Results from Experimentation on Driver Behavior at Control Entry Points

Target Behavioral Response Laboratory

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13. SUPPLEMENTARY NOTES

14. ABSTRACT

We will present findings from our testbed experimentation of driver behavior at checkpoints. The work falls under the presentation topic area of "operational and influence modeling and decision support." For the last three years, the Target Behavioral Response Laboratory has been conducting research on driver responses to non-lethal weapons and systems in checkpoint/entry control point scenarios. Data and results from this testing will be presented. Approach to checkpoints can be divided into the early Hail/Warn phase and later Suppression phase. The presentation will discuss the differences in driver behavior when visual and acoustic devices, green dazzling lasers, and non-coherent lights are presented for hailing and warning with and without supplementary instructions. The presentation will also discuss results of experimentation of effectiveness of green lasers, bright white lights, and windshield obscurants for suppressing driver's approach. The presentation will conclude with a discussion on applications to modeling and simulation efforts.

15. SUBJECT TERMS

non-lethal weapons, laser, non-coherent lights, checkpoint, driver behavior, acoustic, hailing, warning, suppression, windshield obscurants,effectiveness

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Target Behavioral Response Laboratory

Gather empirical data on real human behavior in response to non-lethal weapons and systems using real people in tactically relevant situations

The Problem

- Checkpoints are critical to peacekeeping and counterinsurgency operations.
- Security is a prime concern because checkpoints are often scenes of violence or have the threat of violence.
- Losses occur when using lethal fire on non-belligerents drivers mistakenly perceived to be a threat.

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Specific Objectives

- To compare the effectiveness of several non-lethal energies, methods, and modalities
- For Hailing and Warning
  - To identify non-lethal devices and methods that can be unequivocally perceived and understood
- For Suppression
  - To identify effective non-lethal means to impede a driver's approach to a checkpoint

Method

- 30 Drivers/Four Experiments/Two trials per condition
- Hail/Warn Experiments (x2)
  - Can subject see/hear/understand and comply with instructions?
  - Red, green, white non-coherent lights
  - Green dazzling laser
- Suppression Experiment (x1)
  - Does the driver hesitate, slow down, or stop?
  - Bright White Light
  - Paintball Windshield Obscuration
  - Green dazzling laser
- Baselines Included (no light stimulus/obscurant presented)

Instrumentation

- Testbed
  - Pressure hoses
  - Videorecorder

- Vehicle
  - Depressions of brake
  - Potentiometer recording of wheel turning
  - Accelerometer
  - Three video cameras (views of driver and driver's view out of front windshield)

Experimental Control Center


Track Lanes and Pressure Hoses

Instrumentation

- Testbed
  - Pressure hoses
  - Videorecorder

- Vehicle
  - Depressions of brake
  - Potentiometer recording of wheel turning
  - Accelerometer
  - Three video cameras (views of driver and driver's view out of front windshield)

Instrumented Vehicle


Instrumented Vehicle

Treatments

- Green dazzling laser light
- Bright non-coherent lights (red, green, white)

