Distracted Driving Effects on CMV Operators

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Overview

1. Introduction
2. Importance
3. Our Study Overview
   A. Subjects
   B. Variables
4. Design
   A. Variables
   B. Conditions
   C. Measures
5. Surveys
6. Materials
   A. Distractions
   B. EEG
   C. Simulator
7. Results
   A. Performance
   B. Physiological
   C. Survey
8. Conclusions
9. Future Work

Introduction: Distracted Driving. 1

- **Project Objective:** measure the effects of specific internal and external distractors on CMV drivers' performance.
- Definition: **Distracted Driving** is any activity that takes the driver's attention away from the task of driving, that causes a significant increase in driving errors.
- Crash reports and interviews have identified common sources of distraction that include: cell phones, texting, portable music players, passengers, and external events.



Why this is Important. 2

- According to NHTSA (2010) 18% of all fatal car accidents (5,474) and 20% (448,000) of non-fatal crashes were due to distraction in the USA in 2009.
- In Florida in 2009, there were 338,633 crashes involving CMVs, with over 32,000 (10.6%) attributed to distracted and careless driving (Jones, 2010).
- These numbers may not account (an underestimate) for all accidents due to lack of accident reporting. Therefore the problem may be much larger than is reported (GHSA, 2011).

Our Study with CMV Operators. 3

- CMV operators are safe drivers. However, their prolonged exposure to driving puts them at higher risk of distracted driving.
- This makes them a good target for reduction of preventable accidents such as those caused by distracted driving.
- They are expert drivers with unique regulations in special vehicles. Therefore data from the general population cannot be generalized to represent them.

Our Study with CMV Operators. 4

- In state interviews with CMV operators and a crash report analysis pointed to these top 3 distractions.

1. Cell phone calls. (Internal)
2. Portable music player operation. (Internal)
3. Visual external events. (External)

- Many companies have already implemented strict rules and limitations regarding common distractions. For example: GPS, Casual phone calls, texting, passengers, satellite radio

Design: Variables. 5

External visual events – We chose **work zones** since they are the most common and longest distance visual external event noted during interviews.

Portable music player operation. – We used a **touch screen mp3 player** and had the driver select specific tracks since this was noted to be the most relevant type of portable music player as well as an emerging technology.

Cell phone calls – We asked a series of **interview style questions**. This replicates the cognitive action of an important call and represents a situation where a CMV operator might really use a phone. Note: They have strict rules on their use of a cell phone but sometimes have to use one anyways. We asked them to ignore those rules for the duration of the study.

Design: Conditions. 6

Condition 1	• No Internal • No External
Condition 2	• Phone (Internal) • No External
Condition 3	• Mp3 (Internal) • No External
Condition 4	• Phone & Mp3 (2 Internal) • No External
Condition 5	• No Internal • Work Zone (External)
Condition 6	• Phone (Internal) • Work Zone (External)
Condition 7	• Mp3 (Internal) • Work Zone (External)
Condition 8	• Phone & Mp3 (2 Internal) • Work Zone (External)

There were 8 different conditions that incorporated different combinations of internal and external distractions.

These conditions were presented randomly in a balanced fashion to the drivers.

We used a control with no distractions as a baseline for comparison.

Design: Measures. 7

Driving Performance

Measured by the number of driving errors. Errors are dangerous actions or ticketable offences as defined in the Florida Drivers Handbook.

These include: dangerous speed, hazardous breaking, sudden merging, tailgating, collisions, lane deviations, and more.

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Design: Measures. 8

Physiological measures

Electroencephalogram (EEG) was used to record Alpha, Beta, and Theta waves.

Measures were compared to investigate increases in workload (Murata, 2005), which is related to distraction (Young & Regan, 2007). Frontal theta was compared across scenarios to investigate increases in working memory load (Lin et al, 2011).

Surveys. 9

Demographic Survey

- Characteristics of our sample.

