VR Training Prepares Novice and Professional Drivers for the Road

VR MOTION SOLUTION DEMONSTRATES THE BUSINESS VALUE OF USING VR TO TRAIN DRIVERS

Consumers may associate virtual reality with games and entertainment, but organizations increasingly recognize the immense potential of VR as a safe, efficient, and creative solution for a variety of industries. For driving schools, transportation companies, insurance companies, and government agencies, VR is a promising tool to train drivers for a wide range of vehicles.

Traditional, on-road driver training is expensive and time intensive, and it places students, instructors, vehicles, and other drivers at risk. Instructors cannot introduce hazardous scenarios, and they may not notice or have time to point out every driver error. By contrast, VR driver training offers the potential to educate drivers in a safe, highly immersive environment that can be easily adapted and scaled to meet specific training needs. In addition, VR makes it possible to gather and analyze data on individual drivers to improve their skills, and then aggregate data across drivers to improve future VR training and instruction.

To test the effectiveness of VR driver training, Intel and VR Motion partnered to conduct a study in which teen drivers used VR Motion's driver training simulation systems.

STUDY MEASURES DRIVERS' SITUATIONAL AWARENESS

In partnership with Intel, VR Motion developed VR driver training simulation systems that accurately represent vehicle acceleration, braking, and steering. Keith Maher, a technology innovator, and Dominic Dobson, a former professional racecar driver, formed VR Motion after Dobson used a VR simulator to train for and win the Unlimited Division at the Pikes Peak International Hill Climb.[1] Now, VR Motion's systems are being used to train drivers in a variety of commercial applications. In fact, the US Air Force is employing VR Motion's simulation systems to train personnel for high-risk driving environments.[2]

The 2018 teen driver study using VR Motion's driver training systems found that the participants improved their situational awareness, which is linked to improved driver performance. The VR training also allowed students to experience failure in a safe environment that did not put them, their vehicles, or the lives and the property of others at risk.

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BENEFITS OF VR DRIVER TRAINING

- Eliminates dangers of on-road training
- Reduces costs related to vehicle operation, insurance, and accidents
- Allows a safe introduction of different driving conditions, including hazardous scenarios
- Enables driver evaluations for more accurate underwriting
- Gives drivers and instructors the ability to playback and review training

A study participant behind the wheel of a VR driving simulator

VR SIMULATORS HELP STUDENTS LEARN TO DRIVE

For the study, 20 10th-grade students with roughly equivalent real-world driving experience were recruited from an Oregon high school and randomly assigned to two groups of 10. The control group received two sessions of VR driver training: one session at the start and one session at the end of the four-week study period. The test group received VR driver training twice a week for the four weeks, for a total of eight sessions.

"You're doing something that's close to the real thing, but you feel safer because you know that no matter what, nothing will happen to you or the car."

—Study participant

Driving simulation

The VR training took place on a VR driver training system developed by VR Motion and powered by an Intel® Core™ i7-6800K processor. Students wore a Samsung HMD Odyssey* Windows Mixed Reality* headset, an Empatica E4* watch to capture their heart rate and a headband device from Otolith Labs* that improves the VR experience by minimizing motion discomfort. The course was designed by VR Motion using guidelines from the course handbook of a national program for training beginner drivers on the details of car control.

Driving tasks

Each driving session included a brief introduction followed by three driving challenges:

- **Braking:** Come to a fast and complete stop in the braking zone without losing control of the vehicle.
- **Lane change:** While driving 40 to 60 miles per hour, change lanes, either to the right or left, when instructed to do so.
- **Slalom:** Weave between cones as fast as possible without hitting them.

