An Evaluation of Simulator-Based Training on the Development of Backing Skills for Learner Truck Drivers

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Presentation Plan

- **Background and evolution of simulator-based training**

- **Model of skill acquisition**
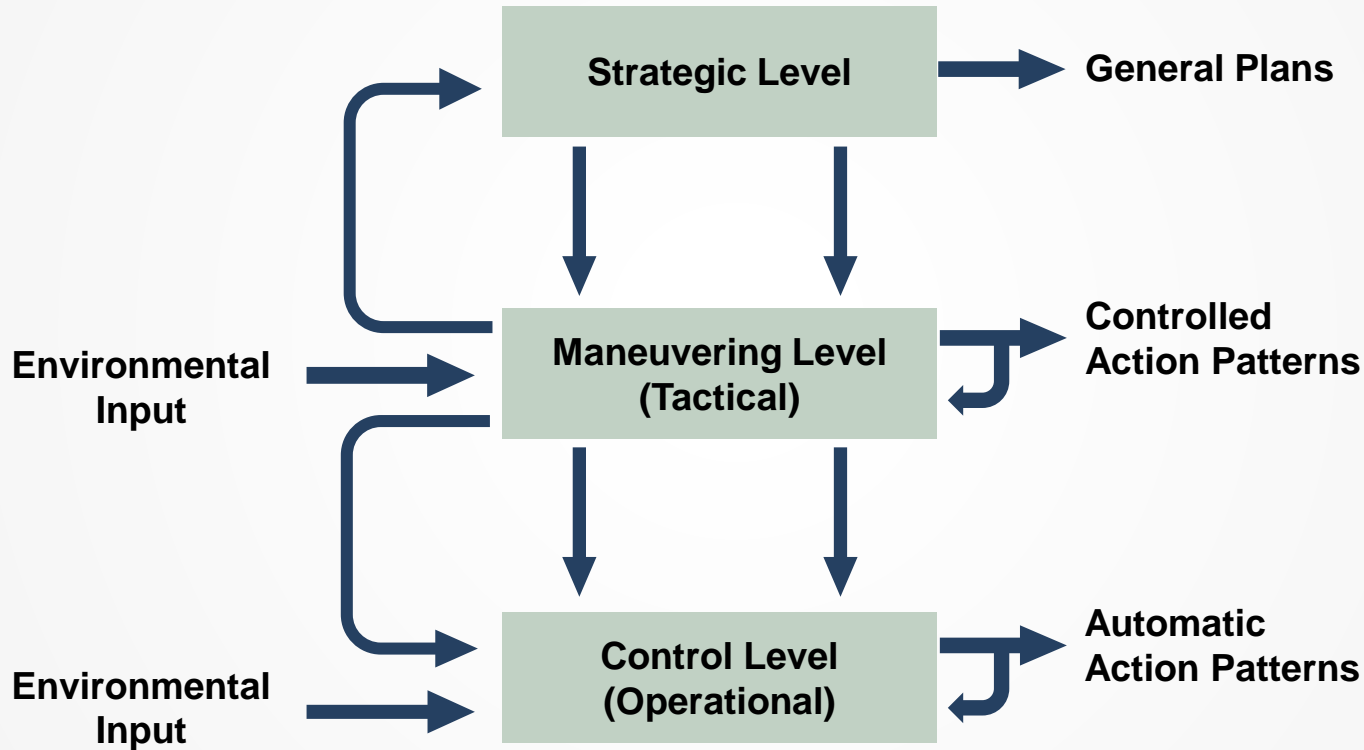
- **Experiments A and B**

- **Results**

- **Discussion**

Disclosure

Pierro Hirsch is an employee and shareholder
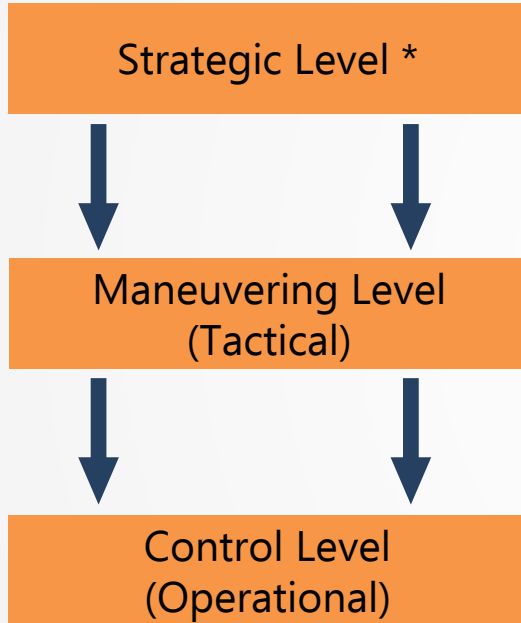
at Virage Simulation.

