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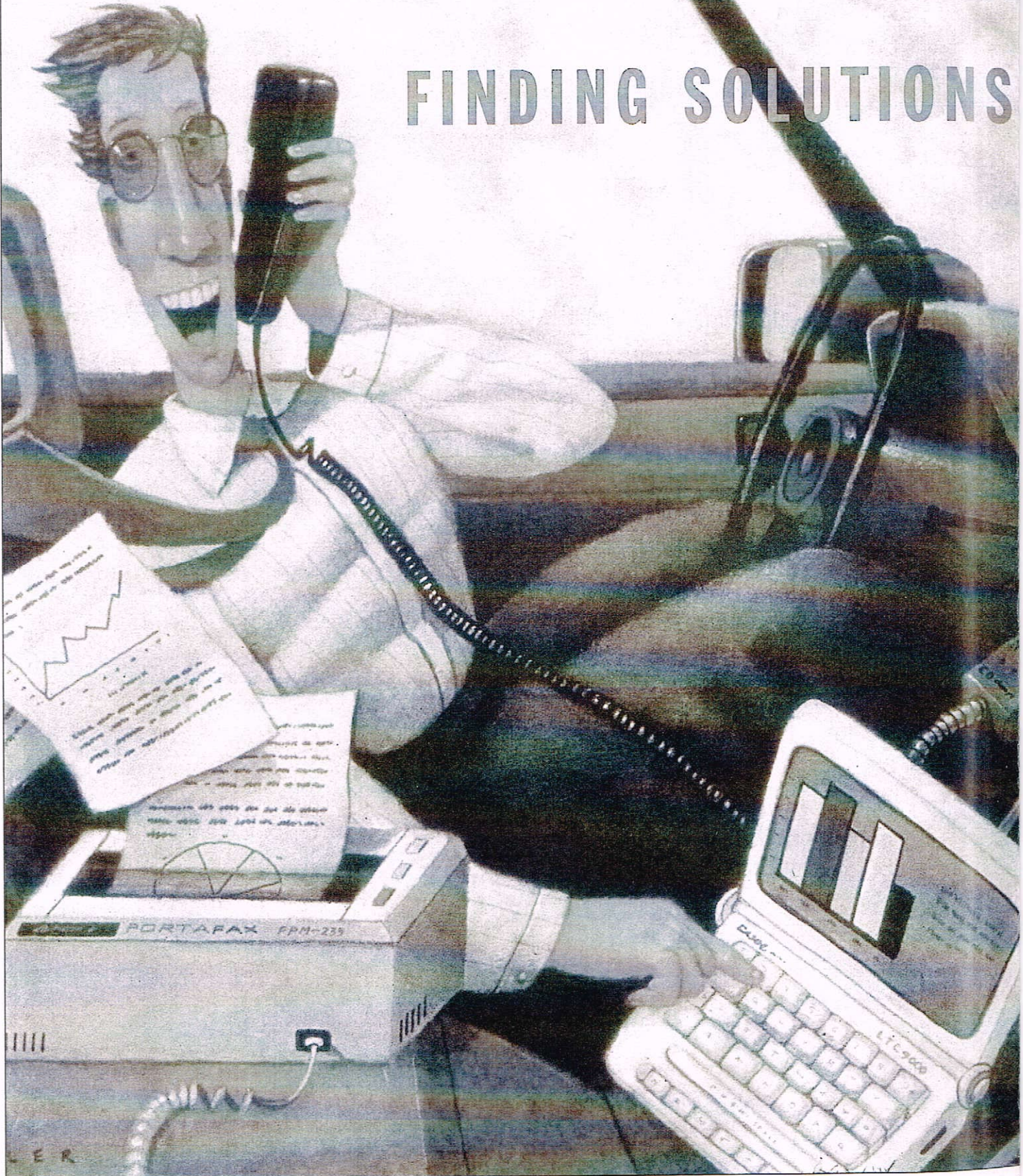
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## *Shifting* GEARS

Keeping Pace  
with Technology



# FINDING SOLUTIONS





FOR TODAY'S

# DISTRACTED DRIVERS

BY LAUREN DEANGELIS

**W**hen Scott Falb conducts public programs on driving behavior, there's always someone who brings up an infamous distracted driver.

"We had one person on a big commute from a small town who was noted for reading books while driving down the interstate," said Falb, driver services specialist for the Iowa Department of Transportation. "People were telling us about him all the time."

