National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: June 13, 2003

In reply refer to: H-03-03 through -07

Honorable Jeffrey W. Runge, MD
Administrator
National Highway Traffic Safety Administration
400 Seventh Street, SW
Washington, DC 20590

On February 1, 2002, about 8:00 p.m., on the outer lanes of Interstate 95/495 near Largo, Maryland, a 1998 two-door Ford Explorer Sport, traveling northbound at an estimated speed of 70 to 75 mph, veered off the left side of the roadway, crossed over the median, climbed up a guardrail, flipped over, and landed on top of a southbound 2001 four-door Ford Windstar minivan. Subsequently, a 1998 four-door Jeep Grand Cherokee ran into the minivan. Of the eight people involved in the accident, five adults were fatally injured, one adult sustained minor injuries, and two children were uninjured. [1]

The National Transportation Safety Board determined that the probable cause of the February 1, 2002, collision of the Ford Explorer Sport with the Ford Windstar minivan and Jeep Grand Cherokee was the Explorer driver's failure to maintain directional control of her high-profile, short-wheelbase vehicle in the windy conditions due to a combination of inexperience, unfamiliarity with the vehicle, speed, and distraction caused by use of a handheld wireless telephone. Contributing to the severity of the accident was the lack of an effective median barrier at the accident site.

Shortly before the accident, the accident driver made a wireless telephone call to a friend whom she had been following and was talking on the telephone when the accident occurred. Since no hands-free devices were found with the telephone, the driver was probably holding the telephone in one hand and steering with the other hand at the time of the accident. Given the content of the telephone conversation as reported by the friend, the accident driver was probably scanning the roadway ahead and searching for his vehicle, which was somewhere on the highway ahead of her. The cognitive effect of this conversation may have been greater than that of a casual conversation. Not only did the cognitive process of the conversation probably distract her, her attention was likely to have been redirected from the driving task to a searching task. As a result, the accident driver was most likely not attending to the driving task, was instead focused on the conversation and a searching task, and was further hampered by physically holding the wireless telephone, which left only one hand for driving.

[1] For additional information, read National Transportation Safety Board, *Ford Explorer Sport Collision With Ford Windstar Minivan and Jeep Grand Cherokee on Interstate 95/495 Near Largo, Maryland, on February 1, 2002*, Highway Accident Report NTSB/HAR-03/02 (Washington, DC: NTSB, 2003).

Research has shown that the cognitive effects of conducting a conversation on a wireless telephone can decrease situational awareness and that wireless telephone use can increase reaction time. In their 2001 study,[2] Parkes and Hooijmeijer reported that drivers engaged in wireless telephone conversations were unaware of traffic movements around them. Safety Board accident investigations[3] in several transportation modes have documented the relationship between poor situational awareness and poor performance. These investigations found that when airline pilots, railroad engineers, and ship crews lose situational awareness, they sometimes make operational errors that lead to accidents. In the case of the Largo accident driver, the potential decrease in situational awareness is likely to have delayed her awareness of the effects of the wind on her vehicle. This delayed recognition of and reaction to the effects of wind probably precipitated her steering overreaction. Therefore, the Safety Board concludes that the accident driver's distraction due to the wireless telephone conversation with her friend contributed to her loss of control of the vehicle.

The Safety Board could not determine the exact extent of the role of distraction due to wireless telephone use in the Largo accident. However, use of a wireless telephone while driving is inherently dangerous, as is any distraction that diverts one's attention from the driving task. Young, inexperienced drivers are particularly vulnerable to accidents, are easily distracted, and are known to engage in risk-taking behavior. In 2002, the Safety Board investigated two accidents, Largo, Maryland, and Korona, Florida,[4] in which young drivers were following another vehicle, lost control, and ran off the road. The Largo and Korona accident drivers were 20 and 16 years old, respectively; both were unbelted and engaged in wireless telephone conversations when they lost control of their vehicles. Young drivers continue to be overrepresented in traffic crashes and deaths. In 2001, according to the National Highway Traffic Safety Administration (NHTSA), drivers under age 20 constituted only 6.8 percent of the driving population but were involved in 14.3 percent of fatal accidents. While the Board recognizes that having access to communication in one's vehicle can be valuable, drivers in this age group, in particular, should attend only to the task of driving.

