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THE ENGINEER'S LAMENT

Two ways of thinking about automotive safety.

By Malcolm Gladwell

In the early nineteen-seventies, Denny Gioia worked in the recall office of the Ford Motor Company. His job was to read field reports from the engineers Ford had posted around the country. If a safety problem was spotted, the Ford representative in that district would write up the case on a standardized form—single sheet, two sides, sometimes with a photograph stapled to the page—and send it on to Detroit.

Gioia looked for patterns. "You have to be able to identify something that's breaking," he said not long ago. "Otherwise, I've got an imaginary event. I try not to engage in magical thinking. I've also got to have a pattern of failures. Idiosyncrasies won't do. Question is, do you have enough here indicating that these failures are not just one-off events?" He was looking for what he called "traceable cause."

From the case reports that came in, Gioia built files, hundreds of them. He posted updates on a large bulletin board listing all the recalls that Ford had open at the time. Once a week, he would drive to the "chamber of horrors"—a huge depot a few miles from Ford's headquarters, where all the problematic parts and vehicles were sent. His responsibility was to put cases on the "docket," the slate of potential recalls. There were five people in the office. They would go through every case on the docket and vote on whether to send it to the executive committee.

"I was young, I was relatively low pay grade, but it was an extraordinarily powerful position, in the sense of being able to influence people to do things," Gioia said. "If I picked up the phone and said, 'This is Gioia from recall office,' people jumped. I'm a twenty-six-year-old guy having people drop everything to respond to my requests."

Gioia is a car guy. His everyday drive is a 2013 Porsche 911 S, and his weekend ride is a red 1979 Ferrari 308 GTS—the kind with an engine that can rattle windows. His first job was with Boeing's aerospace division at Cape Kennedy, where he was part of the

team that made sure the arms on the scaffolding that held the Apollo 11 and the Apollo 12 in place before liftoff retracted at precisely the right moment—because terrible things would happen if they didn't. Gioia is capable and direct and intelligent, with the easy self-confidence of someone who has mastered mechanical things. The walls of his office are covered with pictures of Ferraris and memorabilia from NASA and the slide rule he used on the Apollo projects. He grew up in rural Pennsylvania and Florida: working-class parents, state schools all the way for engineering, and then business school. He was beloved at Ford. When he was recruited, someone in H.R. wrote "Crown Prince" across his file.

"One of the cases I inherited when I got the job had to do with speed-control devices," Gioia recalled. At the time, they were regulated by a vacuum valve, which was failing in two of Ford's most expensive cars, the Lincoln Mark IV and the Thunderbird. "The Thunderbird is a behemoth," Gioia said. "It's got a four-hundred-and-sixty-cubic-inch engine hanging out at the front. I mean, the hood is almost as long as the rest of the car. And nothing you could do from inside the car could slow it down. You're supposed to be able to hit the brake and shut it off. Nope, won't do it. Hit the switch. No, it won't shut off. This thing is in the accel mode. It weighs forty-five hundred pounds—it's almost a light truck. It's driven by little old ladies from Pasadena and it's on its way to a hundred miles an hour.

"The advice we got from the engineers was 'Just tell the drivers to turn the ignition off.' Well, then there's no vacuum assist on the power brakes. Steering turns heavy. Ain't nothing going on. So what would you rather have—somebody who can't steer the car or stop the car or somebody who's on his way to a hundred miles an hour? That's a problem that's going to kill someone."

The T-bird case was straightforward: clear traceable cause, obvious pattern of failure. Often, though, the troubles were more difficult to locate. Gioia could get twenty to twenty-five reports a day. The pace was unrelenting. Everything was a crisis. When he started, he was told, "We only have time to put out the big fires and piss on the little ones." He said, "I had to become aware that you can't attend to everything. You have to prioritize the most dangerous problems. Then you have to figure out when to pull the trigger. When do I actually have enough information that says it goes on the docket?

Then how do I have enough information to make a compelling case to convince an executive panel that they really should spend thirty million dollars on a recall?"

Several times, Gioia used the present tense in describing his time at Ford, even though it had been decades since he'd worked there. Finally, he caught himself: "You hear how I'm talking now? I get pitched back in time. I haven't been there for forty years. But I still speak in the 'we' when I'm talking about these events."

