel tank was pierced by a front suspension leaf spring, and a raging fire and dense black smoke quickly engulfed the school bus interior. Twenty four children and three adults were entrapped within the burning school bus, and they died in the fiery holocaust. I served

as a vehicle safety consultant in the legal case on behalf of two families who each lost a young daughter.

My investigation and hands-on inspection showed that the fuel tank was vulnerably located right next to the entry-exit doors, and was exposed outboard of the main frame rails, and had no protective structure or cage around it. In the collision, the exposed fuel tank was punctured, and the fire was immediate. The seat cushion foam and upholstery were highly flammable and toxic, and there was no automatic fire extinguishing system. There were no emergency exit windows. The only exit was at the rear, at the end of a long, narrow aisle that was only one foot across, and it was partially blocked by the last row of seats.



It turned out that Ford had built 6,000 of these 1977-model school bus chassis with the holes already drilled in the frame rails, and the fuel tank protective cages were stacked up near the assembly line. But when NHTSA relaxed its then-pending requirement to protect fuel tanks and thus give the industry a nine-month delay, Ford Motor Company decided to leave off the protective cage and saved about $80 per bus. The Kentucky accident bus was built just *eight days* before the deadline that finally forced Ford to install the cages. Eight days and $80 dollars. Neither the manufacturer nor NHTSA conducted any subsequent recall to install safety cages around the vulnerable fuel tanks on these older schoolbuses.

Because of that terrible Kentucky school bus accident, and the national publicity it generated, and Congressional Hearings and National Transportation Safety Board Hearings, the lessons from that tragedy have led to tougher safety requirements, and most recent-vintage schoolbuses in general have a decent safety record in local travel. If ever a vehicle needed to be as safe as possible, shouldn't that apply to a school bus that often carries as many as 66 of our children to and from their home to their school each day, and sometimes on longer higher-speed highway trips as well. Isn't it time we design a truly modern technology school bus that *maximizes* protection for our children in any crash situation ? Why does it often take a major tragedy to point out and force safety improvements in our vehicles, when the safer design could and should have been made *at the inception* ?

To sum up…

You Must Study What Actually Happens in the Real World

FIRST, you must get out and study what happens in real collision accidents.

How and why did the children and the adults get injured ? Would safer design have prevented the tragedies ? Should the schoolbus fuel tank have been better protected ? Should airbags inflate only in crashes above 20 mph, and initially inflate upward, and with a force tailored to the severity of crash and size of the passenger ? Commendably, some companies have been designing safer airbags for years, such as in various models by Mercedes, BMW, Honda, Acura, Lexus, and Volvo, and most recently by Ford.

SECOND, you must evaluate realistic tests, and design for extremes.

Evaluate tests and simulations with mock-ups, prototypes, and production vehicles to study what would happen with various design alternatives in a realistic variety of forseeable accident situations. Don't just design for the average person in an average situation, but instead design for *the wide spectrum of people* who will ride in that vehicle. Infants, children, short-stature adults, large and heavy and tall adults, pregnant women, paraplegics and quadriplegics in wheelchairs, feeble and elderly citizens. Design for the extremes, not just the minimal or average.

THIRD, you must get continuing feedback from what really happens when the vehicles are on the road, and they get into various collision accidents. Investigate and

evaluate what happened, why the accident occurred, why the people were injured. Was any of it preventable by a safer design of the subject vehicle, or of the road, or of the multiple vehicles involved that might have been mismatched due to their different sizes, weights, and types ? What design improvements are needed to make these vehicles and situations safer, and more safely compatible in the traffic mix ?

Have the courage to tackle our nation's and world's toughest transportation and vehicle problems, and find solutions that are fair and compassionate. If you'd like further information about many of the auto safety issues we've discussed, and others, check out my website at **www.AutoSafetyExpert.com** You can also send me an E-mail through my website. I'd welcome any of your comments and questions and suggestions. Let's get a constructive dialogue going!

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