The use of wireless communication devices is becoming increasingly prevalent. In May 2003, according to the Cellular Telecommunications & Internet Association, the number of U.S.

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[2] A.M Parkes and V. Hooijmeijer, "Driver Situation Awareness and Carphone Use," First Human-Centered Transportation Simulation Conference, 2001, University of Iowa, Iowa City, Iowa, November 4-7, 2001.

[3] (a) National Transportation Safety Board, *Derailment of Amtrak Train No. 2 on the CSXT Big Bayou Canot Bridge Near Mobile, Alabama, September 22, 1993*, Railroad-Marine Accident Report NTSB/RAR-94/01 (Washington, DC: NTSB, 1994). (b) National Transportation Safety Board, *Aircraft Accident in Guantanamo Bay, Cuba, August 18, 1993*, Aviation Accident Report NTSB/AAR-94/04 (Washington, DC: NTSB, 1994). (c) National Transportation Safety Board, *Controlled Flight Into Terrain, Korean Air Flight 801, Boeing 747-300, HL7468, Nimitz Hill, Guam, August 6, 1997*, Aviation Accident Report NTSB/AAR-00/01 (Washington, DC: NTSB, 2000). (d) Aeronautica Civil of the Government of Colombia, *Controlled Flight Into Terrain, American Airlines Flight 965, Boeing 757-223, N651AA, Near Cali, Colombia, December 20, 1995*, Aircraft Accident Report. (e) National Transportation Safety Board, *Ramming of the Spanish Bulk Carrier URDULIZ by the USS DWIGHT D. EISENHOWER (CVN 69), Hampton Roads, Virginia, August 29, 1988*, Marine Accident Report NTSB/MAR-90/01 (Washington, DC: NTSB, 1990). (f) National Transportation Safety Board, *Grounding of the U.S. Tank Ship STAR CONNECTICUT, Pacific Ocean, Near Barbers Point, Hawaii, November 6, 1990*, Marine Accident Report NTSB/MAR-92/01 (Washington, DC: NTSB, 1992). (g) National Transportation Safety Board, *Grounding of the Panamanian Passenger Ship ROYAL MAJESTY on Rose and Crown Shoal Near Nantucket, Massachusetts, June 10, 1995*, Marine Accident Report NTSB/MAR-97/01 (Washington, DC: NTSB, 1992). (h) National Transportation Safety Board, *Head-on Collision of Two Burlington Northern Santa Fe Freight Trains Near Clarendon, Texas, on May 28, 2002*, Railroad Accident Report NTSB/RAR-03/01 (Washington, DC: NTSB, 2003).

[4] Docket Number HWY-02-IH-016.

wireless telephone subscribers was approximately 145 million. The 2003 Gallup Organization study[5] and the 2002 North Carolina study,[6] which indicated that 25 percent and 58 percent of drivers interviewed, respectively, had used a wireless telephone while driving, suggest that the public may not be aware of the dangers associated with using a wireless telephone while driving. Considering the widespread use of wireless communication devices in vehicles today and the associated risks of an accident, the Safety Board concludes that all drivers should be educated about the risks of distracted drivering, including the cognitive demands associated with use of interactive communication devices. This instruction can be accomplished through media campaigns and driver education courses. NHTSA is already developing a public information campaign. The Advertising Council, Inc., represents the media in public service advertising and has worked with NHTSA before in disseminating public safety messages, particularly regarding drunk driving and seat belt use. Therefore, the Safety Board believes that they should jointly develop a media campaign stressing the dangers associated with distracted driving.