By "these events," he was referring to one case in particular. It first came to his notice in 1973, when he got a field report on one of Ford's top-selling cars, a compact called the Pinto. The Pinto went on to spawn a series of devastating lawsuits, a federal investigation, a "60 Minutes" exposé, and a recall of 1.5 million vehicles, culminating in the indictment of the Ford Motor Company—the entire company—for reckless homicide in the deaths of three teen-age girls. (Full disclosure: In 2011, I gave a talk at a marketing conference sponsored by Ford.) Honda's current crisis over defective air bags, General Motors' multibillion-dollar ignition-switch recall last year, and Toyota's sudden-acceleration problems in 2009 and 2010 all follow the template created by the Pinto case forty years ago. A car company knows about a problem, and doesn't fix it—why not? Denny Gioia has spent the better part of a lifetime thinking about this question. Sometimes there was a picture on the field reports that came across Gioia's desk. The Pinto case had multiple photographs, stapled front and back. Gioia remembers everything about that first moment. "Oh, God," he says, "like it was yesterday."

There is an old joke about an engineer, a priest, and a doctor enjoying a round of golf. Ahead of them is a group playing so slowly and inexpertly that in frustration the three ask the greenkeeper for an explanation. "That's a group of blind firefighters," they are told. "They lost their sight saving our clubhouse last year, so we let them play for free."

The priest says, "I will say a prayer for them tonight."

The doctor says, "Let me ask my ophthalmologist colleagues if anything can be done for them."

And the engineer says, "Why can't they play at night?"

The greenkeeper explains the behavior of the firefighters. The priest empathizes; the doctor offers care. All three address the social context of the situation: the fact that the firefighters' disability has inadvertently created conflict on the golf course. Only the engineer tries to solve the problem.

Almost all engineering jokes—and there are many—are versions of this belief: that the habits of mind formed by the profession enable engineers to see things differently from the rest of us. "A pessimist sees the glass as half empty. An optimist sees the glass as half full. The engineer sees the glass as twice the size it needs to be." To the others, the glass is a metaphor. Nonsense, the engineer says. The specifications are off. He doesn't give free rein to temperament; he assesses the object. These jokes, like many of the jokes people tell about themselves, are grievances. The engineer doesn't understand why the rest of us can't make sense of the world the way he does.

Toyota's safety crisis was, in a sense, a version of the golf-course conundrum. One of the problems facing the company was "sticky" accelerator pedals: drivers would take their foot off the accelerator, and in a small number of cases the pedal wouldn't spring back up immediately. After four cases in Europe were brought to Toyota's attention, the company determined that under conditions of high heat or humidity the synthetic material used in part of the pedal mechanism was degrading slightly.

Toyota's engineers approached the problem armed with the two concepts that define the engineer's world: tolerances and specifications. A system's tolerance is its ability to cope with changes and unplanned variation; systems need to be tolerant because you can never perfectly predict what stresses and unexpected behaviors they will encounter. Specifications are constraints. No one tells you to build a perfect car. People tell you to build a car in eighteen months that will sell for twenty-five thousand dollars. The fact that a car is revealed to be imperfect, in other words, is not sufficient reason to recall it: imperfections and compromises are inevitable. The issue is how tolerant the car is of those imperfections and compromises.

The University of Michigan engineering professor Jeffrey Liker (writing with Timothy N. Ogden) describes what happened next in the book "Toyota Under Fire" (2011):

> The primary concern was
> determining if the sticky pedals

> affected the ability of drivers to stop their vehicles. This question is the hidden factor around which much of the subsequent controversy revolved: if the sticky pedals kept drivers from stopping or materially increased the amount of time required to bring a car to a halt, then the sticky pedals were clearly a safety defect and required immediate corrective action. If, on the other hand, braking performance was unaffected by the sticky pedals, then, the engineers felt, the pedals were not a safety defect but a customer-satisfaction and component-reliability issue.

What did Toyota's engineers find? When the pedal stuck, it made no difference in how quickly the car could be brought to a stop: the brakes were powerful enough to override the problem if applied with sufficient force. Then they looked at the federal accident database, and learned that no crash had been credited to a sticky accelerator pedal. The system was, to their mind, sufficiently tolerant of imperfection. They decided against an immediate recall, choosing instead to redesign the part and introduce it in new model lines. Their solution was not empathy or care. It was *play at night*.

The public saw things very differently. They didn't think about the necessary compromises inherent in the design process. They didn't understand that a car was engineered to be tolerant of things like sticky pedals. They looked at the part in isolation, saw that it did not work as they expected it to work—and foresaw the worst. What if an inexperienced driver found his car behaving unexpectedly and panicked? To the engineer, a car sits somewhere on the gradient of acceptability. To the public, a car's status is binary: it is either broken or working, flawed or functional.