Falb isn't the only one with stories about distracted drivers. Fred Zwonechek, administrator for the Nebraska Office of Highway Safety, has seen his fair share of inattentive driving habits.

"We compress time and that forces a lot of people to do things behind the wheel that they normally wouldn't do," he said. "Every morning I drive to work, I see a guy shaving," he said. "He's got the visor down and he's shaving."

But the problem of distracted driving goes well beyond the shaver in Nebraska or the reader in Iowa. With advanced technologies allowing drivers to do even more in the car than ever before, inattentive driving has swept the nation. According to the National Highway Traffic Safety Administration (NHTSA), distracted driving behaviors are responsible for 20 to 30 percent of all traffic crashes in the United States.

But with the development of new safety technology, help is on the way. Highway safety advocates are finding solutions that will put the brakes on today's distracted drivers.

#### ► SPEED READ

- Distracted driving has serious consequences
- "Wonder car" warns inattentive drivers
- Technology tracks eye movement
- Legislators and researchers tackle the problem
- Long-term solutions vary



“...a person’s relative risk of being involved in an accident when they are talking on a cell phone...,” according

## THE DANGER OF DISTRACTIONS

Dr. Ron Knippling, senior research scientist with the Virginia Tech Transportation Institute (VTTI), described the three common ingredients of distracted driving crashes: (1) A pre-event misbehavior, such as speeding or following too closely, (2) Transient inattention to the road, such as a glance or reach down, and (3) An unexpected event ahead, such as a lead vehicle braking for a left turn.

Often an accident occurs when two of the ingredients are present, but accidents are most likely when all three ingredients occur.

“Drivers need to optimize their visual resources, but it’s almost inevitable that something is going to happen when they’re not looking,” Knippling said.

In June 2005, VTTI completed the first instrumental vehicle study to collect pre-crash naturalistic driving data. Dubbed the “100-Car Study” and sponsored by NHTSA, the Virginia Department of Transportation and the Virginia Transportation Research Council, it collected data from over 100 volunteer drivers for a year in the Northern Virginia area.

The study showed that nearly 80 percent of all crashes and 65 percent of all near-crashes involved driver inattention just prior (within 3 seconds) to the onset of the conflict. In addition, it showed that total crash involvement may be more than five times higher than police-reported crashes. Cell phones and Personal Data Assistant-type devices were involved most often in distraction-related events, and fatigue was a contributing factor in 12 percent of all crashes.

According to an analysis of 2000-2003 Crashworthiness Data System (CDS) data, 25.5 percent of crashes involve drivers who are inattentive. However, Knippling said the actual percentage may be even higher. He uses an “iceberg” analogy to illustrate.

“Police may be reluctant to allege distraction without explicit statements from drivers or witnesses,” he said. “Just below the surface, you have situations where drivers know they were distracted, but don’t tell police. At the deepest level, you’ve got situations where the drivers themselves aren’t aware they were distracted.”

Another study by the University of North Carolina’s Highway Safety Research Center (HSRC) shows that almost all drivers are distracted in some way, even to a small degree. Sponsored by the AAA Foundation for Traffic Safety, the study involved videotaping 70 people in Pennsylvania and North Carolina as they drove over a one-week period. Dr. Jane Stutts, associate director for social and behavioral research at HSRC, reviewed the results.

“We found that 30 percent of our subjects talked on cell phones, almost 46 percent groomed themselves in some way, 71 percent ate or drank beverages, and almost 92 percent fiddled with radios or CD players,” Stutts said.

## WEIGHING DISTRACTIONS

Dr. David Strayer, professor of Psychology at the University of Utah, has spent eight years studying distracted driving and how the mind works in naturalistic settings. He has found that not all activities are equally distracting. For example, when Strayer compared a person listening to a book on tape while driving with that same person having a cell phone conversation, he found that the tape produced no interference.

His studies have also found that a person’s relative risk of being involved in an accident increases four to five times when they are talking on a cell phone, and that hands-free phones are just as distracting as hand-held phones, a fact that renders recent hand-held cell phone bans ineffectual. A person is also 10 times more likely to run a stop sign while on a cell phone, whether it’s hands-free or not.

Dr. John Lee, associate professor of mechanical and industrial engineering at the University of Iowa, warns that safety technology like the hands-free cell phone must be developed carefully so that it doesn’t encourage more use.

“I conducted a study where we used an e-mail system operated by a voice computer that talked to the driver,” Lee said. “Even though the driver’s hands were on the wheel the whole time, the driver was still slower to respond to the road ahead if the vehicle in front slowed down.”

