DRIVER OPINIONS OF SIMULATOR-BASED COMMERCIAL DRIVER TRAINING

Justin Morgan[1], Scott Tidwell[1], Myra Blanco[1], Alejandra Medina[1],
Richard Hanowski[1], & Olu Ajayi[2]
[1] Virginia Tech Transportation Institute, Blacksburg, Virginia, USA
[2] Federal Motor Carrier Safety Administration, Washington, DC, USA
Email: jfmorgan@vt.edu

Summary: Simulator-based training provides the opportunity to train drivers in a potentially lower cost and safer environment than traditional, behind-the-wheel, training methods. Thus, many motor carriers have begun adopting simulators for use during in-house driver training. This report presents the result of focus groups with drivers who experienced truck simulator-based training at two large motor carriers. In general, drivers at both carriers had positive opinions of simulator-based training. Most suggestions to improve the program were directed towards modification of how the program was implemented and/or creating a more realistic simulation of the driving environment.

COMMERCIAL DRIVER TRAINING IN THE UNITED STATES

There is a continual demand for qualified commercial motor vehicle (CMV) drivers in the United States (US). This has resulted in intense competition to hire qualified drivers. However, high turnover rates for long-haul and newly licensed CMV drivers further complicate this situation (Paz-Frankel, 2006). Additionally, there is some evidence suggesting that entry-level CMV drivers do not receiving adequate training prior to beginning their professional driving careers (Dueker, 1995). There are currently no minimum training standards for CMV drivers in the US. Because of a lack of high-quality entry-level CMV driver training, many carriers began operating in-house training programs (commonly known as “driver finishing” programs) to ensure a minimum skill level for fleet drivers (Knipling, Hickman, & Bergoffen, 2003). Many carriers continue this approach to training and require Drivers to engage in regularly scheduled refresher training courses. Truck simulators hold promise in increasing the efficiency and quality of novice CMV driver training for both types of CMV driver training programs.

Simulation-based training for CMV drivers has some potential benefits, such as the ability to quickly and easily record driver performance metrics which is typically much greater in truck simulators as compared to real trucks. This allows instructors to have quantifiable measures of driver performance while reducing the demand on the instructor to provide in-process feedback and to observe driver performance. There may also be cost savings in terms of reduced wear and maintenance. Simulators allow drivers to make mistakes during the training process (e.g., proper vehicle set-up for a right turn) without damage to property or equipment, in highly controlled environments that reduce training time and increase trainee throughput. However, simulator-based approaches are associated with some disadvantages as not all users are able to comfortably use driving simulators due to phenomena cluster of symptoms known as “simulator sickness” (Pausch, Crea & Conway, 1992).

The present study presents the results of two focus groups conducted with CMV drivers who recently completed a simulator-based refresher training course offered by their carrier. The results from this study can help shape and guide future training efforts involving simulation-based training across a variety of domains.

MATERIAL AND METHOD

Carriers and Participants

Class-A Commercial driver license (CDL) holders from two large motor carriers served as participants in the present study. Both carriers, identified here as Carriers A & B, employ or contract over 10,000 Class-A CDL drivers and have fleets of over 10,000 trucks/power units and 40,000 trailers. Both carriers recorded over 1,000,000 miles in the year 2008.

The two carriers differed in their hiring practices with respect to driver training. Carrier A does not hire drivers without a valid Class-A CDL and does not offer entry-level Class-A CDL driver training. Carrier B hires drivers without a Class-A CDL and offers entry-level CDL driver training. Both carriers offer driver finishing programs for newly licensed CDL drivers and regularly scheduled refresher training using a truck simulator. Sixteen males and 1 female (demographics, Table 1) participated in the focus groups (M = 45 years old, SD = 7.7). All participants had prior experience driving CMVs (i.e., were not newly-licensed CMV drivers).

Table 1. Participant demographics

	Age	Sex	Mean Years of CMV Driving Experience	Tenure with Carrier (years)	Moving Violations	Crashes (all types)	Crashes (at-fault)
Carrier A	46.8 (12.2)	5 males, 0 females	13.8 (8.1)	8.7 (6.7)	0.20 (0.45)	0.40 (0.55)	0.40 (0.55)
Carrier B	44.3 (5.4)	11 males, 1 female	12.2 (10.2)	all newly hired	0.33 (0.49)	0.08 (0.29)	0.00 (0.00)

Note: Moving violations and crashes are presented as self-reported values for the past 36 months

Although both carriers used similar simulator equipment and software (MPRI TranSim VS III; Figure 1), they had different approach to the implementation of their respective training programs.