In the wake of the sticky-pedal problem, customers started complaining that Toyotas were prone to sudden, unintended acceleration. "Whenever someone called in to say, 'I've had an episode of unintended acceleration,' Toyota would dispatch a team of

engineers," said Roger Martin, a former dean of the University of Toronto's Rotman School of Management and a member of the advisory panel that Toyota put together during the crisis. "And they would do a thorough examination of the car and pronounce it fine—because it always was—and assure the owner that everything was going to be fine. They were probably just pressing the accelerator when they thought they were pressing the brake. There wasn't a problem. Just be more careful next time. And they got more and more complaints."

The engineers were right. A series of exhaustive investigations by federal regulators, with help from NASA engineers, established that the perception of an electronic failure was almost certainly illusory. The problem was caused either by the fact that some people put in poorly fitted, nonstandard floor mats or by the fact that drivers were pressing the accelerator thinking that it was the brake. (Pedal error, as it is known, is a well-documented source of vehicle malfunction, affecting drivers of many makes and models.) Cars are engineered to be tolerant of pedal error: the driver who depresses the accelerator, thinking it's the brake, still has the option of simply putting the car in neutral or turning it off. (That's one of the reasons that cars have gearshifts and ignition switches.) But in the public mind a car that accelerated unexpectedly was *broken*. The teams of engineers that Toyota sent out didn't make the problem better. They made it worse.

"The Toyota guy explained this to the panel," Martin went on. "He said, 'Here's our process.' So I said to him, 'What do you imagine the people are thinking? They're shaking like a leaf at the side of the road and after that whole experience they are told, "The car's fine. Chill out. Don't make mistakes anymore." Of course they are not going to be happy. These people are scared. What if instead you sent people out who could be genuinely empathetic? What if you said, "We're sorry this happened. What we're worried about is your comfort and your confidence and your safety. We're going to check your car. If you're just scared of this car, we'll take it back and give you another, because your feeling of confidence matters more than anything else." ' It was a sort of revelation. He wasn't a dumb guy. He was an engineer. He only thought about doing things from an engineer's standpoint. They changed what those teams did, and they started getting love letters from people."

It is hard to find an auto-safety controversy that does not divide along these lines. Last year, Tim Murphy, the chairman of the House Subcommittee on Oversight and Investigations, opened the first of two congressional hearings on the Chevrolet Cobalt ignition-switch recall by saying, "Today we will ask G.M. and N.H.T.S.A. what they are doing, not just to fix the car but to fix a culture within a business and a government regulator that led to these problems." Murphy was taking the public view. Since the Cobalt was broken, the fact that the National Highway Traffic Safety Administration did not order it recalled in a timely fashion represented a moral failure. "This is about restoring public trust," he went on, "and giving the families and crash victims the truth about whether this tragedy could have been prevented and if future ones will be prevented."

Then the acting head of the N.H.T.S.A., David Friedman (whose Ph.D. thesis involves ways of mathematically modelling fuel-cell stacks), gave his testimony, and he spoke another language. In the dry, empirical vernacular of the engineer, he explained exactly why the agency had done what it did. The Cobalt in the model years 2005-2010 was equipped with an ignition switch that, under certain conditions, shut off in mid-operation, disabling the air bags and the power assistance on the steering and the brakes. Accidents involving nonfunctioning air bags are monitored as a matter of course by the N.H.T.S.A.'s Special Crash Investigation (S.C.I.) division. In 2005, when the S.C.I. first received field reports on the Cobalt, it passed the cases on to the Early Warning Division (E.W.D.), which collected all the data it could on air-bag non-deployment (A.B.N.D.) and referred the information to the Data Analysis Division (D.A.D.), which came up with a statistical comparison of air-bag non-deployment in the Cobalt and its peers.

"The data available to N.H.T.S.A. at the time was not sufficient to warrant a formal investigation," Friedman explained, at which point you can imagine the members of the investigative committee either rolling their eyes or falling asleep. But Friedman soldiered on. A.B.N.D. rates as calculated by the D.A.D., with an assist from the E.W.D. and the S.C.I., can be obtained for every compact car sold in the United States in the early two-thousands, and then ranked in order of how frequently a model's air bags failed to deploy in an accident. The average for the group is 1.22 non-deployments per hundred thousand kilometres driven. The worst offenders were the 2005 Toyota Echo (3.9 A.B.N.D.), the 2003 Kia Optima (3.79), and the 2004 Hyundai

Accent (3.15). The 2006 Cobalt is right in the middle of the pack, and the 2005 Cobalt is just slightly worse than the average.