In a to-be-released study, Strayer directly compares the same person on two separate occasions, one while using a cell phone, and one while driving with a Blood Alcohol Concentration of .08.

“We found that the cell driver was actually worse and had slower reactions than the impaired driver,” he said. “In another comparison, we found the reactions of a 20-year-old driving while on a cell phone are similar to those of a 70-year-old driving without a cell phone.”

Through studies on brain waves and eye movement, Strayer has found that brain activity is reduced by half when on a cell phone during traffic situations.

“People don’t scan their visual environment as effectively,” he said. “They have tunnel vision. In addition, what they’re looking at isn’t registered as well. This is sometimes called inattention blindness. The eyes are looking, but the mind is not processing.”



# accident increases four to five times when to a study by Dr. David Strayer.

## CAR COACH DOES IT ALL

The Massachusetts Institute of Technology Media Lab has come up with a solution for drivers suffering from what Strayer dubs "inattention blindness." In 2003, the Media Lab began work on one of the most advanced intelligent cars ever built. With the help of DaimlerChrysler and Motorola, associate professor Ted Selker and the MIT team developed Car COACH (Cognitive Adaptive Computer Help), a computerized system that senses distracted driving. Wired into a test car called the Chrysler 300M IT, the system used software and artificial intelligence to interpret information from sensors that are already present in almost every car.

"We figured out how to help the driver without changing the infrastructure of the car," Selker said. "This is about teaching a person to drive well by reminding them to pay attention. The insight for our system was, 'Everyone is a good driver, but rarely are they performing at their best.'"

Car COACH analyzes the driver's behavior in relation to brakes, steering, blinkers, gas, speed, and even cup holders. If a driver is engaging in dangerous or careless behavior, the system lets them know by either speaking to them or vibrating their seat and other instruments. Selker and his team found ways to give feedback that would maximize driver performance.

"If we give feedback a half second to two seconds after the driver does something, they do better than if it was immediate because there's less cognitive load," he said. "And if we give feedback rarely, it makes people do better. Negative feedback is detrimental, so we give more positive feedback. We put vibrators in so that feedback is obvious to the driver and no one else. Or, we use positive audio. We'll say, 'Thanks for blinking,' or 'Easy on the brakes' and 'Be careful.'"

The Car COACH system was well received by testers.

"People often changed their driving behavior immediately, and positive scheduled feedback reduced driving errors," Selker said.

And better yet, at under \$10, implementation costs are minimal. While Selker feels the system should be implemented immediately, Ford and DaimlerChrysler passed it over. However, DaimlerChrysler is testing a similar steering wheel control system called Driver Advocate in its Town and Country minivan. Developed by Motorola, the three-button system helps manage the driver's workload. Each button corresponds to a managed system: incoming cell phone calls, navigation, and vehicle diagnostic information.

In addition to Car COACH, Selker is developing another system, called the ExerCar, to deal with driver fatigue. The driver must use pedals to accelerate, ensuring he or she stays awake through constant movement.

## Discussing Distraction

Despite the obstacles ahead, the pursuit of distracted driving solutions has become a prominent issue throughout North America.

### UNITED STATES

• Distracted Driving has been a topic at the last two annual Governors Highway Safety Association meetings, and will be featured at the 2006 meeting.

• For the past eight years, the Network of Employers for Traffic Safety has sponsored Drive Safely Work Week, a workplace traffic safety campaign. DSWW 2005 took place Oct. 3-7 and addressed distracted driving.

• A proposed restriction banning teenagers from using cell phones or other wireless devices while learning to drive made the National Transportation Safety Board's 2006 list of "most wanted" safety improvements.

### CANADA

• The International Conference on Distracted Driving, organized by the Canadian Automobile Association and the Traffic Injury Research Foundation, took place in

October 2005. The conference aimed to identify rational and effective programs and policies for controlling the problem of distracted driving.

• Peter Burns, chief of the Ergonomics and Crash Avoidance Division for Transport Canada, said his organization is negotiating a memorandum of understanding between the government and motor vehicle manufacturers. The MOU proposes a process-based safety management systems approach for better vehicle design.

• The Canadian Council of Motor Transport Administrators (CCMTA) is also working on a national strategy on driver distraction, according to Jean Wilson, manager of Road Safety Research for the Insurance Corporation of British Columbia. Wilson serves as chair of a CCMTA subgroup on driver distraction. The strategy aims to define the nature of the problem, review legislation and regulations, and assist in measuring the problem through research.