The States' driver education course materials discuss the risks of distractions while driving, but the material is general in nature and does not stress the cognitive demands of using a wireless telephone, whether handheld or hands-free. The Largo accident underscores the vulnerability of young, inexperienced drivers and involves many risk factors commonly present in accidents involving 16- to 20-year-old drivers. The importance of not engaging in distracting behavior is critical, especially for this age group, given its low experience level. Therefore, the Safety Board concludes that driver education materials should emphasize the risks of distracted driving, including the cognitive demands associated with use of interactive communication devices. The American Driver and Traffic Safety Education Association is compiling a new driver's education curriculum, and NHTSA is developing a generic driver's manual for the States' use. The Safety Board believes that they should jointly develop a module for driver education curriculums that emphasizes the risks of engaging in distracting behavior.

The traditional method of establishing public policy based on accident statistics alone may not be appropriate for the issue of driver distraction resulting from wireless telephone use. This safety risk is not the first to be substantially underrepresented in the available data sources because of underreporting by investigating agencies. In its 1992 safety study,[7] *Heavy Vehicle Airbrake Performance*, the Safety Board reported that in 9 of its 15 brake-related accident investigations, State and local agencies had failed to identify deficient brakes as a factor in their final accident reports. Thus, the available data did not permit the role of braking deficiencies in accidents to be accurately evaluated.

A new approach may be necessary to develop appropriate and effective accident countermeasures. Many researchers believe that data collection in a naturalistic setting is the preferred means for obtaining human factors data, particularly on precrash driver behavior. The NHTSA, Virginia Department of Transportation, and Virginia Polytechnic Institute and State University study, "100-Car Naturalistic Driving," which uses data collected for 1 year on 100

[5] Dawn Royal, *National Survey of Distracted and Drowsy Driving Attitudes and Behaviors: 2002*, Volume 1-Findings Report, The Gallup Organization, DOT NHTSA 809566, March 2003.

[6] Jane C. Stutts, Herman F. Huang, and William W. Hunter, "Cell Phone Use While Driving in North Carolina: 2002 Update Report," University of North Carolina, Highway Safety Research Center, December 2002.

[7] National Transportation Safety Board, *Heavy Vehicle Airbrake Performance,* Highway Safety Study, NTSB/SS-92/01 (Washington, DC: NTSB, 1992).

drivers in vehicles instrumented with 5 cameras and 23 recording sensors, should provide the more accurate precrash driver behavior information needed to develop accident countermeasures. In addition, the NHTSA and University of Iowa National Advanced Driving Simulator projects should provide specific and more reliable information on distraction and wireless telephone use. Such research will help redress the underreporting of wireless telephone use and other driver distractions.

The U.S. Congress and State and local legislative bodies have expressed heightened concern regarding the growth of wireless communication device use and the effects it has on highway safety. The proliferation of restrictions on wireless telephone use worldwide shows similar concern. NHTSA can provide guidance to policymakers regarding the safety implications of wireless communication devices by updating the 1997 report, *An Investigation of the Safety Implications of Wireless Communications in Vehicles,* and combining its findings with preliminary results from both the "100-Car Naturalistic Driving" study and National Advanced Driving Simulator research. The Safety Board believes that NHTSA should determine the magnitude and impact of driver-controlled, in-vehicle distractions, including the use of interactive wireless communication devices, on highway safety and report your findings to the U. S. Congress and the States.

The Explorer involved in this accident is an example of vehicle design that is inherently susceptible to wind gusts because of its relatively short wheelbase[8] and large side area, or profile, compared with most passenger cars. The Safety Board conducted computer simulations to evaluate the controllability of the Explorer traveling at 70 mph in crosswinds of 23 mph, gusting to 44 mph. The simulations showed that the wind gusts were not severe enough to have made the Explorer uncontrollable for an alert driver who had two hands on the steering wheel. But the accident driver was distracted and, most likely, holding the telephone in one hand. Under these circumstances, the winds would have initially caused the Explorer to move to the right and rotate clockwise away from the driver's intended path of travel. However, the amount of lateral movement depended on the duration of the gust, the driver reaction time, and the steering input, none of which could be precisely determined from the available evidence. The driver most likely attempted to compensate for the wind gust by steering sharply to the left, causing the vehicle to swerve off the road.