Participants wore an Empatica E4* watch to measure heart rate

VR MOTION ENTERPRISE SYSTEM SPECIFICATIONS

VR Motion proprietary virtual driver training simulation

Computer configuration

Processor:
Intel® Core™ i7-6800K

- 3.4 GHz base frequency
- 16 GB memory

Graphics card:
NVIDIA GeForce* GTX 1080Ti

Operating system:
Windows® 10

Headset:
Samsung HMD Odyssey*
Windows Mixed Reality*

Motion hardware

Two-axis force feedback motion platform

Additional equipment

Otolith Labs* vertigo dampening device

Empatica E4* watch

The braking challenge required students to brake quickly without losing control

The lane change challenge involved sudden lane changes in response to instruction

The slalom course involved rapid weaving through a series of cones

Stroop exercise

A Stroop exercise was introduced to the test group in the third session to simulate a driving distraction. The exercise, named after psychologist John Ridley Stroop, tests the effect of a distraction on a subject's reaction time. For the student drivers, the distraction was the appearance during the simulation of a word such as "blue" or "yellow." The students had to ignore the word itself and instead call out the color of the font (e.g., if the word "green" appeared in yellow letters, the student should say "yellow").

The aim of the Stroop exercise was to create a high cognitive load, simulating driving distractions that occur in the real world and helping students understand how actions such as checking their phones affect their driving.

An example of a Stroop exercise in which students see the word "Blue" but should say the word "Red"

WEEK	CONTROL GROUP SESSION NUMBER	TEST GROUP SESSION NUMBER	CONDITION
1	**1**	**1, 2**	**Daytime, dry road**
2		**3, 4**	**Nighttime + Stroop**
3		**5, 6**	**Daytime, overcast, wet road + Stroop**
4	**2**	**7, 8**	**Daytime, dry road + Stroop**

Figure 1. Test group participants experienced four distinct driving conditions

Driving conditions

In addition to the Stroop exercise introduced in week two, the simulated driving conditions changed from week to week (see Figure 1). Test group participants each drove on a dry road in the daytime, then a dry road at night, then a wet road under overcast skies, followed by a dry road in the daytime again. Control group participants drove in the same condition (daytime, dry road) twice, first without the Stroop distraction in week one and the second time with the distraction in week four.

Scoring

In each session, participants started with 10,000 points, with deductions for each minor error made during the three challenges (braking, lane change, slalom).

During each training session, the VR simulator can gather granular data on all aspects of drivers' actions at each moment, including where they are looking, how much pressure they are applying to the brake pedal, and how far they are turning the steering wheel. Beyond simply knowing whether a student hit a cone, for instance, the data can be analyzed to suggest why such errors occur. The data can also be aggregated across drivers to better understand what novice drivers tend to do overall, leading to better future instruction.

STUDENTS IMPROVE DRIVING SKILLS IN A SAFE ENVIRONMENT

Study results showed that the simulation was highly effective in several elements that are critical to successful commercial applications of VR driver training: engaging participants, increasing their situational awareness, and improving their overall driving performance.

A complete sense of immersion

After each driving session, participants rated their immersion in the VR environment. Ninety-eight percent of the time they agreed or strongly agreed that they were completely immersed.

Better focus, less distractibility

After the first session, students in the control group and the test group responded similarly to the statement, "Most of the time, I was able to focus on the driving tasks and did not feel distracted." When the Stroop exercise was introduced to the test group in the third session, their ability to focus initially dropped, but it rebounded in later sessions, suggesting that they had effectively learned to deal with the distraction and focus on their driving (see Figure 3).

One participant said the Stroop exercise accurately reflected real-world distractions "like calling someone or conversing with someone," suggesting an understanding of the effect such distractions have on driving. Another participant noted that the training "taught me to stay in my lane and gave me the challenge of having to focus on the road while still having distractions, so it brought reality into it."

Students in the test group also appeared to become more aware of how fast they were driving, another test of their situational awareness. After the first session, only 20 percent strongly agreed with the statement, "Most of the time, I was aware of how fast I was driving." By the last session, the percentage strongly agreeing with that statement had tripled to 60 percent (see Figure 4).