Green Dazzling Laser Mounted on Tripod with Red Dot Sight


Non-coherent lights

Natural Reaction Test

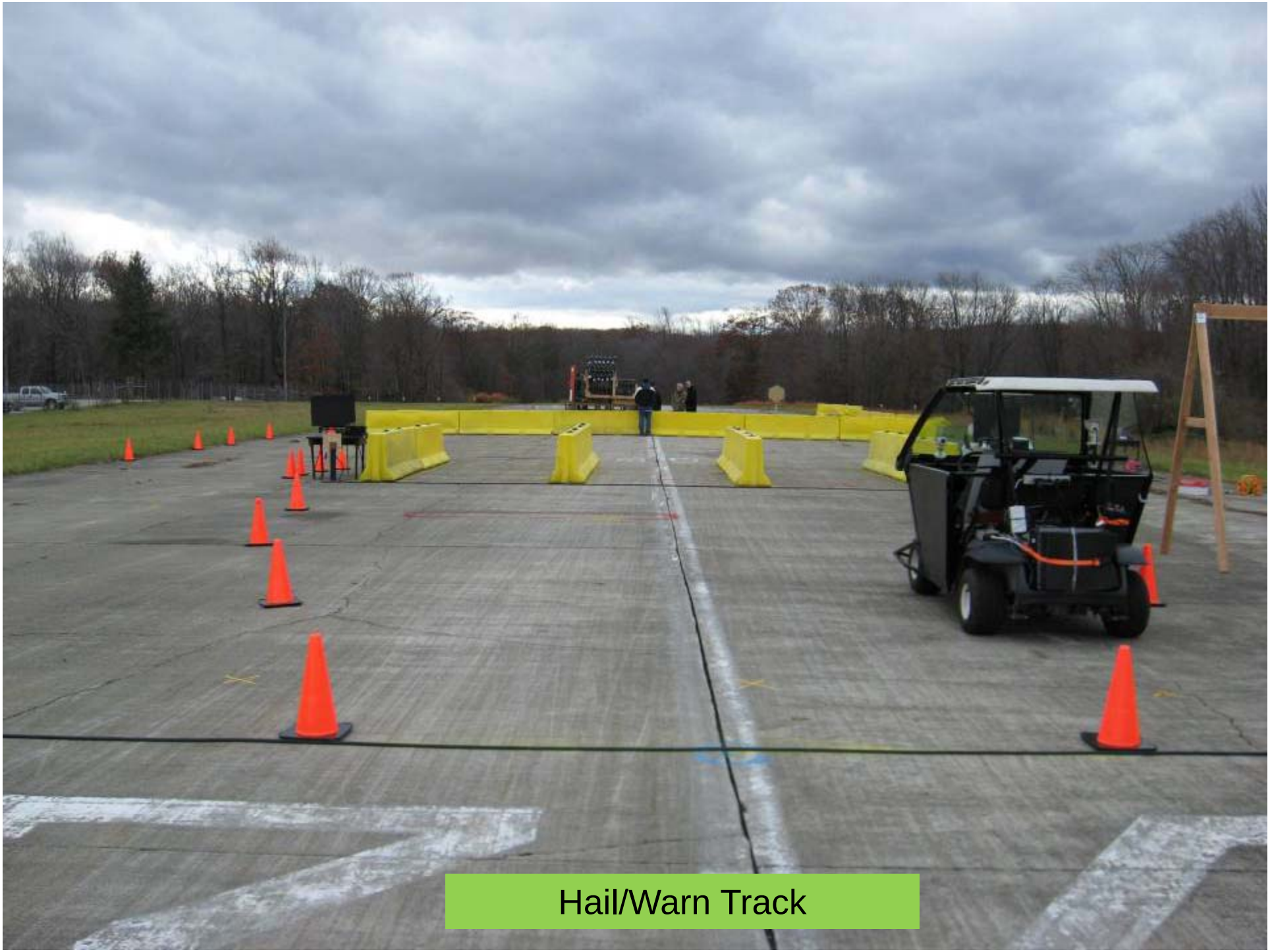
Drivers drive in a straight path, traveling toward the middle of the three-channel lane.

Light stimuli (randomized order) presented 10m from the entrance to the channels

- 1.4-sec laser exposures
- 1-sec exposures of green, red, or white lights.

Question

What is the driver's natural reaction to these light stimuli when presented during driving?


Hail/Warn Track


Red Non-Coherent Light
Stimulus

Findings

- No subject naturally stopped in response to any of the light stimuli.
- The most frequent natural response to laser or non-coherent light stimuli: continue on straight as usual.
- No difference was noted in responses to each of the light stimuli.

Perceptibility Test

Subjects were informed ahead of time what to do when presented with each light stimulus:

- White Light- “Take Right Channel”
- Green Light (laser or non-coherent)- “Take Left Channel”
- Red Light- “Stop”
- If don’t see light- “Go Straight”

Question

Can subjects perceive the light stimuli?