# “...the system distinguishes and begins tracking the head and face of the driver,” said Seeing Machines’ Nick Langdale-Smith.

## VIRTUAL EYES ON THE ROAD

In similar fashion to Selker’s Car COACH, the Australian-based Seeing Machines, founded in part by Volvo, is also pioneering technology to deal with driver distraction. The company’s faceLAB technology originated with Chief Technical Officer Alex Zelinsky in the Systems Engineering lab at the Australian National University. The technology allows a computer to “see” what a human face is doing, according to Nick Langdale-Smith, senior sales executive for Seeing Machines.

“The technology works by analyzing image data provided by a sensor that observes the driver,” Langdale-Smith said. “Using computer vision techniques, the system distinguishes and begins tracking the head and face of the driver, the eyes and their blinking behavior.”

This data is fed into the car’s computer and used to warn the driver when the level of inattention or fatigue becomes dangerously high. Seeing Machines technology is being used for research by almost every automotive company worldwide, including Nissan, Toyota, Volvo, and Daimler Chrysler. Volvo’s test vehicle, the S80, is wired with camera sensors and a flashing LED warning system. Warnings range from audio messages to vibrating seat shoulder pads to automatic emergency braking.

The Virginia Tech Transportation Institute recently completed data collection on a drowsy driver warning system (DDWS) that similarly measures eyelid closure and eye glances. The DDWS study did not use the Seeing Machines technology, but rather the “Co-Pilot,” an alertness monitor developed by Attention Technologies, Inc.

The NHTSA- and Federal Motor Carrier Safety Administration-sponsored system, which is still under development, measures eyelid positioning by using a reflection of the cornea.

If the eyelids are closed, there is no reflection, and the system beeps at the driver. Knippling envisions an eventual drowsiness monitor or “alertometer” in cars, analogous to a fuel gauge, which would show levels of attention and awakens.

## COLLABORATING FOR SAFETY

In addition to individual efforts, many organizations are working together to develop even more robust distraction-monitoring technology.

NHTSA’s Crash Avoidance Research Division of the Office of Applied Vehicle Safety Research is developing a Safety Vehicle using adaptive Interface Technology (SAVE-IT) to minimize driver distraction. The SAVE-IT contract, which began in March 2003, was won by a Delphi Delco Electronics Inc.-led team, including the University of Michigan Transportation Research Institute, the University of Iowa, Seeing Machines, Inc., Ford and General Motors. The Volpe National Transportation Systems Center provides program management and technical support for the three-year project.

The vehicle will include sensors that monitor the roadway, nearby traffic, vehicle operation, and driver state. Based on this information, the system decides whether it is safe to display information for the driver. NHTSA is hoping the development of the vehicle, which is now in its second phase, will create a basis for possible industry standards needed for application of a common adaptive interface.

The Adaptive Integrated Driver-vehicle interface (AIDE) is a European team-driven project similar to NHTSA’s SAVE-IT. The four-year project, which began in March 2004, focuses on human-machine interaction (HMI) and moderating distraction. Partners include coordinator Volvo Technology, BMW, DaimlerChrysler, the European Com-

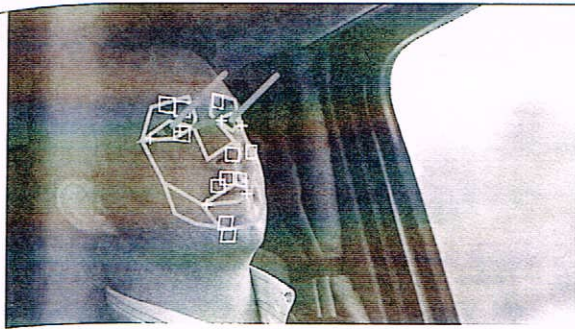
### CarCoach Feedback

ACTION	FEEDBACK	TYPE
Overexerting the car	Throttle vibrates AUDIO: “Easy on the gas.”	Criticism
Strong braking	Brake vibrates AUDIO: “Brake gently.”	Criticism
Turn without signaling	AUDIO: Steering vibrates AUDIO: “Please signal.”	Criticism
Turn with signaling	Seat vibrates AUDIO: “Thank you for signaling.”	Affirmation
Erratic steering	Steering vibrates	Criticism
Smooth acceleration, braking	Seat vibrates	Affirmation

### CarCoach Sensor Effects

SENSOR	EFFECT
Setup knobs	No criticism feedback
Criticism off	
Setup knobs	No affirmation feedback
Affirmation off	
Cell phone is in active call	Eliminates audio messages
Reverse gear	Busy light turns on no feedback
Many mistakes this drive	Warning light turns on
Drinking from cup	Eliminates feedback





mission Joint Research Center, Centro Recherche de Fiat, the German Federal Highway Institute, and 22 others.