The underlying data set that Friedman's charts drew from is a blizzard of numbers that would take up half a column on this page. But, if you take the time to sift through them, it is clear that Friedman gave a rigorous answer to the question of why it took so long for G.M. and federal regulators to see that the Cobalt had a problem. It took so long because for the longest time there was little evidence to suggest that Cobalts *had* a problem. They were just somewhere in the middle of the gradient between unacceptable and high-performing. "All the brilliant engineers and workers in the world won't matter if the people don't really care," Murphy told the assembled witnesses, in his opening statement. "As the old saying goes, 'People don't care that you know until they know that you care.' " He meant: If all you do is give me numbers, I can't understand you. Friedman, in giving him numbers, had effectively responded: If I don't give you numbers, how do we know what to care about?

In this exchange, none of the categories that we typically use to account for belief and behavior are particularly helpful in making sense of their differences. Identity politics—the great explanatory growth engine of our time—focusses on gender and ethnicity. But the fact that these are two middle-aged white men tells us nothing. Murphy is a Republican and Friedman was appointed by a Democrat. But this doesn't help, either. Their disagreement isn't political. It's professional. Murphy holds a Ph.D. in psychology (and continues to see patients); Friedman is pursuing one in engineering. Their perspectives turn on a category—profession—that we have pushed to the bottom of the pile. Surely this is why Jimmy Carter remains the most puzzling American President in recent times. We have too often insisted on trying to understand him using the default modes of identity politics: as a white, Southern born-again Christian. But Carter was by profession and training an engineer—a disciple of the greatest and most influential engineer in the history of the U.S. Navy, Admiral Hyman Rickover. Rickover, Carter once said, had more influence on him than anyone except his parents. In his literalness, his relentless candor, his practicality, Carter was the Toyota engineer by the side of the road doggedly lecturing us on how to drive the car. Carter's true nature is puzzling only if we remain rooted in the fantasy that the world we inherit somehow matters more than the world that we chose for ourselves—and that surrounds us, from nine to five, every working day of our adult lives.

"I'm a child of the sixties," Gioia said, on this point. "I was an active member of the protest movement against the war in Vietnam and, curiously, the behavior of corporate America. I'm one of those guys who faced off with the bayonets as a result of the Kent State thing. During my M.B.A. program, in my classes, I was the voice for social activism. I got the reputation as the bleeding-heart liberal in the room, and that was the reputation I carried with me to Ford."

Gioia says he went to Ford with the idea that he would "fight them from the inside," but sooner or later, inevitably, the world that surrounds us, all the working day, takes precedence. "Here's the guy that went in with a strong value system, with intent and purpose, and got flipped within the space of two years," he went on. "If it could happen to me, it could happen to anybody."

He joined Ford in 1972, and by 1974, when concerns about the Pinto began to emerge, he was thinking differently. He had become an automotive engineer. Reflecting on his own changes, he was put in mind of Ariel Sharon: "When he was asked later in his career why he was making all these concessions to the Palestinians now that he's in the Israeli government, he simply said, 'It looks different from here.' I guess it looked different from there."

On the afternoon of August 10, 1978, just outside Elkhart, Indiana, three teen-age girls stopped for gas on their way to a volleyball game. The driver was Judy Ulrich. Her cousin Donna and her younger sister Lyn were passengers. They were in a 1973 Pinto. At the gas station, as Lee Patrick Strobel recounts in his book "Reckless Homicide?," a history of the Ulrich trial, the girls accidentally left the gas cap on the roof of the car, and after a mile or so it slipped off and rolled across the road. Judy slowed down. There was a high curb along the side of the highway, so pulling off the road was impossible. She put on her emergency flashers. Coming down the road behind them was a van driven by a twenty-one-year-old man named Robert Duggar. He had two half-empty bottles of Budweiser next to him (although he wasn't under the influence), and he took his eyes off the road for a moment as he reached for a cigarette. When he looked up, the Pinto was ten feet in front of him. He could not stop in time. The Pinto exploded in flames. Shards of glass scattered in every direction. The car spun around and around, stopping a hundred and fifty feet from the point of impact. The fire reached almost thirteen hundred degrees, melting the sunglasses

around Lyn's eyes. Lyn and Donna were killed instantly. Judy Ulrich lay in the grass with burns over ninety-five per cent of her body, crying out, "Help me. Please, help me." She died eight hours later.