Background

- Effectiveness of flight simulators - *unquestioned*

- Demonstrations of truck simulator effectiveness - *underdeveloped*

- Uhr et al. (2003), found positive 1:1 transfer of backing skills learned on truck simulator to the real world

- Novice truck drivers with 60% of their training in a simulator performed as well in real trucks as novices trained only in trucks (Morgan et al., 2011)

- The Golden Shifter Program, courseware designed to support competency-based learning of gear-shifting skills, reduced training time by 50% or more (Hirsch et al., 2011; Hirsch & Bellavance, 2013)

Hierarchical Control Levels* (Land or Air Vehicles)

Strategic Level → General Plans

Maneuvering Level (Tactical) → Controlled Action Patterns

Control Level (Operational) → Automatic Action Patterns

Environmental Input

Environmental Input

* Adapted from Michon (1985)

Evolution of Simulator Pilot Training

Strategic Level *

Maneuvering Level
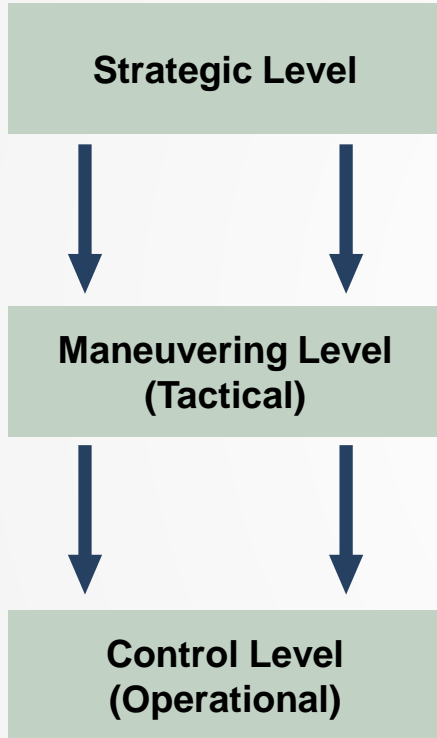(Tactical)

Control Level
(Operational)

Cessna-type Trainers,
e.g. Navigation Skills

Bi-Annual Recurrent Training

1983 Zero Flight Time

1920s

Evolution of Simulator Driver Training

Strategic Level

Maneuvering Level (Tactical)

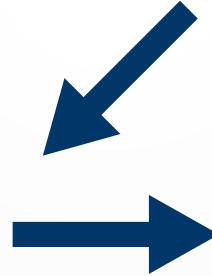**Control Level (Operational)**

1940s

2014

Study Origin

The Centre de Formation en Transport de Charlesbourg (CFTC), a multi-site truck driver training school in Quebec, "**open to research and innovation**".

5 + 1 weeks

10 weeks

1,000 graduates annually

Study Origin

CFTC teachers observe that students devote disproportionately more time to mastering basic vehicle control skills than to the more safety-critical, higher-order skills.

Virage Simulation was commissioned to develop simulator-based learning programmes to accelerate the mastery of basic driving skills.

1st The Golden Shifter Programme for gear shifting (CMRSC XXI).
2nd The Golden Mirror Programme for backing skills (CMRSC XXIV).

Research Questions

1. Is learning backing skills on the truck simulator equivalent to learning in a real truck?

2. What percentage of training can be done in the truck simulator?

3. What is optimal use of this learning technology?

Design

- Forward transfer-of-training field study

- Convenience sample - Learners volunteered to participate in the experimental group

- Between-subjects comparison of evaluations of controls (in-truck training only) and experimental groups (combined simulator and truck training)

Methods – Experiment A

Three (3) days of training in backing skills within the first 12 days of in-truck training,

- Learners complete GMP (5 levels) **before** starting in-truck training in backing maneuvers (**20%** of total training).

