



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

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In reply refer to: H-09-14

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The National Transportation Safety Board (NTSB) is an independent Federal agency charged by Congress with investigating transportation accidents, determining their probable cause, and making recommendations to prevent similar accidents from occurring. We are providing the following information to urge your organization to take action on the safety recommendation in this letter. The NTSB is vitally interested in this recommendation because it is designed to prevent accidents and save lives.

This safety recommendation is twofold and addresses the following safety issues: (1) the risk of pedal misapplication and the need for plans to ensure that school bus drivers undergo annual refamiliarization training on all bus types in their fleets; and (2) the risk of unintended acceleration during loading and unloading activities. This recommendation is derived from the NTSB's special investigation report on pedal misapplication in heavy vehicles and is consistent with the evidence we found and the analysis we performed.¹ As a result of this investigation, the NTSB has issued four new safety recommendations, one of which is addressed to both the National Association of State Directors of Pupil Transportation Services and the National Association for Pupil Transportation. Information supporting the recommendation is discussed below. The NTSB would appreciate a response from you within 90 days addressing the actions you have taken or intend to take to implement our recommendation.

In May 2005, the NTSB began its investigation of a school bus accident that occurred in Liberty, Missouri. During the course of the investigation, information was uncovered that suggested pedal misapplication as a factor in the accident—that is, depressing the accelerator instead of, or in addition to, the brake pedal.

The NTSB subsequently investigated four additional accidents involving heavy vehicles in which pedal misapplication was determined to be a factor. These accidents occurred in Falls Township, Pennsylvania; Asbury Park, New Jersey; Nanuet, New York; and Newtown,

¹ For more information, see *Pedal Misapplication in Heavy Vehicles*, Highway Special Investigation Report NTSB/SIR-09/02 (Washington, DC: National Transportation Safety Board, 2009), which is available on the NTSB website at <<http://www.ntsb.gov/publictn/2009/SIR0902.pdf>>.

Pennsylvania. Despite varying circumstances, these five accidents share common elements. In all five, the drivers either reported a loss of braking or were observed by vehicle occupants to be unsuccessfully attempting to stop the vehicles, though no evidence of braking system failure was found.

Despite the efforts of the NTSB, the National Highway Traffic Safety Administration (NHTSA), and others, unintended acceleration incidents attributed to pedal misapplication continue to occur. Such accidents warrant serious attention because they can be so injurious. To date, both the NTSB and NHTSA have focused on passenger cars. However, as the accidents discussed in the report demonstrate, pedal misapplication can occur in heavy vehicles as well as light vehicles. Any vehicle operated by a driver is susceptible to the loss of control caused by human error.²

The NTSB has investigated both light and heavy vehicle sudden acceleration accidents. In 1997, the NTSB investigated a Normandy, Missouri, accident involving a transit bus.³ The bus driver had just discharged passengers when the bus accelerated into pedestrians, resulting in four fatalities. In 2003, the NTSB investigated an accident in Santa Monica, California, in which a passenger car accelerated into a farmer's market, resulting in 10 fatalities.⁴ The Board concluded that pedal misapplication was the probable cause in both of these accidents.

In this special investigation of pedal misapplication in heavy vehicles, the National Transportation Safety Board determined that the probable cause of the Liberty, Missouri, accident on May 9, 2005, was a pedal misapplication by the school bus driver. In addition, the National Transportation Safety Board determined that the probable cause of the January 12, 2007, accident in Falls Township, Pennsylvania, was a pedal misapplication by the driver. Contributing to the occurrence of pedal misapplication was the driver's unfamiliarity with the school bus.

Pedal Configuration

The Falls Township accident occurred as the driver initiated departure from the high school on his typical afternoon run—but using a bus that was significantly different from the one to which he was normally assigned. The driver's usual bus, manufactured by International Corporation, was equipped with a bulkhead-mounted accelerator pedal that operated along a different arc of travel than the floor-mounted accelerator found on the accident bus, manufactured by Thomas Built. Moreover, each bus was equipped with a floor-mounted brake pedal that functioned along an arc of travel that was comparable to the accelerator on the accident bus.

² R. Schmidt, "Unintended Acceleration: A Review of Human Factors Contributions," *Human Factors*, vol. 31, no. 3 (1989), pp. 345–364.

³ *Bus Collision With Pedestrians, Normandy, Missouri, June 11, 1997*, Highway Accident Summary Report NTSB/HAR-98/01/SUM (Washington, DC: National Transportation Safety Board, 1998).

⁴ *Rear-End Collision and Subsequent Vehicle Intrusion Into Pedestrian Space at Certified Farmers' Market, Santa Monica, California, July 16, 2003*, Highway Accident Report NTSB/HAR-04/04 (Washington, DC: National Transportation Safety Board, 2004).