The Explorer was not equipped with an electronic stability control (ESC) system, nor was one available for the vehicle. Such a system may have assisted the driver in maintaining control of the vehicle. Hence, the Safety Board assessed whether such a system might have made a difference in this accident. In collaboration with Continental Teves, a manufacturer of ESC systems, the Safety Board initiated several simulations to evaluate how an ESC system might have responded to a series of vehicle movements and wheel inputs similar to that of the accident sequence. The simulations compared a standard sport utility vehicle (SUV) with an ESC-equipped SUV.[9]

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[8] Vehicle stability, or the tendency to continue traveling in a straight line, is directly affected by the vehicle's wheelbase, or length between the front and rear axles. The greater the wheelbase, the less the vehicle is affected by wind perturbations or sharp steering inputs.

[9] The simulation modeled a generic SUV that had a wheelbase similar to that of the accident vehicle; however, the ESC system applied was not specifically tailored to the vehicle model. Therefore, the results represented the minimum benefits of the ESC system.

The first comparison evaluated both vehicle models traveling straight at 70 mph with a driver-initiated quick left steering input, followed by a counter-steer to the right, then hard left steering, and, finally, quickly reducing the steering angle to zero, or straight. In this comparison, the standard SUV continued to sideslip and yaw at the end of the simulation, even though the driver steering input was straight ahead. This yawing and sideslip indicated that the vehicle was not yet under control or stable when the simulation ended. However, in the ESC-equipped vehicle, the sideslip and yaw velocities were zero at the end of the simulation, indicating that the stability control system brought the vehicle under control and that the vehicle was steering along the path intended by the driver.

In the second comparison, the same type of steering maneuver was assumed (left steer, right steer, left steer); however, the final steering input was modified to return the vehicle to its original path. The standard SUV was unable to regain its original path but instead crossed that path, and the sideslip increased and the vehicle yawed, indicating that the vehicle would be very difficult to control through steering alone. In contrast, the ESC-equipped vehicle intersected its original path at a slight angle with essentially zero yaw velocity and sideslip, and the vehicle could be easily steered back onto that path.

The simulations demonstrated that ESC systems can reduce sideslip and yaw in situations in which steering or lateral movements are encountered, allowing a driver to regain control of a vehicle. Additionally, the simulations showed that ESC may assist drivers of errant vehicles to not only regain control, but also return to their intended path. In both cases, the amount of time available to a driver to steer the under-control vehicle to avoid an accident increased significantly.

Moments before the actual crash, the accident driver probably had the steering wheel positioned so that the Explorer would remain in its travel lane as the wind gust began pushing it to the right. Had the Explorer been equipped with ESC, once the vehicle was pushed to the right by the wind, and assuming the sideslip and yaw rotation associated with the path deviation to the right were great enough, the sensors would have signaled the ESC's computer that a correction was necessary to maintain the driver's intended path straight ahead. The ESC system would then have applied the appropriate braking to intervene and reduce the yaw acceleration, thereby greatly increasing the vehicle's responsiveness to steering inputs. Such an ESC intervention may have been sufficient to allow the driver to maintain control of her vehicle.

Following the wind gust, the driver probably attempted to steer sharply to the left, causing the vehicle to swerve off the road. As the Explorer departed the road, an ESC system would have been monitoring the vehicle's rotational motion and in this situation, as in the wind gust situation, may have applied braking to compensate. Such an ESC intervention could have provided the driver with enough additional reaction-response time to steer her vehicle back onto the roadway.

The Safety Board cannot conclusively determine the degree to which an ESC system might have affected either the vehicle's initial reaction to the wind gust or the vehicle's reaction to the driver's sharp, high-speed steering input. Detailed driver inputs, exact wind forces, and precise vehicle dynamics are unknown. Additionally, ESC system design is tailored to each individual vehicle. An ESC application was not available for the Explorer. Nonetheless, ESC systems can make a difference in accidents by providing drivers with added stability and tracking control that may prevent loss of control. As demonstrated by the simulations, ESC systems can increase vehicle stability and control so that drivers in situations such as this accident may have

more time to react and regain control of their vehicle. The driver's loss of control in this accident is similar to many such occurrences each year. The Safety Board concludes that an ESC system may have helped the accident driver maintain control of her vehicle during the Explorer's initial response to the wind gust and during the subsequent reaction by the driver.