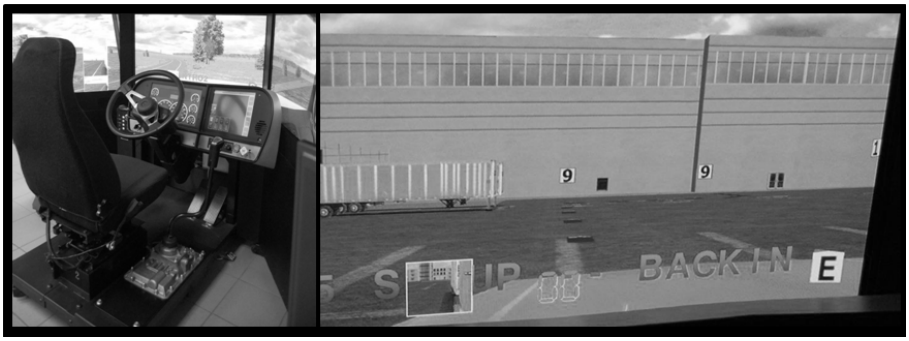

Figure 1. TranSim VS truck simulator cabin (left) and example backing scenario (right)

While Carrier A used their simulator for refresher and targeted training, Carrier B used their simulator for all new hires, entry-level drivers, and refresher training.

Procedure

The two focus groups were held in a private room at each carrier's terminal over two separate days. Each meeting lasted approximately 2 hours. Following informed consent, participants were engaged in discussion topics related to truck simulation-based training. Topics included the differences in simulator and behind-the-wheel (BTW) training, changes in driver training resulting from the use of simulators, drivers' perceived transfer of training, and the role of simulators in training. Following the meetings, the transcripts were examined and summarized by topic area.

RESULTS

Contrasts and Changes in Training Between in Simulator- and Real Truck-Training

This topic asked participants to discuss the similarities and differences between training in a truck simulator and training in a real vehicle (i.e., BTW training), as well as how training changed as a result of simulator use. Fifteen participants provided responses to the question by individually listing their top similarities and differences for the moderator, who listed the responses on a whiteboard. A majority of participants indicated the greatest similarity between simulated and BTW driving were the kinematic reactions of the vehicle. However they also noted differences in steering and shifting (such as having different transmission types) between the two vehicle types. When asked about the greatest differences between simulated and BTW driving, the majority of participants identified the safety of a truck simulator compared to BTW training. It should be noted that some responses provided were identified as both similarities and differences across the different participants. This occurred in participant responses regarding vehicle reactions, mirrors, the subjective realism of driving, and steering response. These differences are summarized in Table 2.

Table 2. Participant rating split for similarities and differences

Rating Category	Rating as Similar	Rating as Difference
Vehicle Reactions	4	2
Mirrors	2	1
Subjective Realism	1	3
Steering Response	1	1

Follow-up questioning revealed that many participants believed the reactions of the simulated vehicle were actually very similar to those of a real truck. These similarities were primarily in the accuracy of the interaction between engine speed and shifting/gear selection (especially while ascending and descending steep grades). Other similarities between the two driving environments included dealing with in-cab vibrations, monitoring engine speed, handling tire blowouts, and mirror use. However, it should be noted that some participants indicated the truck simulator mirrors were more effective than mirrors in a real truck. These participants suggested the simulator mirrors should be adjustable to reflect a different visual field-of-view and should

include blind spots similar to those of a real truck. It should be noted that the truck simulators used at both carriers used "virtual mirrors" (i.e., graphical representations embedded within screens). Some participants mentioned that discrepancies in driver mindset between simulator and BTW training could have an effect on the training process and training outcomes. Most participants believed the truck simulator encouraged a belief, or mindset, that their performance and interactions in the simulated environment were not real and would have little effect on anything. Various aspects of the simulation appeared to encourage this mindset, including the condensed nature of scenarios (participants believed that incidents and events occurred at a much higher frequency in the simulated environment than in the real world) as well as differences in the simulator's steering and braking performance. Additionally, although the greater safety of truck simulator training was identified as a positive aspect, some participants noted the lack of direct consequences fostered a negative attitude towards the simulator and lead some individuals to view the simulator as a game. Yet, some participants took a contrary view. For instance, one participant described the differences between the truck simulator and real trucks as being complementary (a view that did find support among other participants). This participant's carrier (Carrier A) had trainees practice the maneuver in the truck simulator prior to practicing the same maneuver in a real truck; the participant believed this was a very beneficial use of the simulator.