Another collaborative research effort involves Seeing Machines, Australia's ICT Centre of Excellence, and National ICT Australia. In July 2005, they signed a one-year research agreement to explore the use of information and communications technologies relating to driver fatigue. The research will make use of the Seeing Machines-developed Driver State Sensor (DSS), which can monitor fatigue by observing eye-lids as well as 3D head position and orientation.

## BANNING DISTRACTION

With safety technology on the horizon, legislation is the logical next step to cut down on distracted driving. Every state has considered legislation on the subject in the past four to five years, according to Matt Sundeen of the National Conference of State Legislatures. As of August 2005, legislators in 39 states had considered or were considering 135 bills related to distracted driving. While no U.S. jurisdiction has banned all potential distractions, 22 states and the District of Columbia have laws restricting cell phone use while driving. In Canada, Newfoundland/Labrador is the only province with a law banning hand-held cell phones.

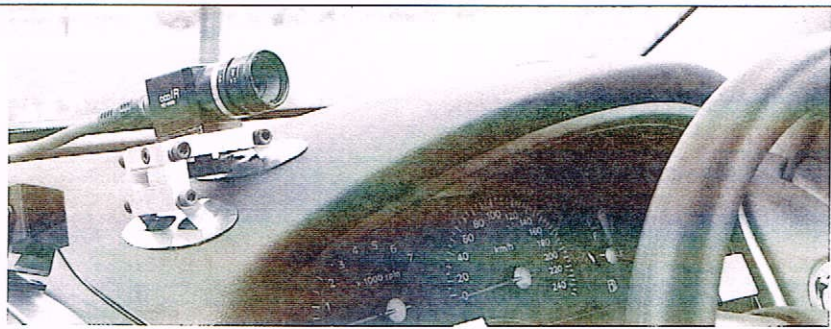
Connecticut and the District of Columbia have more comprehensive laws prohibiting personal grooming, reading and other behaviors while driving. In June 2003, New Jersey became the first U.S. jurisdiction to outlaw drowsy driving with "Maggie's Law," named for a 20-year-old college student killed by a collision with a fatigued driver in 1997. In June 2005, New Jersey again became a distracted driving pioneer when Assemblyman John McKeon introduced a measure to ban smoking while driving.

Sundeen said legislators are still trying to get caught up on the distracted driving issue, mainly because there is so little research.

"Clearly there's no consensus on what, if anything should be done," he said. "There's no consensus on the issue and no federal legislation. There's nothing really pushing the states to do anything."

Barbara Harsha, executive director of the Governors Highway Safety Association, urges states not to pass specific laws, such as those banning hand-held cell phones, until more research is conducted.

"If states want to address the issue, they should more strongly enforce the negligence laws they've already got," Harsha said.



## IS THERE A SOLUTION?

With so many factors at play in distracted driving, how can we put a stop to it?

Dr. Strayer at the University of Utah sees a three-pronged approach. First, there should be a well-grounded set of laws based on scientific research. Second, we need education to "make people aware that, when you're distracted, you're impaired to the level of a drunk driver," Strayer said. Third, distracted driving should take on a social stigma, just like drunk driving has, so that people are socially pressured not to do it.

VTI's Ron Knipling feels that driver education should place more emphasis on driving as a performance task with potential errors.

"Driver's education mainly teaches control of the vehicle and rules of the road," he said. "Aspects that aren't addressed are the ideas of risk and driving as a performance task. Every time you pick up that cell phone, you're making a decision to be less attentive to your driving."

The Nebraska DMV's Zwonechek feels people need to understand consequences.

"We have to elevate it to a level of critical importance," he said. "The consequences for being distracted can be very serious and can result in serious injuries or loss of life. We need to get people to realize the costs of making errors."

Others, like Iowa DOT's Scott Falb, envision a more drastic long-term solution.