EEG survey

- Checked that EEG settings were set correctly.

Fatigue surveys

- were given after run 4 (half way point) and then after run 8 (at the end) to assess fatigue and acquire feedback.

SSQ survey

- Assess simulator sickness at the end of all runs.

Materials: Distractions. 10

Distraction devices:

- **Apple iPod Touch 3rd generation**.
- **The driver's personal cell phone.**
- **L-3's Scenario Builder** software was used for making the custom work zone scenarios.
  - Work zones followed Florida regulations and were modeled after features in real work zones to remain realistic.

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Materials: EEG. 11

EEG

- **ABM, B-alert ten channel EEG/ECG**
  - Can take measures in independent lobes from 6 brain waves.
  - Can validate that nodes are connected correctly prior to recording.
  - A baseline was established where participants were left in a low stimulation environment.

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Materials: Simulator. 12

High fidelity simulator allows for realistic measure of human performance.

L-3 Mark III Truck Driving Simulator

- Motion-based platform with 6 degrees of freedom
- 260 degree field-of-vision
- Realistic interior
- Real rear view mirrors
- CHRISTIE high contrast Projectors.

Motion was used because according to (Alessi, 1988) expert operators will be attuned to vehicle motion and get less sick and more immersed when using it.

Results: Performance. 13

All of the scenarios caused a significantly higher average number of combined errors than the control scenario with a p-value of less than 0.05 alpha.

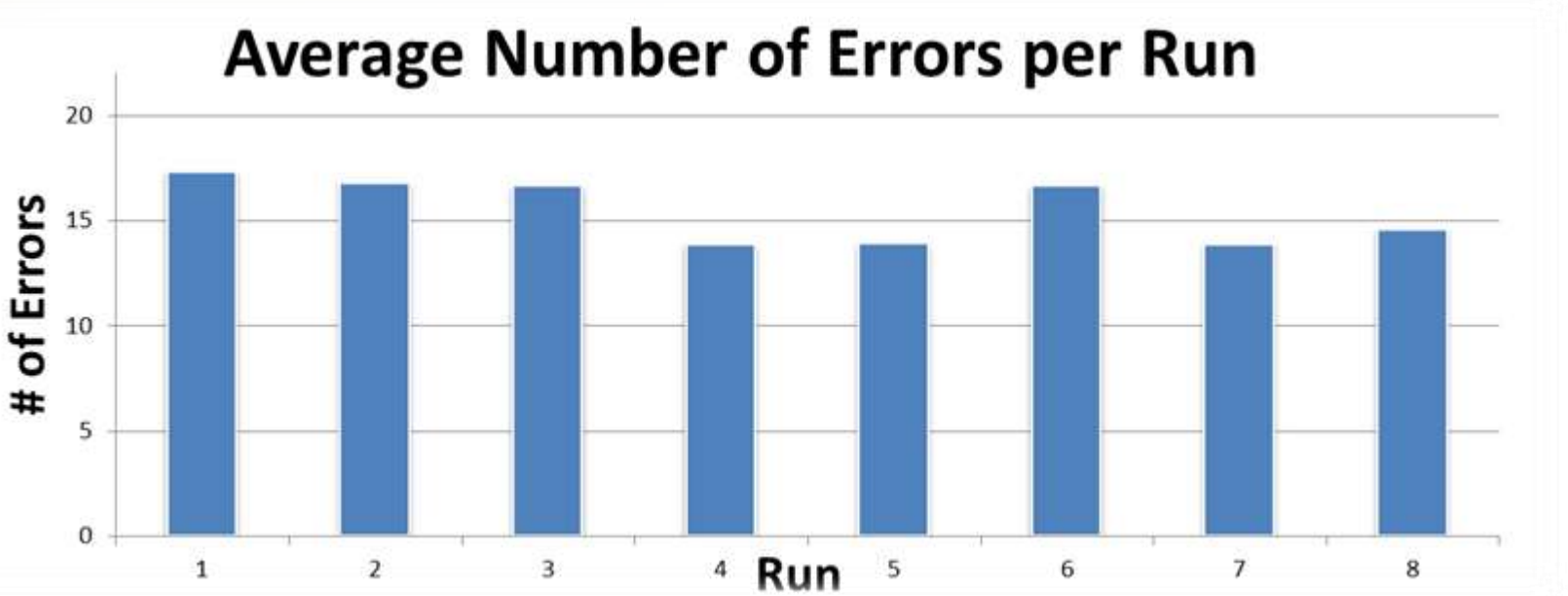
Multiple sample T-Tests were used to compare conditions.