The European experience with ESC-equipped vehicles has suggested that this technology may provide safety benefits to drivers in the United States. NHTSA has not analyzed accident data related to ESC-equipped vehicles in the U.S. fleet; consequently, the benefits of ESC in reducing crashes cannot be determined. The composition of the U.S. fleet is somewhat different from the European fleet because the former includes more SUVs, light trucks, and vans, which are more susceptible to rollover and to the effects of wind than passenger cars.[10] Thus, the potential benefits of ESC are quite likely greater in the United States. For the 2003 model year, most European passenger cars sold in the United States have an ESC system as standard equipment; however, non-European manufacturers only offer ESC systems as optional equipment on some luxury models or, sporadically, on other models in their fleets.

In light of the potential for accident reduction and the comparatively low cost of installing ESC on vehicles ($150 to $400, depending on existing standard equipment), the Safety Board believes that NHTSA should expand its current evaluation of ESC systems and determine their potential for assisting drivers in maintaining control of passenger cars, light trucks, SUVs, and vans. NHTSA should include in this evaluation an accident data analysis of ESC-equipped vehicles in the U.S. fleet. Furthermore, the Safety Board believes that if the results of this evaluation of electric stability control systems are favorable, NHTSA should initiate a phased-in ESC mandate for passenger cars, light trucks, SUVs, and vans.

Therefore, the National Transportation Safety Board recommends that the National Highway Traffic Safety Administration:

> Develop, in conjunction with The Advertising Council, Inc., a media campaign stressing the dangers associated with distracted driving. (H-03-03)
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> Develop, in conjunction with the American Driver and Traffic Safety Education Association, a module for driver education curriculums that emphasizes the risks of engaging in distracting behavior. (H-03-04)
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> Determine the magnitude and impact of driver-controlled, in-vehicle distractions, including the use of interactive wireless communication devices, on highway safety and report your findings to the U. S. Congress and the States. (H-03-05)
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> Expand your current evaluation of electronic stability control systems and determine their potential for assisting drivers in maintaining control of passenger cars, light trucks, sport utility vehicles, and vans. Include in this evaluation an

[10] According to NHTSA, in 2001, the rollover occupant fatality rate per 100,000 registered sport utility vehicles was three times higher than that for passenger cars. Rollover fatalities represented more than 60 percent of sport utility vehicle fatalities and 22 percent of passenger car fatalities. In addition, 46 percent of sport utility vehicle serious injuries took place in rollover crashes, and 16 percent of passenger car serious injuries took place in rollover crashes. (Jeffrey W. Runge, Administrator, NHTSA, from his speech, "Meeting the Safety Challenge," Automotive News World Congress, Dearborn, Michigan, January 14, 2003.)

accident data analysis of electronic stability control-equipped vehicles in the U.S. fleet. (H-03-06)

If the results of your evaluation of electronic stability control systems are favorable, initiate a phased-in electronic stability control mandate for passenger cars, light trucks, sport utility vehicles, and vans. (H-03-07)

The Safety Board also issued safety recommendations to 49 States (exclusion—New Jersey), the American Driver and Traffic Safety Education Association, and The Advertising Council, Inc. In addition, the Board reiterated safety recommendations to the Federal Highway Administration and the American Association of State Highway and Transportation Officials.

Please refer to Safety Recommendations H-03-03 through -07 in your reply. If you need additional information, you may call (202) 314-6177.

Chairman ENGLEMAN, Vice Chairman ROSENKER, and Members GOGLIA, CARMODY, and HEALING concurred in these recommendations.

Original Signed

By: Ellen G. Engleman
Chairman