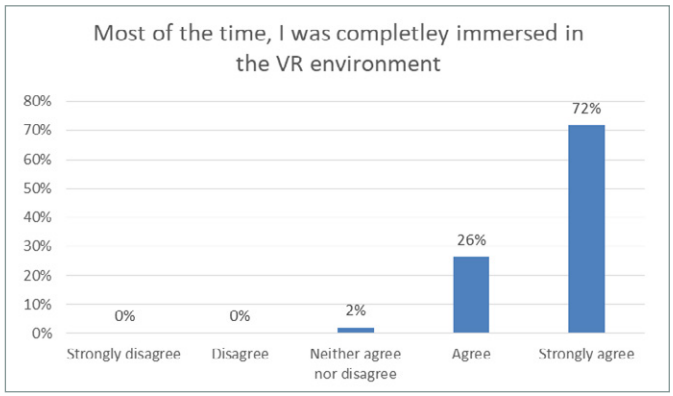

Figure 2. In 72 percent of the sessions, participants indicated full immersion in the VR environment

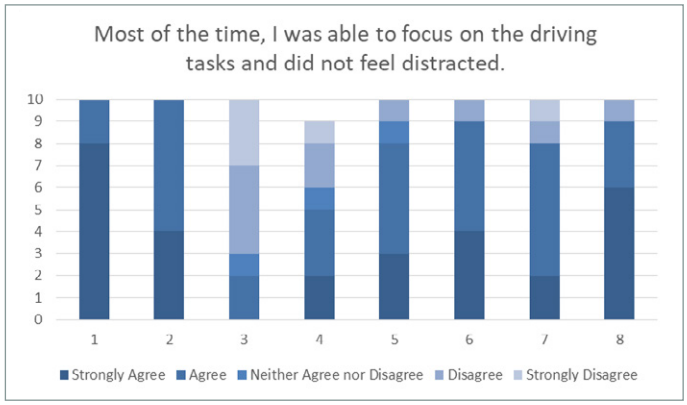

Figure 3. The test group's self-rated distraction increased when the Stroop exercise was introduced in session three, but rebounded by session eight

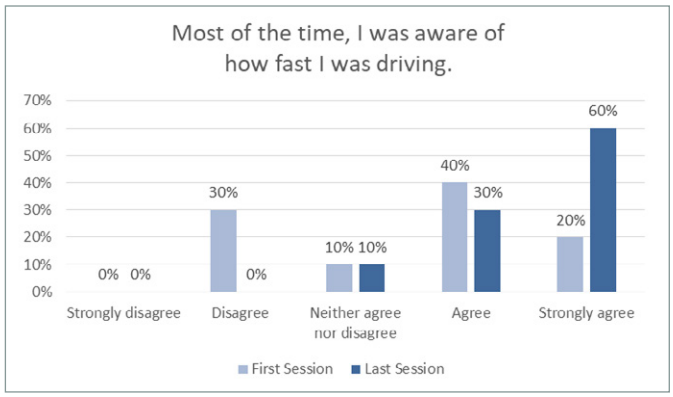

Figure 4. After the last session, 60 percent of test group participants strongly agreed that they were aware of how fast they were driving

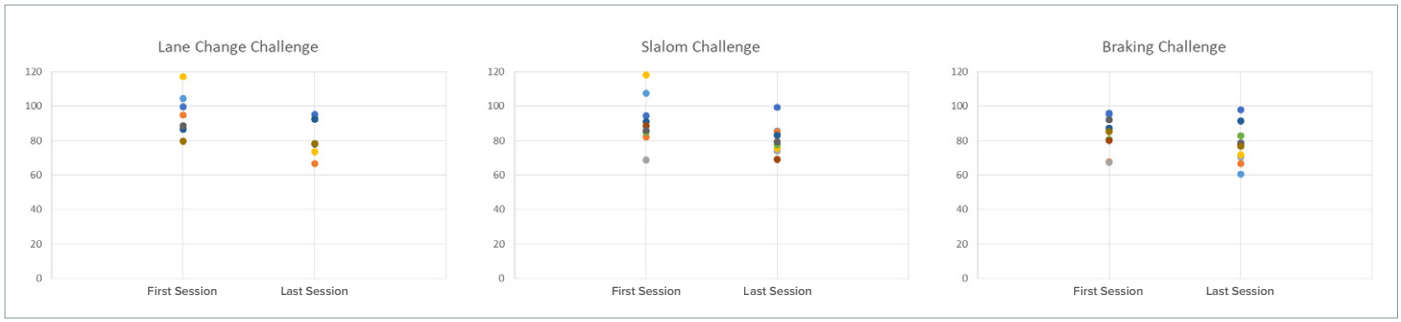

Figure 5. Test group participants' average heart rates tended to decline from the first session to the last

Heart rate

The study participants wore the Empatica E4* watch to track their heart rate during each simulated driving session. From the first session to the last, students in the test group appeared to adapt to the stressors in the three challenges, as indicated by the lower average heart rates shown in Figure 5.