In 1994, another driver was involved in a collision while operating the Falls Township accident bus, only weeks after it had been placed in service. An investigation by the school district, with input from Thomas Built, concluded that this earlier accident was the result of pedal misapplication. Of particular interest, both drivers of the accident bus (in 2007 and in 1994) had previously operated International buses. Accordingly, it appears that drivers transitioning from one bus to another—especially from a bus with a different pedal configuration—may be more prone to pedal application error.

When a driver firmly establishes a pattern of performance—that is, a habit—it is typically more difficult to learn a new, similar pattern of performance. People have a tendency to resort to habitual, overlearned behaviors, particularly during times of stress.⁵ When people resort to doing things as they first learned them, and the circumstances call for a response that is slightly different, the result is a response that is inappropriate for the current circumstances—or, in other words, an error.

When the two Falls Township drivers operated the controls on the Thomas Built bus, where both pedals were mounted on the floor, they each lost the ability to distinguish the pedals based on the characteristic feedback inherent in their regular buses. Coupled with the limited spatial separation of the brake and the accelerator pedal in the replacement vehicles, the propensity for misapplication was significant. To the extent that the drivers were dependent on kinesthetic or proprioceptive⁶ feedback to recognize and correct errors of pedal application, prior learning interfered with their transition to the new pedal configuration, which did not offer the dissimilarity of pedals found in their regular bus.

The same condition applies to differences in the spatial location or orientation of the pedals—drivers anticipate the location of foot pedals (which they typically cannot see) based on prior experience. When the spatial location of pedals differs among vehicles, the driver may attempt to depress a pedal in the location where he or she expects it to be, rather than where it actually is. The result may be unintended actuation of the accelerator pedal (when the intention was to depress the brake) or simultaneous activation of the brake and accelerator pedals (because of their proximity).

As in the Falls Township accident, the Nanuet bus driver was driving a substitute vehicle—a 1995 Bluebird bus—because her 2004 International conventional-style school bus was being repaired. The pedals on the two buses are similar; however, the accelerator on the International bus is set further back than the brake pedal, relative to the driver, while the two pedals are on the same plane in the accident Bluebird bus. Further, on the Nanuet driver's usual bus, a console is located immediately to the right of the accelerator; on the accident bus, there are no objects next to the accelerator—just empty space. As in the Falls Township accident, the Nanuet driver's learned pedal response from her usual bus likely interfered with her attempted braking response on the day of the accident. In addition, though the movement of the accelerator

⁵ (a) L. Curry, "Habit as the Source of Inappropriate Response," *Ergonomics*, vol. 18, no. 4 (1975), pp. 435–442, as cited in Schmidt (1989). (b) C. Gielen, R. Schmidt, and P. van den Heuvel, "On the Nature of Intersensory Facilitation of Reaction Time," *Perception and Psychophysics*, vol. 34, no. 2 (1983), pp. 161–168, as cited in Schmidt (1989).

⁶ Proprioceptive refers to a sensory receptor—chiefly in muscles, tendons, and joints—that responds to internal stimuli.

in the Nanuet accident bus is similar to the brake movement in the driver's usual bus, it is not the same as the accelerator movement in her usual bus—thereby reinforcing her belief that her foot was on the brake pedal.

Although the Liberty accident vehicle was the driver's usual bus, the accelerator pedal and the brake pedal were nearly identical. In addition to having similar size, the two pedals had the same arc of travel and were both mounted to the vehicle at the bottom of the pedal.

The NTSB concludes that the Falls Township and Nanuet accidents demonstrate that unfamiliarity with the pedal configuration of an alternate bus may lead to error and pedal misapplication. Therefore, the NTSB recommends that the National Association of State Directors of Pupil Transportation Services and the National Association for Pupil Transportation advise their members—through their newsletters, websites, and conferences—of the risk of pedal misapplication and the need to educate school bus drivers about such incidents, and the need to develop and implement plans to ensure that school bus drivers undergo annual refamiliarization training on all bus types that they might drive.

Positive Separation

Although both brake transmission shift interlock (BTSI) devices for heavy vehicles and pedal redesign have the potential to improve safety by reducing pedal misapplications, these solutions would likely apply only to newly manufactured vehicles—not vehicles currently on the road. Also, given the time required to conduct research, propose rulemaking, and implement a final rule, either remedy would require years to come to fruition. Therefore, it is necessary to examine ways to mitigate the effects of pedal misapplication in the near term, especially in areas where large numbers of people form queues to board buses.