Combined variable conditions always had significantly more errors than single variable conditions

Most common error was lane deviation.

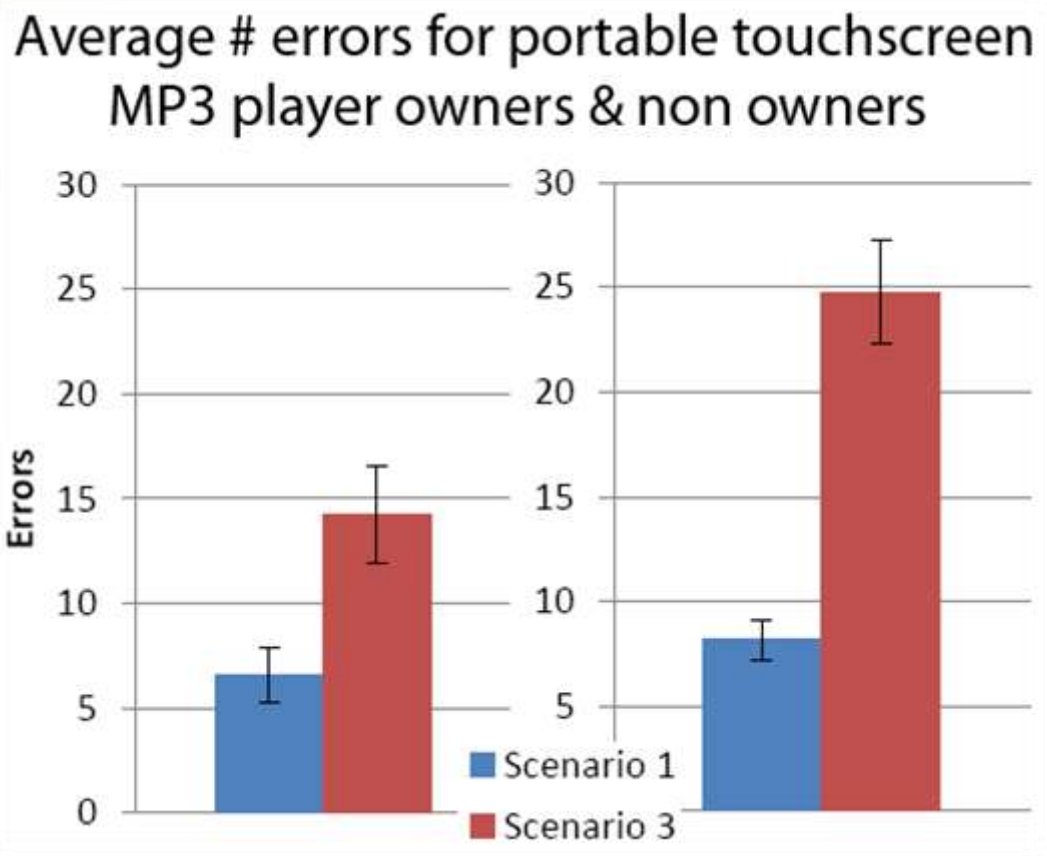
Most distracting variable was the MP3 player.

Results: Performance. 14



The experiment showed balanced randomization because there was no significant difference found between the run position and total number of errors.