The Ulrich crash is what led to Ford's being charged with homicide. It is also very similar to the Pinto case that had come across Denny Gioia's desk five years earlier: a rear collision, leading to a fire. In Gioia's case, however, the kinds of detail that made the Ulrich case so emotionally compelling—the three girls, the volleyball game, the melting sunglasses, Judy Ulrich's cry for help—were absent. He had a typed double-sided sheet, with photographs. That's what a recall officer sees. It would come in the morning mail with a pile of other case reports, not as the subject of a "60 Minutes" exposé or a sensational front-page story. He would see that people had died. But a death to him does not register the same way as a death does to us. The recall officer goes to the chamber of horrors every week. He looks at car crashes for a living. "People dying was a normal part of the job," Gioia said. "It really affected me when I first started. I had a hell of a time getting used to what was required, because the first thing that gets you going is always an awareness that someone has been grievously injured or killed in one of your products. And the only thing I'll say to you is *You've got to get over that.* If you want to let emotion drive the recall coördinator's job, you ain't going to be a very good recall coördinator. You have to accept that, if you're a manufacturer who's building a product like a vehicle, people are going to get killed."

So imagine the case in the recall officer's stripped-down version. The relevant question is not *who* died. He's not dwelling on the tragedy of three teen-age girls. His question is: *Why* did they die? The prosecutor in the Ulrich trial, Michael Cosentino, said that Ford was to blame. Why didn't blame reside with the municipality, which built a highway with a curb that made it impossible for anyone to pull over safely? Or with Robert Duggar, who casually reached for a cigarette and took his eye off the road?

Cosentino's answer was that he had traceable cause. As Strobel recounts, Cosentino argued in his opening statement that there was something inherent in the Pinto's design that "invited fire in the event of normal highway collisions." This allegation was made repeatedly in the many lawsuits involving the Pinto. The Pinto's gas tank sat behind its rear axle—instead of above it—and was separated from the back bumper by only a few inches of "crush space." In a rear collision, the tank would be slammed

against exposed studs on the axle, punching holes in the tank, ripping out the fuel-filler neck, and spilling gas into the passenger cabin. If any part of the metal scraping on metal or metal scraping on pavement that is typical in a crash produced a spark, the car would erupt into a fireball. A few months before the Ulrich crash, the N.H.T.S.A. released the results of an investigation into the Pinto's safety record, detailing thirty-eight instances in which a Pinto had been struck from behind and burst into flames. Under pressure from the N.H.T.S.A., Ford eventually agreed to install a plastic protective "flak jacket" between the gas tank and the axle. The Ulrich crash was in August of 1978. The recall was supposed to start that fall. Hence the trial, and the pressing question: Why did Ford wait until 1978 to fix the gas tank of a car that first came out in 1970?

But does a rear-positioned gas tank qualify as traceable cause? Traceable cause suggests a deviation from the norm. It turns out, however, that most compacts of that era had fuel tanks behind the rear axle. A former head of the N.H.T.S.A. testified on Ford's behalf, stating that in his opinion the Pinto's design was no more or less safe than that of any other car in its class, like the Chevrolet Vega or the A.M.C. Gremlin. Under cross-examination, one of the chief witnesses for the prosecution—an automobile-safety consultant named Byron Bloch—conceded the point. In "Reckless Homicide?," Strobel writes:

> Bloch agreed that the American Motors Gremlin, Chevrolet Vega, and Dodge Colt had their gas tanks behind the axle; that those cars had essentially the same bumpers ("I would say that they were all bad," Bloch said); that the Vega had no body rails at all; that all four cars had somewhat similar distances from the tank to the rear bumper; that all of them had at least some sharp objects near the tank; and that the thickness of the gas tank metal on the Pinto was in

the upper one-third of other 1973
(era) cars.

Here are the deaths per million vehicles for 1975 and 1976 for the best-selling compact cars of that era, compiled by Gary T. Schwartz in his landmark law-review article “The Myth of the Ford Pinto Case”:>

Gremlin

274

315

Vega

288

310

Datsun 1200/210

392

418

Datsun 510

294

340

Pinto

298

322

Corolla

333

293

VW Beetle

378

370

Suppose we focus just on the subset of accidents involving a fire. That's a rare event—it happens once in every hundred crashes. In 1975-76, 1.9 per cent of all cars on the road were Pintos, and Pintos were involved in 1.9 per cent of all fatal fires. Let's try again. About fifteen per cent of fatal fires resulted from rear collisions. If we look just at that subset of the subset, Schwartz shows, we finally see a pattern. Pintos were involved in 4.1 per cent of all rear-collision fire fatalities—which is to say that they may have been as safe as or safer than other cars in most respects but less safe in this one.