- Evaluation consists of two trials each in a real truck for straight-line and angle parking (**4 trials in total**).

- Evaluation in real truck by single evaluator after the first week of truck training.

Methods – Experiment B

The following modifications added to Experiment A

- Creation of extra level to practice parking under more challenging, variable conditions

- Learners practice GMP (6 levels) *alternating* morning simulator training with afternoon in-truck training over three days

- Evaluation consists of three trials each in a real truck for straight-line and angle parking (**6 trials in total**)

Participants

EXPERIMENT	SIMULATOR / TRUCK TRAINING		TRUCK ONLY TRAINING	
	N	**Age** (mean ± SD), gender	N	**Age** (mean ± SD), gender
A	9	(**32.8** ± 13), all ♂	11	(**29.8** ± 12), 2 ♀
B	10	(**26** ± 11), 2 ♀	10	(**34.2** ± 10), 2 ♀

Golden Mirror Program™

Six* interlinked modules designed to allow learners to achieve competence in backing a tractor-trailer truck.

Backing and parking tasks are segmented and arranged in increasing order of complexity.

Learners receive continuous feedback on their performance while progressing at their own speed and without the supervision of a teacher.

*Latest version

Golden Mirror Program

Level 1   Straight-Line Backing and Reverse Lane Changes - Tractor only

Level 2   Straight-Line Parking - Tractor only

Level 3   Straight-Line Backing and Reverse Lane Changes - Tractor-Trailer

Level 4   Straight-Line Parking - Tractor-Trailer

Level 5   Angle Parking - Tractor-Trailer

Level 6 *   Straight and Angle Parking with Obstacles - Tractor-Trailer

Training Platform

VS600M Truck Simulator

- Real truck components

- 180-degree forward field of view plus rear view mirrors

- Manual shifter provides realistic force feedback and vibrations

- The driver's seat, steering column and dashboard are mounted on a three degree of freedom motion / vibration platform