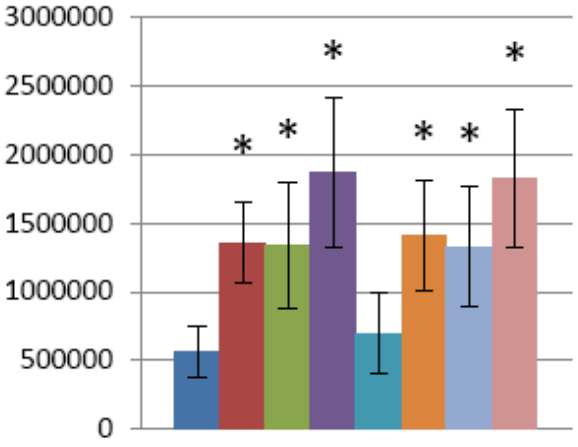
Results: Performance. 15



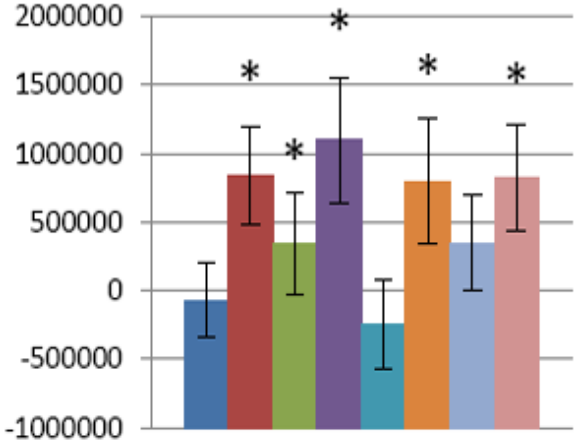
Surveys revealed that owning a portable MP3 player did not influence the significance found between the control and MP3 player conditions.