Later, after Gioia's initial brush with the Pinto, he recalled finding out about internal Ford tests showing that the fuel tank of the Pinto would rupture in rear crashes

involving speeds as low as twenty-five miles per hour. The corresponding figure for its competitors, like the Vega, was closer to twenty-seven or twenty-eight miles per hour, he said. The disparity was pointed out by Cosentino at the Ulrich trial. Ford knowingly sold a car that performed worse than its competitors in the most horrifying of scenarios—a fire from a rear collision. He was thinking speculatively and symbolically. What's the worst that could happen? And what does that fact say about the company's motivations?

Yet, from an engineer's standpoint, the same information is much more ambiguous. Every car on the road is different—safer in some ways and less safe in others. So does the one area where the Pinto is worse—by two miles per hour in an infrequent subset of a rare kind of fatal crash—mean that the car is defective? A radically redesigned Pinto would not have saved the Ulrich girls. In the trial, the defense successfully argued that Duggar was driving at close to fifty miles per hour, and nothing short of a Sherman tank could have survived the impact of a four-thousand-pound van at full speed.

Around this time, the N.H.T.S.A. passed a revised version of what's called the 301 rule, which stated that the fuel systems of passenger cars had to be safe from rupture in collisions of thirty miles per hour. The N.H.T.S.A. decided to fix the problem of the Pinto's gas tank through regulation. But when the N.H.T.S.A. went back in 1990 and analyzed the effect of the new regulation, it concluded that "fatalities were not affected." The difference between twenty-five and thirty miles per hour, or between 27.5 and thirty, was too small to pick up, or maybe it didn't exist at all, or maybe the problem all along was rear collisions at fifty or sixty miles per hour. *Fatalities were not affected.* We are back to where Friedman was with the air-bag non-deployment rates of the Cobalt. Was the car broken? Or was it just somewhere on the gradient between unacceptable and high-performing?

In the nineteen-nineties, the sociologists Matthew Lee and M. David Ermann interviewed the key engineers who had worked on the Pinto, and even then—two decades after the controversy—they were resolute. "They didn't see the fuel-tank issue as the central problem, and they didn't see the fix that was implemented as the result of the recall as doing anything worthwhile," Lee said recently. "In their view, the flak jacket was pretty much useless." They had seen the data. They had looked at the record

of events like the Ulrich crash, and the 1990 N.H.T.S.A. 301 report. They concluded that we would be better off focussing on other things. Lee went on, "They would say things like 'The gas tank was problematic, as it was for all the other small cars and as it still is today for many small cars.' Then they would say, 'But the real issue is this'—and they would go off on a passionate discussion of safety glass."

You and I would feel safer in a car that met the 301 standard. But the engineer, whose aim is to maximize safety within a series of material constraints, cannot be distracted by how you and I feel. If you are busy empathizing with blind firefighters—if your goal is to treat them with the same consideration you would sighted golfers—how do you get them to consider that everyone might be better off if they played at night? The grievance at the heart of that joke is that we wrongly think of the engineers' attitude as callous, when to their mind, in their focus on identifying the real problem, they are the opposite of callous.

At one point, Gioia began to tell the story of the time his team got word of a problem at Ford's big-truck plant in Kentucky. A batch of wheel hubs was defective: clear traceable cause, obvious pattern of failure. "They had identified twelve highway tractors, the big ones, where they knew the front hubs were going to break," he said. "Not if, *when*. And so we dropped everything. We had to find those trucks. We're talking about a big truck at highway speeds. The momentum on a heavy vehicle will literally knock down a house. We stayed up for several days until we found them all. One was in Alaska. Another was on a boat to Hawaii."

He went on, "So many people, especially the people writing about G.M. right now, are saying, 'It's a collection of bad actors, and they have inured themselves to their responsibilities.' But I think it's important to say that, at least in the recall office where I worked, it was not populated by a collection of ogres. They were people that cared."

That is, these were people who cared about the problems *they thought were problems*. The entire time that Gioia was working on the Pinto case, he drove a Pinto. "Look, the facts of the matter are that in normal use this car is perfectly fine," he said, shrugging. Later, he sold his Pinto to his sister, for six hundred dollars. At the time, the Pinto was being tried in court for the murder of three teen-age girls. But it should be remembered that, in the end, Ford won the Ulrich case. The engineers got the chance to present their evidence, and their testimony carried the day.