Parking Maneuvers (GMP™)
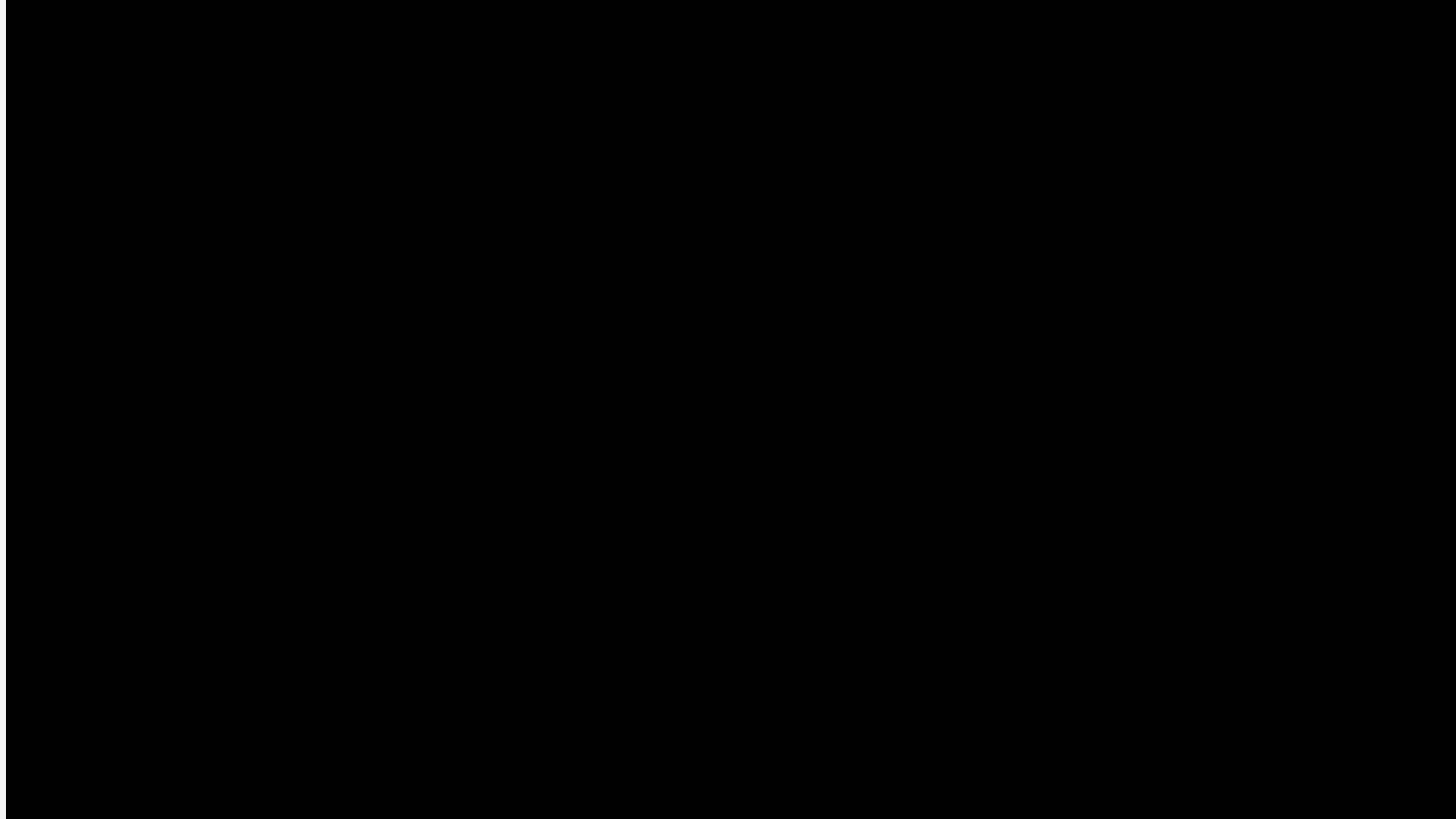
STRAIGHT-LINE

ANGLE

Training duration : 3 days

Truck simulator training combined in-truck

Vs.

In-truck training

In-Truck Evaluation of Backing Maneuver

Success criteria:

- Correctly position the vehicle before backing up
- Activate 4-way flashers
- Reverse into final position without touching the "wall" (horizontal wood blank)
- Complete the maneuver in less than 5 minutes (SAAQ standards)

Causes for immediate failure:

- Touching a traffic cone
- Incorrect final position

Straight-Line Parking

Angle Parking (45°)

Is learning backing skills on the truck simulator equivalent to learning in a real truck?
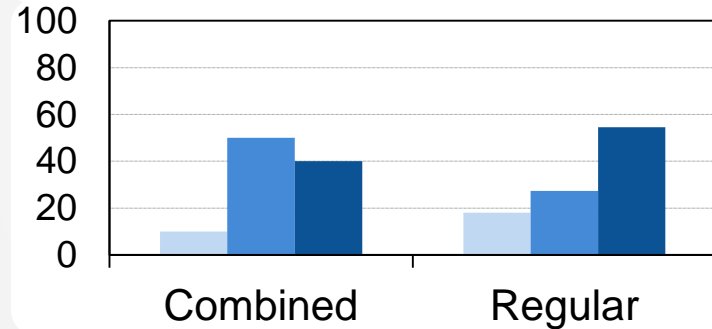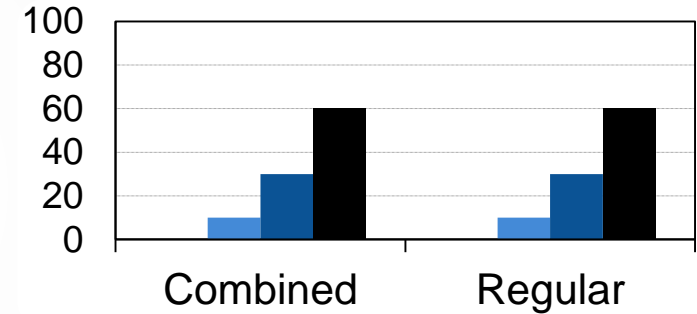
Frequency Distribution