Although positive separation—for example, bollards⁷ or other physical barriers—is not a solution to the problem of unintended acceleration, it can mitigate pedestrian injuries that may result from pedal misapplication. Positive separation is not a new idea. As a result of the NTSB investigation into the Normandy, Missouri, accident⁸—also the result of pedal misapplication—the NTSB recommended in 1998 that the Federal Highway Administration (FHWA) ensure that future transit facility designs that direct errant vehicular traffic toward pedestrian-occupied areas include provisions for positive separation between the roadway and pedestrian areas.

Although there has been some progress on this and related recommendations, the NTSB finds it disappointing that, in the 12 years since the Normandy, Missouri, accident, there is still no *requirement* for positive separation of pedestrians and traffic in transit facilities. However,

⁷ A bollard is a post, pipe, or tube designed and positioned in series to prevent vehicular traffic from entering a particular area; bollards may be permanent or removable.

⁸ NTSB/HAR-98/01/SUM. In this accident, a transit bus collided with seven pedestrians in a “park and ride” facility. The bus was being operated by a 31-year-old driver trainee, who had just completed a routine stop at the station. After allowing the passengers to debark, the driver began to move the bus forward to provide clearance for another bus to pass. Reportedly unable to stop the bus, the driver allowed it to surmount the curb and continue onto the station platform. The NTSB determined that the probable cause of this accident was the driver's misapplication of the accelerator, resulting in the vehicle's override of the curb and travel onto the occupied pedestrian platform. Two safety issues were identified: the insufficiency of pedestrian protection provided by the saw-tooth parking bay design and the need for positive separation between the roadway and pedestrian areas of parking bay facilities.

some jurisdictions have taken voluntary action. The city of New Orleans, Louisiana, for example, has employed positive separation since the early 1980s to keep errant vehicles out of the pedestrian mall on Bourbon Street. Although the city does not keep records of the effectiveness of these measures, damage to the bollards and the lack of reports of vehicles entering the pedestrian mall indicate that the bollards have served their intended purpose. Following the Falls Township accident, the Pennsbury School District installed positive separation at Pennsbury High School, seeking to protect students and other pedestrians from errant vehicles.

The school environment presents a unique risk with respect to unintended acceleration. A typical loading or unloading operation involves multiple vehicles and many children. Often, the children line up, wait, or congregate near the buses, as was the case in the Falls Township and Newtown accidents. Every bus at the loading area can introduce an opportunity for pedal misapplication, and the large number of children represents a potential increase in the severity of the outcome should pedal misapplication and unintended acceleration occur. Therefore, the NTSB concludes that the nature of the bus loading and unloading activities at schools creates a situation where an errant vehicle, such as one experiencing an unintended acceleration, could easily strike pedestrians.

The NTSB's 1998 recommendations on positive separation do not address the potential hazard posed during bus loading and unloading at schools, as demonstrated by the Falls Township accident. Therefore, the NTSB recommends that the National Association of State Directors of Pupil Transportation Services and the National Association for Pupil Transportation advise their members—through their newsletters, websites, and conferences—of the risk of unintended acceleration during loading and unloading activities, as exemplified by the Falls Township, Pennsylvania, accident on January 12, 2007; and suggest possible mitigation strategies, such as installing bollards or starting buses only after loading is complete.

As a result of the special investigation on pedal misapplication in heavy vehicles, the NTSB makes the following recommendation to both the National Association of State Directors of Pupil Transportation Services and the National Association for Pupil Transportation:

Advise your members—through your newsletters, websites, and conferences—of the following safety issues: (1) the risk of pedal misapplication and the need to educate school bus drivers about such incidents, and the need to develop and implement plans to ensure that school bus drivers undergo annual refamiliarization training on all bus types that they might drive; and (2) the risk of unintended acceleration during loading and unloading activities, as exemplified by the Falls Township, Pennsylvania, accident on January 12, 2007; and suggest possible mitigation strategies, such as installing bollards or starting buses only after loading is complete. (H-09-14)

The NTSB also issued three new safety recommendations to the National Highway Traffic Safety Administration, along with reiterating and reclassifying two 1999 recommendations. The NTSB reclassified one previously issued recommendation to the Community Transportation Association of America.

In response to the recommendation in this letter, please refer to Safety Recommendation H-09-14. If you would like to submit your response electronically rather than in hard copy, you may send it to the following e-mail address: correspondence@ntsb.gov. If your response includes attachments that exceed 5 megabytes, please e-mail us asking for instructions on how to use our secure mailbox. To avoid confusion, please use only one method of submission (that is, do not submit both an electronic copy and a hard copy of the same response letter).

Chairman HERSMAN, Vice Chairman HART, and Member SUMWALT concurred in this recommendation.

[Original Signed]

By: Deborah A.P. Hersman
Chairman