Assumption: drivers do not follow instructions when they do not perceive the light stimulus

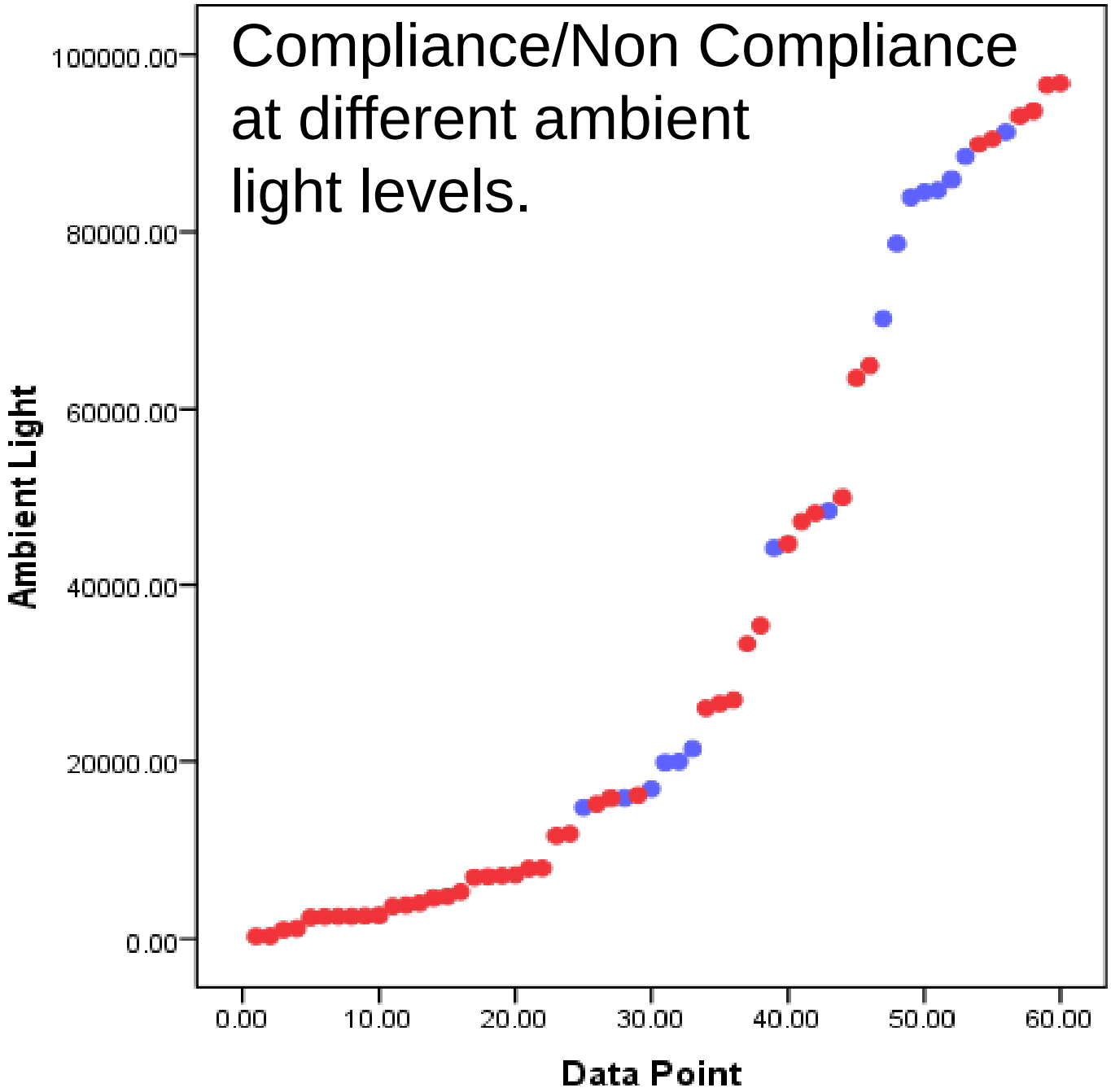
Comparison: driver's compliance reactions to the different light stimuli

Conclusion: different reactions reflect different perceptibility of light stimuli

Findings

- No differences in perceptibility among the different wavelengths of non-coherent colored lights.
- Laser was harder to see than the non-coherent lights (lower compliance when laser was presented).
- Significant negative correlation between ambient light and compliance rates under the laser presentation
  - -- in other words, in darker settings it is reliably easier to see this laser light.

Compliance/Non Compliance at different ambient light levels.



- The darker the ambient light the more compliance with instructions associated with laser light.
- The darker the surroundings, the easier it is to see green laser light.
- 100% compliance at darker than 14,800 lux

Suppression Experiment

Subjects were exposed to a potentially suppressive stimulus prior to driving a serpentine course:

- Green dazzling laser
- Non-coherent bright white light
- Windshield obscurants

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Green Dazzling Laser
on Driver


Bright, White Light Stimulus

Bright White Light Mounting


Bright White Light Stimulus
on Driver

Paintball Array


Paintball Obscurant on Windshield

Question

Do any of the three stimuli produce a suppressive effect?