"In the long term, I think we may need to take the driver out of control of the vehicle," he said. "We can run electronics through the pavement and use central traffic control. If people want to read, groom or answer e-mail like they are passengers, then we should make them passengers so they can do it safely." ■

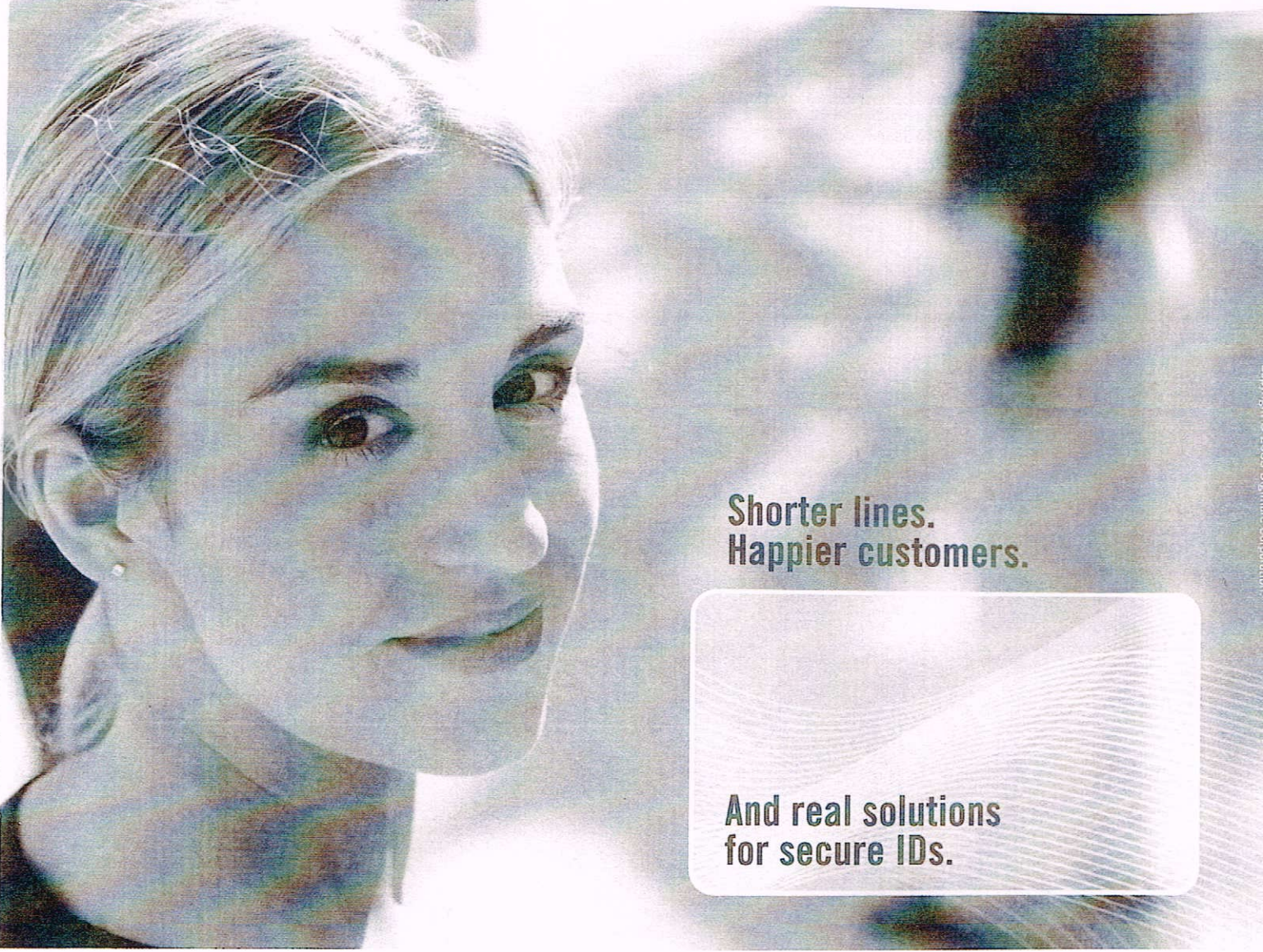
## A Guide to Alertness

According to NHTSA, at least 1,500 people die each year in fatigue-related crashes, and even more people are injured. Alertness Solutions, a scientific consulting firm led by former NASA scientist Dr. Mark Rosekind, has developed a unique tool to help drivers understand the dangers of drowsy driving—Awake at the Wheel.

"Awake at the Wheel" is a 32-page guide that combines information, self-evaluation tools, alertness strategies, travel planning, and safe driving activities. The guide, priced at \$19.95, comes with a 36-minute audio CD that includes drowsy driving facts and more. For more information, see the Alertness Solutions Web site at [www.awakeatthewheel.com](http://www.awakeatthewheel.com).

Seeing Machines technology uses sensors to track a driver's head, face and eyes.





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