All participants believed that training in a simulator changed the process of training when compared to traditional BTW training. One of the most important changes identified by participants was the inability to train drivers for scenarios that depend on subtle kinematic cues from the truck. Participants believed the lack of realistic physical simulations restricted the ability for trainees to recognize subtle driving cues such as impending skids, or learning the implications in shifting while towing heavy loads. Participants also noted that the lack of direct safety consequences in the driving simulator led to a number of changes to driver training. Participants believed the lack of safety consequences allowed drivers to train for rare, hazardous, or otherwise dangerous scenarios (e.g., steering tire axle blowouts and skids) which could not be easily accomplished in BTW training. Participants did not report receiving BTW training for these higher risk scenarios, and all reported that the inclusion of these scenarios was a benefit to training.

The ability to review and play back driver actions was noted by participants as one of the critical components in simulator truck training. Although many participants stated they were highly aware of being monitored within the truck simulator, some participants indicated that this led to more careful and reserved driving in the truck simulator than in a real truck. Yet, these participants also believed that the ability to pause and replay driving behavior and performance in the truck simulator had a positive impact on safety and was an opportunity to review a mistake and learn the root cause (rather than merely being informed of a mistake, as in the real truck).

Perceived Transfer of Training

Participants were asked if they believed the skills they learned and practiced within the truck simulator would transfer to real-world driving. Participants were asked to gauge this transfer among a three point scale, with anchor points of not at all, somewhat, and high carry over between environments. All participants reported that some level of transfer-of-training between simulated and real environments would occur, with the majority (63 percent) believing the

specific training received in the simulator would "somewhat" transfer to real-world driving. The remaining participants (38 percent) believed that a high degree of transfer-of-training would occur between simulator training and real-world driving.

As a follow-up question, participants were asked what factors they believed influence the transfer-of-training between simulated and real world environments. Those participants who responded with a "somewhat" level in transfer-of-training would occur between truck simulator to real-world driving (6 participants) believed driver attitudes and related factors would be the most important factor influencing transfer-of-training. These participants believed transfer-of-training depends on the driver's attitude towards simulator-based training; if the trainee driver was consciously altering behavior in response to being observed, the quality of the pre-drive briefings, and as well as the time spent in the simulator. Participants who reported a high level of transfer-of-training from the truck simulator to a real truck (9 drivers) believed specific skills (such as responding to skids) and general skills (safety awareness) would be likely to transfer from a truck simulator to a real truck.

When specifically asked by the moderator if any negative transfer-of-training could occur between the truck simulator and a real truck, some participants noted that situational awareness and an understanding of traffic flow patterns would be unlikely to transfer from a truck simulator to a real truck and that this would result in a reduced driving performance. One participant stated that the simulated drive should always be accompanied by a BTW test of driving abilities because, although the real world rarely presents complex driving challenges (such as those presented during simulator driving), overall awareness of driving safety can only be learned and assessed in BTW driving. The participant reporting traffic flow as being unlikely to transfer from a truck simulator to a real truck believed the simulator presented an unrealistic depiction of traffic patterns, with errors such as oncoming traffic failing to slow in response to a crash.

All participants, across all levels of subjective response to the simulation, reported that the truck simulator would provide drivers with some beneficial transfer-of-training to a real truck. One participant described this as, "…taking tools into the [real] truck which you didn't have before." Another stated, "Although it didn't feel the same, the knowledge is still there." A veteran driver stated, "You lose a tire at 70 mi/h and it's a whole different world than what's on the simulator. But the principle is still there, and you're not going to be that shocked when it happens." This led another participant to indicate that simulator-based training for emergency maneuvers increased his confidence in driving, stating, "You know how many videos of [steering tire] blowouts I've watched? But before I did it on the simulator I've always had the fear of the blowout."

The Role of Truck Simulators in Training (including best practices)

For this topic, participants were asked what the best role of a truck simulator is within a novice CMV driver training program. The majority of participants, 77%, indicated the truck simulator would best be used prior to introducing the trainee to BTW driving. The remainder of participants believed some form of BTW training should occur prior to the use of truck simulators, with the simulator serving as a skill refinement tool. Follow-up questioning revealed some differences in participants' views of when truck simulator training should be implemented.