Last August, the traffic-safety expert Leonard Evans published a paper in the *American Journal of Public Health*. In the early nineteen-seventies, Evans wrote, the United States was often said to have the safest roads in the world, and since then traffic fatalities in the U.S. have declined by forty-one per cent. That sounds like an impressive number. But then Evans pointed out that, in the same period, traffic deaths in the Netherlands, for instance, declined at twice that rate. The United States, once No. 1 in the world in safety, has fallen to nineteenth place. If American highway deaths had followed the European pattern, Evans concluded, twenty thousand lives would have been saved in 2011 alone.

Evans is a physicist and a member of the National Academy of Engineering, who worked for years for General Motors, and you get a clear sense of what he would like to see: the causes of traffic fatalities ranked in order of significance, and a safety campaign organized accordingly. Excessive speed, for example, is implicated in an overwhelming number of fatal crashes. Traffic enforcement cameras—"speed cameras"—have been shown, conclusively, to reduce road fatalities. Western European countries have been aggressive in adopting speed cameras, which is one of the main reasons that their road deaths have fallen so dramatically. The United States has not. Even simple police enforcement of the speed limit, in some states, has been lacking. A few years ago, the economists Gregory DeAngelo and Benjamin Hansen wrote a paper looking at road deaths and injuries in the state of Oregon, which—in part because of a "tax revolt"—has cut the size of its highway patrol repeatedly since the end of the nineteen-seventies. "We find that Oregon would have experienced 2,302 fewer fatalities from 1979-2005 if the number of state police had been maintained at their 1979 levels," the two concluded.

There is also a clear, demonstrated relationship between the cost of alcohol and the number of drunk-driving deaths. Research has shown that raising social awareness around drunk driving—as groups like Mothers Against Drunk Driving have done—is not enough. In most Western European countries, the sales tax on alcohol ranges between sixteen and twenty-five per cent. In the United States, it is somewhere between one-half and a third of the European rate—and because the federal excise is a flat amount (not a percentage of the sales price) it falls every year with inflation.

"There are extremely negative outcomes that are responsive to the price of alcohol, like highway fatalities," the economist Philip J. Cook, who has written extensively on the subject, says. "I estimated that the tax increase associated with the 1991 excise tax saved sixty-five hundred lives the first year from trauma-related accidents of various kinds. It was an extraordinarily effective measure from the public-safety perspective. What is distressing to me is that it has been allowed to erode. And there is a large segment in Congress seeking to repeal the 1991 increase entirely."

In the United States, issues like taxes or speed cameras tend to be framed in political terms—as matters of individual liberty or economic freedom. But Evans's point is that we have overlooked the fact that these issues are essentially about public safety. Would the people of Oregon have voted so overwhelmingly in favor of an anti-tax ballot measure if they had realized that they were condemning thousands of their fellow-citizens to death?

The number of deaths associated with drinking and speeding obviously dwarfs the number associated with the kind of auto-safety controversies that grab our attention. The N.H.T.S.A.'s conclusion was that, in the first seven years that the Pinto and its later companion model the Bobcat were on the road, two dozen of their occupants were killed by fires from rear collisions. The number of deaths linked to the Toyota sudden-acceleration complaints was about the same. The deaths associated with G.M.'s ignition-switch malfunction have so far totalled around fifty. More people died in an average year in Oregon as a result of too few traffic police than died in all three of those controversies combined. And those are just the fatalities that resulted from a single variation in one factor in one small state in one twenty-five-year period.

The other obvious fact is that the variables that really matter have to do with the driver, not the car. The public approach to auto safety is preoccupied with what might go wrong mechanically with the vehicles we drive. But the chief factor is not what we drive; it is *how* we drive. Richard Schmidt, who is perhaps the world's leading expert on pedal error, says that the Toyota sudden-acceleration controversy ought to have triggered a national discussion about safer driving. He argues for overturning the deeply held—and, in his view, irrational—proscription against two-foot driving. If drivers used one foot for the accelerator and the other foot for the brake, he says, they would be far less likely to mistake one pedal for the other. Accidents could be

prevented; lives could be saved. But in order to talk about solving the pedal-error problem you have to accept the fact that, when it comes to saving lives, things like the number of police on the road, and the price of alcohol, and the techniques we use to drive our cars are vastly more important than where a car's gas tank is mounted.