Improved driving performance

Even after the driving distraction of the Stroop exercise was introduced in week three, test group participants improved their driving performance. They hit fewer cones, did a better job calculating stopping distance, and reacted better to sudden lane changes.

As Figure 6 shows, the test group's scores for driving performance improved from the first session to the last, with all test group participants scoring 8,000 or above on the 10,000-point scale. With only two VR sessions, the control group showed much less improvement in driving performance.

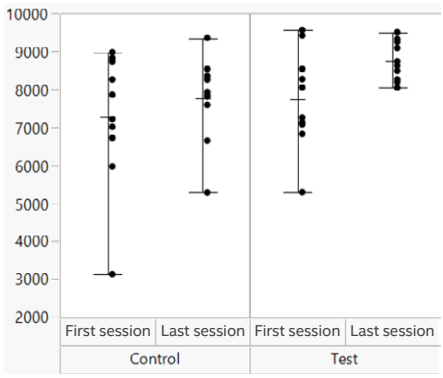

Figure 6. Test group participants showed strong improvement from the first session to the last

Reduced risks and costs

One of the business advantages of VR driver training is that it eliminates real-life dangers and costs. The students' lives—and those of others on the road—were not at risk, and the costs of potential tickets, accidents, and other mistakes were entirely removed.

During the study, the participants hit a total of 197 cones during the braking, lane change, and slalom challenges, and they made 78 incorrect decisions in the lane change and slalom challenges. If each of these 275 total instances of a struck cone, incorrect decision, and missed stop signal resulted in a fender-bender repair cost of $3,000,[3] the total cost of the training for all participants would be $825,000. With the VR training, students were instead able to avoid any costly accidents while learning in a protected environment.

Strong appeal to new drivers

Seventy percent of the study participants found the VR training at least "very useful," and half of the test group subjects—who experienced more VR sessions, including scenarios with nighttime and wet road conditions—rated the driving simulations as "extremely useful."

All the participants in the test and control groups said they were very or extremely interested in doing more driver training in VR.

Ready for more

The test group participants saw great value in practicing driving in nighttime and wet road conditions and were interested in trying additional scenarios. One of the advantages of VR driver training is its adaptability. The software can be created to allow drivers to practice a diverse array of scenarios that are uncommon or unsafe in the real world, such as responding quickly when another car cuts in front of them, driving in icy conditions, and driving on streets with heavy pedestrian traffic.

> "I like the thought of learning driving through VR without being on the open road. I think it would be good for me to learn how to drive in snow, rain, lots of traffic, before actually going out there and doing it. For me, VR just seems like a pretty cool way to learn."
>
> **—Study participant**

VR DRIVER TRAINING PROVES SAFE AND EFFECTIVE

VR driver training holds tremendous appeal for driving schools, transportation companies, insurance companies, and government agencies looking for a safe, cost-effective enhancement to traditional, on-road training methods. The study of VR Motion's driver training systems shows that there is a strong business case for using VR driver training in a variety of commercial and government applications, such as training and testing truck drivers and helping adults prepare for additional driver certifications.

In the study, VR training helped new drivers develop their driving skills in a safe environment that eliminated accident risks. Participants indicated that they were fully immersed in the VR environment and learned critical driving skills, including an enhanced ability to focus and avoid distraction while remaining calm. The results further demonstrate the cost savings associated with VR training and its potential to provide organizations with valuable data and insights, leading to a world of more capable drivers.

Learn more at vrmotioncorp.com.

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2. https://www.newswire.com/news/skidcar-and-vr-motion-provide-immersive-driver-training-to-us-air-force-20648939
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