Follow-up questioning revealed many participants believed the truck simulator should ideally serve as a tool to help improve novice drivers' situational awareness and safety-conscious behavior. Many of these participants also believed the truck simulator's appropriate role was that of a skills-development and maintenance tool, and that the simulator could be used to train basic skills, including shifting, mirror use, and lane-holding skills, or could be integrated into their current commercial defensive driving training course. Specific participant responses provided during the discussion are provided in Table 3.

Table 3. Participant comments regarding the ideal use of truck simulators in an entry-level CMV driver training program

Response	Individual Comments
After BTW	Use specifically for training rare situations
	Emergency maneuvers only. Cannot be used for training backing.
	After CDL testing, use for awareness training.
	If driver has already driven a truck, then simulator. Otherwise, real truck first with truck simulator training afterwards
Before BTW	Use for training situational awareness and recovery from dangerous situations.
	Use for training situational awareness and procedural tasks (mirror checks, lane discipline). Helps reduce anxiety in real trucks.
	Use for training basics, such as shifting.
	Use for teaching situational awareness of common crash scenarios (automotive collisions during right turns; 2 responses)
	Use when introducing Smith System. (3 responses)
	Use for preventing common entry-level driver collisions.

The majority of participants believed the simulator would be useful as a regularly scheduled training tool. When asked how often truck simulator refresher training should occur, suggestions ranged from twice yearly to every two years. However, one participant indicated refresher training should occur on a schedule with driver's license renewal. While many participants viewed training as an inconvenience (and one that prevented the participant from making a revenue-generating delivery and earning income), a consensus was reached that refresher training should be conducted biannually, in order to best support good driving habits.

When asked to indicate the most important scenarios for refresher training, the majority of participants indicated that scenarios involving heavy freeway traffic environment and bad weather would be most beneficial (as they believed it was the most common hazardous driving condition encountered). Other suggestions included steering during tire blowouts, loss of brakes combined with the use of a runaway truck ramp, and rehearsals for post-crash procedures. All participants agreed that simulator-based training should be progressive, with each scenario building on previous knowledge and exercises.

Many participants believed that, in addition to regularly scheduled refresher training, truck simulators should be made more available to drivers. One participant stated he would be willing to pay for this type of simulator access. All participants agreed that on-demand truck simulator training would be a beneficial resource, especially if there were multiple driving scenarios

available, including seasonal driver training, handling run off road ramps, animal strikes, adverse weather conditions, construction areas, sudden vehicle failures, and regional-specific scenarios.

DISCUSSION AND CONLUSION

Participants identified important differences between simulator and truck training. These included the vehicle reactions and mirrors as the primary factors. How the simulator is integrated into the training program (whether as a serious training tool or simply another training requirement) was suggested as a major influence on drivers' acceptance of simulation-based training. While participants differed in their opinions on the best way to implement a simulator-based training program, the majority saw value in simulators for regularly scheduled training.

The majority of participants held generally positive opinions towards simulation-based training for CMV drivers; most offered some constructive suggestions for modifying and improving the implementation of such training programs. These suggestions centered on minimizing the differences between training environments, taking advantage of the unique qualities of the simulator in a training program, and properly integrating the simulator into a training program.

Future efforts in simulation-based training for CMV drivers should take these findings into consideration in order to maximize acceptance of new training packages by CMV drivers. By building upon the suggestions and leveraging the opinions of CMV drivers who have recently completed such training, stronger simulation-based training programs can be implemented.

ACKNOWLEDGMENT

This research was completed as part of a contract from the U.S. DOT Federal Motor Carrier Safety Administration, *CMV Driving Simulator Validation Study (SimVal): Phase II* (DTNH22-05-01019, Task Order #9). The authors wish to thank the FMCSA for their guidance and advice throughout the project.

REFERENCES

Dueker, R. L. (1995). *Assessing the Adequacy of Commercial Motor Vehicle Driver Training: Final Report.* (Publication No. FHWA-MC-96-011). Washington, DC: USDOT, FHWA, Office of Motor Carriers.

Knipling, R.R., Hickman, J.S., & Bergoffen, G. (2003). *Effective Commercial Truck and Bus Safety Management Techniques*. (Commercial Truck and Bus Safety Synthesis Program, Synthesis 1). Washington, DC: Transportation Research Board.

Paz-Frankel, E. (2006, March 31). Truck driver turnover reaches record level. Memphis Business Journal. Retrieved from http:// bizjournals.com/memphis/stories/2006/04/03/story3.html.

Pausch, R., Crea, T., & Conway, M. (1992). A literature survey for virtual environments: military flight simulator visual systems and simulator sickness. *Presence: Teleoperators and Virtual Environments, 1,* 344-363.