"I would argue that our nation has a low tolerance for fatalities associated with airplanes," the N.H.T.S.A.'s David Friedman told me, when we spoke late last year. "In part because of that, fatalities are very, very low from aircraft. Also in part because of that, the F.A.A. has close to fifty thousand employees—an order of magnitude more employees than we do. We have six hundred. To deal with ten thousand people who are dying from drunk driving or ten thousand dying because they didn't wear a seat belt, or the three thousand dying from distracted driving, or the four thousand dying because they are pedestrians or bicyclists and they are hit by a car. That's why the Administration has been asking Congress for more resources for us. With more resources, we could save more lives. And each time the answer from Congress has been no. Zero."

When he said that, Friedman was fresh off another excruciating appearance before Congress, to answer questions about the Honda air-bag recall. He didn't belabor the point. He didn't have to. Here he was, charged with reducing one of the greatest sources of preventable death and injury in the United States, and he was being instructed to direct the energies of his tiny, underfunded agency toward a problem so small that it barely showed up in the traffic-fatality statistics. Engineers have a grievance. They think we should think more like them. They are not wrong.

The 1973 file with the photos stapled front and back got Denny Gioia's attention. He later went to the chamber of horrors, and he saw the problem firsthand: a burned-out Pinto carcass. "You have to imagine what it's like. Have you ever seen a burned-out—not a Pinto but *anything*?" he said. "It's awful. It's just awful. Especially if you use your imagination and remember that people were in it when it turned into that state. *Everything's* melted. All the plastic, and there's a lot of plastic. All of the wiring. Steering wheel is warped. I mean, it starts to rust in days. It's repulsive to see that kind of thing."

Did he have traceable cause? He did later, when he learned about the internal test results. But all he had in the beginning was what the engineer assigned to the case said:

"He told me, 'I spent all day on this damn car. I went over it with a fine-tooth comb. Other than that, it's a tin can.' What does that mean? He meant that it was a two-thousand-pound car on the road with four-thousand-pound cars. It got hit. It lit up. What do you expect?" It didn't look like a defect. It looked like simple physics.

Nor did Gioia see a pattern of failure. This was a rare subset of a rare subset of traffic accident. "Usually, just to put something on the docket, I've got to have twenty cases, pointing to a similar component that was failing," Gioia said. "The whole time I managed the Pinto file, I never got above five." He held out his hand, his finger and thumb separated by a sliver. "In that context of everything else that's going on, it's that big."

In the meantime, he and his colleagues in the recall office were juggling problems, trying to figure out which ones would pass muster with the executives upstairs. "Sometimes we'd look at something and say, 'It's not worth putting forth, because there's no way they're going to recall this trivial problem,' " he said. "And we didn't want to lose credibility. And, remember, on a personal level, I'm the guy who has a reputation as a bleeding-heart liberal. *Gioia will vote to recall anything.* So I had to rein myself in a little bit. And you can't recall everything. You just can't. You know? You want to recall everything that looks like it might be a problem? Guess what, you just put the company out of business."

Gioia now chairs the department of management and organization at Penn State's business school. Some years ago, he put together a study of his role in the Pinto case, and presented it to students. It didn't go well. "It opened me up to all kinds of criticism," he said. "People finger-wagging, saying, 'You're a bad actor,' taking me to task for killing people." He could not explain to a group of students deep in the world of university life how it was to think like an engineer deep in the world of a car company. Now that he is no longer an engineer, even he finds it easy to criticize his former self. "I think I could have made a huge difference if I had just gotten on the horn and started making calls," he said. "What do you know? What's going on here? Here's the pattern I'm seeing from here, what can you tell me about this?" He thinks he could have brought the Pinto case to the attention of Ford's management earlier; he could have lessened the crisis that followed. Then he remembered what it was like in the recall office, the flood of cases, the complexity and the ambiguity of those cases. If

he didn't rely on the numbers, how would he know what to care about? "I had bigger fish to fry," he said. "Bigger, more immediate problems to take care of."

He went back to the office from the chamber of horrors and put the case on the docket. It was a symbolic stand. "I practically got laughed out of the office," Gioia said. He re-created the dialogue from decades earlier:

Well, come on, Den. We're going to go in front of the executive panel with this evidence? What do you got? Two or three field reports? Why are we even discussing this_?_

Well, I just came back from the depot. You should see what I saw.

Den. Come to your senses.

"So I came to my senses," he said. "I realized, O.K., first of all, I'd done what I trained myself not to do, make decisions on the basis of emotion. And, second, I realized, I had to prove it, and I couldn't prove it."

The Pinto case was put to a vote. It lost, 5–0. Gioia voted against it himself. ♦

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