Results: Physiological EEG. 16

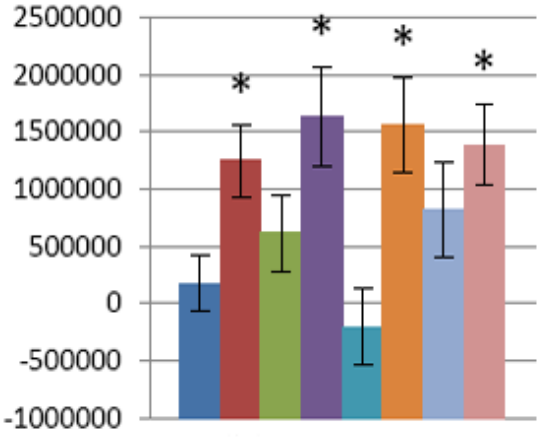
Total Theta: Change From Baseline



Total Alpha: Change From Baseline



Total Beta: Change From Baseline



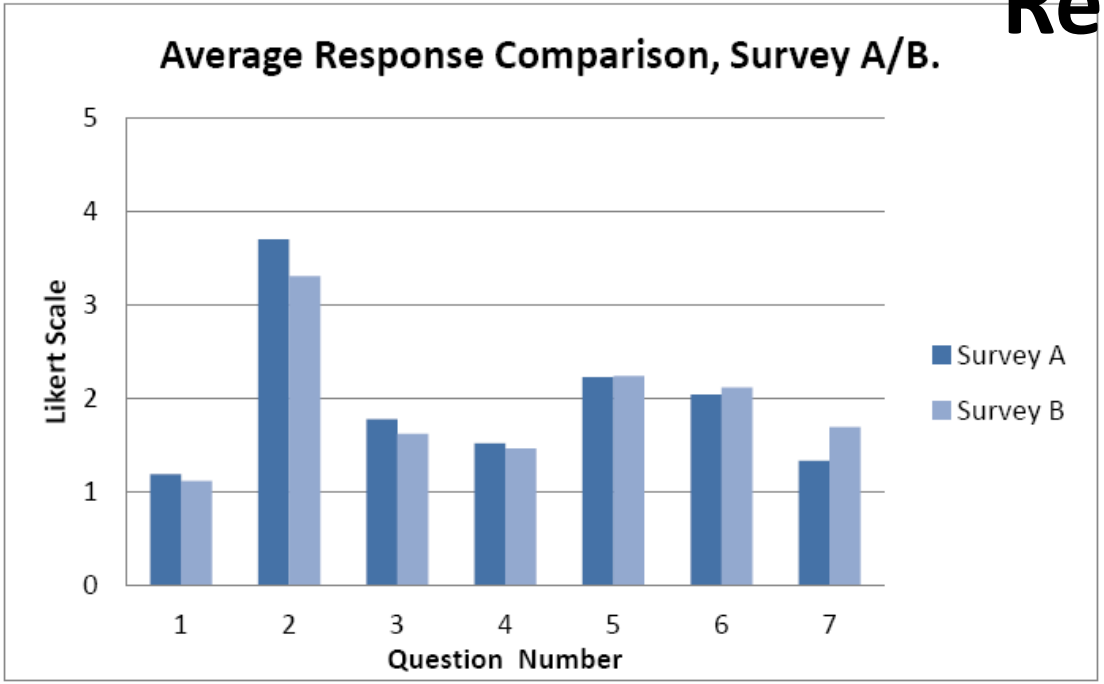
- Significance denoted with *
- External events did not cause an increase in mental workload for CMV drivers but everything else did.
- This is likely because CMV drivers have seen a lot of work zones.

Results: Physiological EEG. 17

Significant main effects were found for total alpha [$F(7,119) = 3.784$, $p = .001$], total beta [$F(7,119) = 5.660$, $p = .000$], total theta [$F(7,126) = 3.509$, $p = .002$], frontal theta [$F(7,126) = 4.814$, $p = .000$], and parietal alpha [$F(7,126) = 4.768$, $p = .000$].

- Scenarios 2, 4, and 8 showed consistent, significant increases across all EEG measures compared to scenario 1.
- Scenario 6 showed significant increases across total alpha, beta, theta, and parietal alpha measures compared to scenario 1.
- Scenario 3 showed increases in total alpha and theta, while scenario 7 showed increases in only total theta.

Results: Surveys. 18



- All answers were moderately to strongly correlated, besides for question 7.
- All responses, including 7, indicated that participants did not feel fatigued and wanted to continue.

Correlation was used to analyze the change in answers from the run 4 and run 8 surveys.

Q1, I enjoyed this experience

Q2, I think the break between drives needs to be longer

Q3, The driving experience was realistic

Q4, Using the phone and/or iPod were distracting to me

Q5, The traffic situation was a distraction

Q6, I could tell what each traffic sign was supposed to be

Q7, I feel I can still go in the simulator for another few runs

Conclusions. 19

- While driving, doing any other task cognitively distracts a driver and causes a reduction in their driving performance.
- The CMV operators do not seem very effected cognitively by work zones but reported them as distracting and errors still occurred significantly higher in such zones than in the control.
  - This is probably due to CMV operators being around work zones frequently, as well as the nature of work zones being passive as opposed to the active nature of the internal distraction tasks.
- Operating touchscreen MP3 players caused errors to occur more than 3 times more often than in the control. This warrants more investigation.
- Cell phone conversations caused nearly twice as many errors than in the control.
- Drivers of any expertise should remain focused on driving and avoid distractions, this includes avoiding construction zones if possible.

Future Work. 20

- The external condition gave us surprising EEG results with only sometimes appearing significant and varying greatly across participants. This warrants further investigation of these zones since they were reported as distracting and seemed to cause a decrease in driving performance.
- Rapter is currently conducting 2 more studies focused on distracted driving that use similar external work zones with different level of expertise from the drivers.

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