MOUNTAIN VIEW, Calif. — Google, a leader in efforts to create driverless cars, has run into an odd safety conundrum: humans.

Last month, as one of Google’s self-driving cars approached a crosswalk, it did what it was supposed to do when it slowed to allow a pedestrian to cross, prompting its “safety driver” to apply the brakes. The pedestrian was fine, but not so much Google’s car, which was hit from behind by a human-driven sedan.

Google’s fleet of autonomous test cars is programmed to follow the letter of the law. But it can be tough to get around if you are a stickler for the rules. One Google car, in a test in 2009, couldn’t get through a four-way stop because its sensors kept waiting for other (human) drivers to stop completely and let it go. The human drivers kept inching forward, looking for the advantage — paralyzing Google’s robot.

It is not just a Google issue. Researchers in the fledgling field of autonomous vehicles say that one of the biggest challenges facing automated cars is blending them into a world in which humans don’t behave by the book. “The real problem is that the car is too safe,” said Donald Norman, director of the Design Lab at the University of California, San Diego, who studies autonomous vehicles. “They have to learn to be aggressive in the right amount, and the right amount depends on the culture.”

Traffic wrecks and deaths could well plummet in a world without any drivers, as some researchers predict. But wide use of self-driving cars is still many years away, and testers are still sorting out hypothetical risks — like hackers — and real world challenges, like what happens when an autonomous car breaks down on the highway.

For now, there is the nearer-term problem of blending robots and humans. Already, cars from several automakers have technology that can warn or even take over for a driver, whether through advanced cruise control or brakes that apply themselves. Uber is working on the self-driving car technology, and Google expanded its tests in July to Austin, Tex.

Google cars regularly take quick, evasive maneuvers or exercise caution in ways that are at once the most cautious approach, but also out of step with the other vehicles on the road.

“It’s always going to follow the rules, I mean, almost to a point where human drivers who get in the car are like ‘Why is the car doing that?’” said Tom Supple, a Google safety driver during a recent test drive on the streets near Google’s Silicon Valley headquarters.

Since 2009, Google cars have been in 16 crashes, mostly fender-benders, and in every single case, the company says, a human was at fault. This includes the rear-ender crash on Aug. 20, and reported Tuesday by Google. The Google car slowed for a pedestrian, then the Google employee manually applied the brakes. The car was hit from behind, sending the employee to the emergency room for mild whiplash.

Google’s report on the incident adds another twist: While the safety driver did the right thing by applying the brakes, if the autonomous car had been left alone, it might have braked less hard and traveled closer to the crosswalk, giving the car behind a little more room to stop. Would that have prevented the collision? Google says it’s impossible to say.
Humans and machines, it seems, are an imperfect mix. Take lane departure technology, which uses a beep or steering-wheel vibration to warn a driver if the car drifts into another lane. A 2012 insurance industry study that surprised researchers found that cars with these systems experienced a slightly higher crash rate than cars without them.

Bill Windsor, a safety expert with Nationwide Insurance, said that drivers who grew irritated by the beep might turn the system off. That highlights a clash between the way humans actually behave and how the cars wrongly interpret that behavior; the car beeps when a driver moves into another lane but, in reality, the human driver is intending to change lanes without having signaled so the driver, irked by the beep, turns the technology off.

Mr. Windsor recently experienced firsthand one of the challenges as sophisticated car technology clashes with actual human behavior. He was on a road trip in his new Volvo, which comes equipped with “adaptive cruise control.” The technology causes the car to automatically adapt its speeds when traffic conditions warrant.

But the technology, like Google’s car, drives by the book. It leaves what is considered the safe distance between itself and the car ahead. This also happens to be enough space for a car in an adjoining lane to squeeze into, and, Mr. Windsor said, they often tried.

Dmitri Dolgov, head of software for Google’s Self-Driving Car Project, said that one thing he had learned from the project was that human drivers needed to be “less idiotic.”

On a recent outing with New York Times journalists, the Google driverless car took two evasive maneuvers that simultaneously displayed how the car errs on the cautious side, but also how jarring that experience can be. In one maneuver, it swerved sharply in a residential neighborhood to avoid a car that was poorly parked, so much so that the Google sensors couldn’t tell if it might pull into traffic.

More jarring for human passengers was a maneuver that the Google car took as it approached a red light in moderate traffic. The laser system mounted on top of the driverless car sensed that a vehicle coming the other direction was approaching the red light at higher-than-safe speeds. The Google car immediately jerked to the right in case it had to avoid a collision. In the end, the oncoming car was just doing what human drivers so often do: not approach a red light cautiously enough, though the driver did stop well in time.

Courtney Hohne, a spokeswoman for the Google project, said current testing was devoted to “smoothing out” the relationship between the car’s software and humans. For instance, at four-way stops, the program lets the car inch forward, as the rest of us might, asserting its turn while looking for signs that it is being allowed to go.

The way humans often deal with these situations is that “they make eye contact. On the fly, they make agreements about who has the right of way,” said John Lee, a professor of industrial and systems engineering and expert in driver safety and automation at the University of Wisconsin. “Where are the eyes in an autonomous vehicle?” he added.

But Mr. Norman, from the design center in San Diego, after years of urging caution on driverless cars, now welcomes quick adoption because he says other motorists are increasingly distracted by cellphones and other in-car technology.

Witness the experience of Sena Zorlu, a co-founder of a Sunnyvale, Calif., analytics company, who recently saw one of Google’s self-driving cars at a red light in Mountain View. She could not resist the temptation to grab her phone and take a picture.

“I don’t usually play with my phone while I’m driving. But it was right next to me so I had to seize that opportunity,” said Ms. Zorlu, who posted the picture to her Instagram feed.
Google, a leader in efforts to create driverless cars, has run into an odd safety conundrum: humans. Last month, as one of Google’s self-driving cars approached a crosswalk, it did what it was supposed to do when it slowed to allow a pedestrian to cross, prompting its “safety driver” to apply the brakes. The pedestrian was fine, but not so much Google’s car, which was hit from behind by a human-driven sedan. Google’s fleet of autonomous test cars is programmed to follow the letter of the law. One Google car, in a test in 2009, couldn’t get through a four-way stop because its sensors kept waiting for other (human) drivers to stop completely and let it go. The human drivers kept inching forward, looking for the advantage “paralyzing Google’s robot. It is not just a Google issue. “Google, a leader in efforts to create driverless cars, has run into an odd safety conundrum: humans. Last month, as one of Google’s self-driving cars approached a crosswalk, it did what it was supposed to do when it slowed to allow a pedestrian to cross, prompting its “safety driver” to apply the brakes. The pedestrian was fine, but not so much Google’s car, which was hit from behind by a human-driven sedan. Google’s fleet of autonomous test cars is programmed to follow the letter of the law. But it can be tough to get around if you are a stickler for the rules. The human drivers kept inching forward, looking for the advantage “paralyzing Google’s robot. It is not just a Google issue.