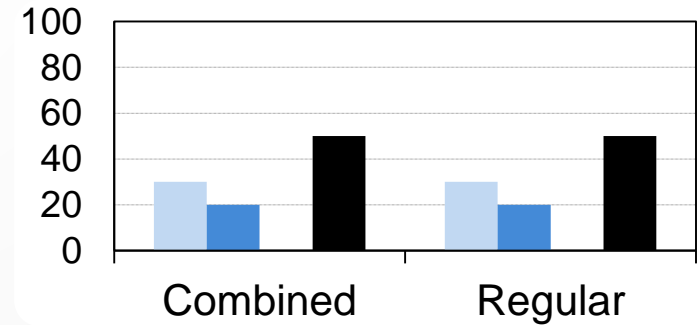Percentages of learner truck drivers who achieved successful parking trials
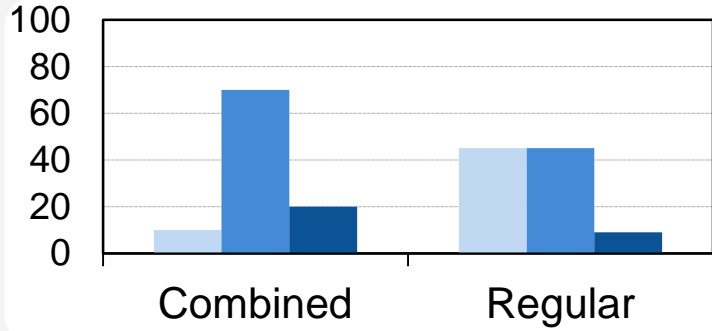
Results 2

What percentage of truck driver training can be done in the truck simulator?

The data from in-truck evaluations in experiments A and B indicate that 20% and 50% of in-truck training can be replaced with simulator training.

Results 3

What is optimal use of simulator learning technology?

Brock et al. (2007) proposed "a set of diagnostic tests that could funnel students into unique optimum learning opportunities" to improve commercial driver training.
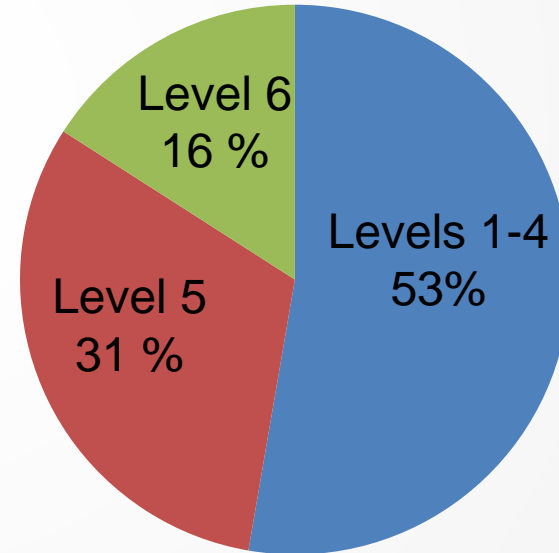
Experiment B – Simulator Group

Distribution of Practice Time Within GMP Levels

Pass Group* (Angle Parked 3 of 3)

Level 6 31%
Level 1-4 38 %
Level 5 31%
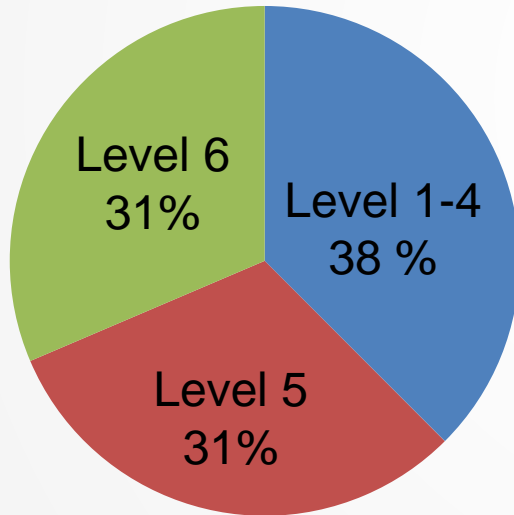
Fail Group* (Angle Parked 0 or 1 of 3)

Level 6 16 %
Levels 1-4 53%
Level 5 31 %

* N=5

A Potential Diagnostic Test

Duration (in seconds) prior to first successful maneuver per level

Pass group	Fail group	Delta (%)	
425	625	32	Level 1
570	890	36	Level 2
1815	2694	33	Level 3
598	1067	44	Level 4
2794	3789	26	Level 5

Pass group achieved first success 26 to 44 percent faster than fail group.

Limitations

- Small sample size

- Conditions at the truck driving school precluded the randomization of participants and control of potential selection biases.

Thank you

Questions?