



Using Haptic Feedback to Increase Seat Belt Use

The legacy of research on increasing seat belt use has focused on enactment of seat belt legislation, public education, high-visibility police enforcement, and seat belt reminder systems. Several behavioral programs have produced large, sustained increases in seat belt use, and several of these techniques have been employed on a communitywide basis to increase seat belt use. Innovative technologies may add to the success realized by the high-visibility enforcement model and elevate the seat belt use rate further.

In the present study, researchers tested an innovative technology that uses haptic feedback to increase seat belt use. This system imposes an increased resistance to the accelerator pedal when the driver is unbuckled and a predetermined speed is exceeded. This concept offers several potential advantages over other technologies. First, the system would not affect drivers who always buckle but do so after motion, nor would it affect drivers who do not buckle in very low-risk situations such as backing a vehicle to a loading dock. Second, because driving at the chosen speed in a comfortable manner should be a powerful reinforcer, the device should produce a rapid and sustained increase in seat belt use to 100%. Third, this system remains in effect until drivers fasten their seat belts. Finally, the system is consistently applied by the vehicle and does not require anyone to monitor driver seat belt use and apply consequences for not wearing the seat belt. The purpose of the present study was to evaluate the effect of this device on seat belt use and driver acceptance of the device.

Method

The efficiency of the imposed pedal resistance system was field tested on 7 drivers of a carpet cleaning fleet. Drivers from this sample were males ranging in age from 24 to 35 who averaged about 9 trips above the criterion speed per day. A multiple baseline design across two groups of participants was employed in this study. The treatment was first introduced for the first group of 2 drivers and later introduced for the second group of 5 drivers.

A microprocessor installed under the driver's seat recorded all data. The recorded data included date, vehicle speed, presence of weight on the driver seat, ignition on or off, brake on or off, seat belt closure switch on or off, pedal force stepper motor on or off, start of trip, end of trip, and trip history in baseline as well as the experimental condition.

A stepper motor increased pedal resistance to 18 kg (40 pounds) when unbuckled drivers exceeded 40 kph (25 mph). When the force was applied it would gradually increase to 18 kg (40 pounds) over a 3-second interval to ensure the driver had time to respond to the increased force to maintain speed. Unbuckled drivers had the option of (a) buckling their seat belts, which gradually removed the increased pedal resistance over a 4-second interval, or (b) exerting a greater down force on the pedal when driving over 40 kph for the remainder of the trip.

To prevent drivers from bypassing the device by buckling the seat belt behind them, the system was designed to apply force when the system detected the seat belt was fastened before the participant sat in the driver's seat. The microprocessor detected zero attempts by drivers to fasten the belts behind them.

If the driver was unbuckled during vehicle motion for more than 1 minute and the driver was traveling over 40 kph, the trip was scored as unbuckled. Seat belt use was only measured for trips that attained a speed of 40 kph or more.

Seat Belt Use

During baseline the first group of 2 drivers buckled their seat belts an average of 69% of the time, and the second group of drivers buckled their seat belts 61% of the time. During baseline one driver in Group 2 removed his belt during motion for less than a minute. There were 3 instances of buckling after motion in the second group of drivers with the drivers buckling 3, 7, and 29 seconds after motion. These were all scored as buckled trips.

Activating the pedal force contingency increased seat belt use to 100% for both groups of drivers. Drivers in Group 1 buckled their seat belt 7% of the time in response to increased pedal resistance, while drivers in Group 2 buckled their seat belt 13% of the time in response to increased pedal resistance. In each case the drivers buckled within 25 seconds of the force being applied with an average latency of 12 seconds.

Driver Acceptance

After completing the intervention, drivers provided feedback about the perceived effectiveness, reliability, usefulness, acceptance, and annoyance of the deaccelerator system. The participants' comments were overwhelmingly positive. In general, the drivers indicated that the system was very reliable indicating that it activated when they went over 40 kph and were unbuckled. This feedback also supported the seat belt use data, with drivers stating that the pedal force got them to buckle. All participants felt that novice drivers would benefit from the system, and many drivers said they would accept it being available for all vehicles, particularly if having it provided an insurance break. Negative comments about the device were limited. Two drivers commented that the device was somewhat noisy. No driver could think of a way to bypass the system other than intentionally breaking it.

Discussion

The results of this study support the effectiveness of an innovative technology approach in producing high levels of seat belt use. It is interesting to note that all drivers indicated that they would always wear the seat belt to avoid the pedal force during the initial demonstration. However, drivers occasionally failed to wear their seat belts until the force was applied during the treatment condition. It was necessary to explain and demonstrate the contingency at the start of the trial because it affected the feel of the accelerator pedal. Participants indicated that the demonstration of the accelerator pedal was an important factor in their acceptance of the technology. In particular, the drivers appreciated knowing how the pedal force could be overcome in an emergency by exerting greater down pressure on the accelerator pedal, how it felt when the force initiated, and how the force gradually reduced when the buckle was in place.

Given the suddenness of the change in seat belt use, it is apparent that the demonstration of the contingency had an immediate effect on seat belt use. It is likely that this effect was mediated by the formation of rule-governed behavior of the general form, "If I don't buckle, the accelerator pedal will be harder to press when I go over 40 kph."

This device has several advantages over interlock systems. First, it does not require the drivers to wear their seat belts to start the vehicles before scraping the windshield or to preheat the vehicle in winter or cool it in summer. This represents a significant advantage over an ignition interlock system. Second, it does not require the drivers to fasten their seat belts to move the vehicle (operators of vehicle fleets often need to move their vehicles short distances at very low speeds). Instead this system only requires the operator to fasten the seat belt when the driver exceeds a predetermined speed criterion that defines an actual trip. Third, this system can be installed in vehicles with both standard and automatic transmissions, which is a clear advantage compared to other seat belt shift interlock systems.

Previous research showed that the use of an accelerator pedal force schedule was effective in reducing speeding behavior. Unlike speed or RPM governors, this system can be overridden in an emergency if a driver needs to increase speed to avoid a crash and offers the advantage of being used to control multiple driving behaviors.

In summary, this field study showed that an accelerator force contingency could increase seat belt use to 100% among a small group of adult drivers. Another study will test the system using a larger sample of drivers and will track seat belt use over a longer period of time to further increase the generality of this finding.

How to Order

To order *Using Haptic Feedback to Increase Seat Belt Use of Service Vehicle Drivers* (23 pages), prepared by Western Michigan University, write to the Office of Behavioral Safety Research, NHTSA, NTI-130, 1200 New Jersey Avenue SE., Washington, DC 20590, fax 202-366-7394, or download from www.nhtsa.gov. Ian Reagan was the task order manager for this project.



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Administration**

1200 New Jersey Avenue SE., NTI-132
Washington, DC 20590

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