- Can we make the driver choose to stop?
- Can we make the driver lose control of the vehicle?
- Can we make the driver hesitate?
- Can we make the driver slow down?

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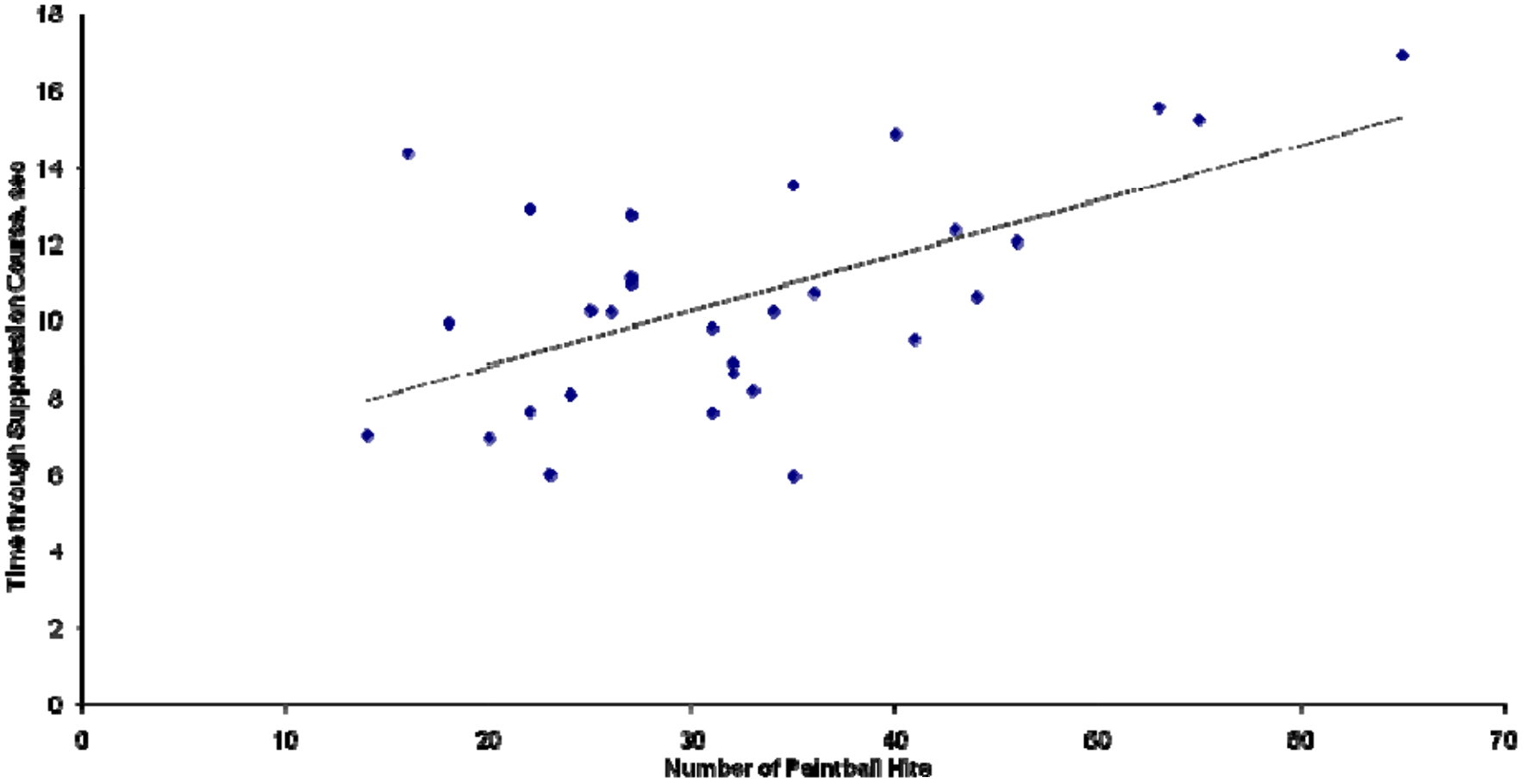
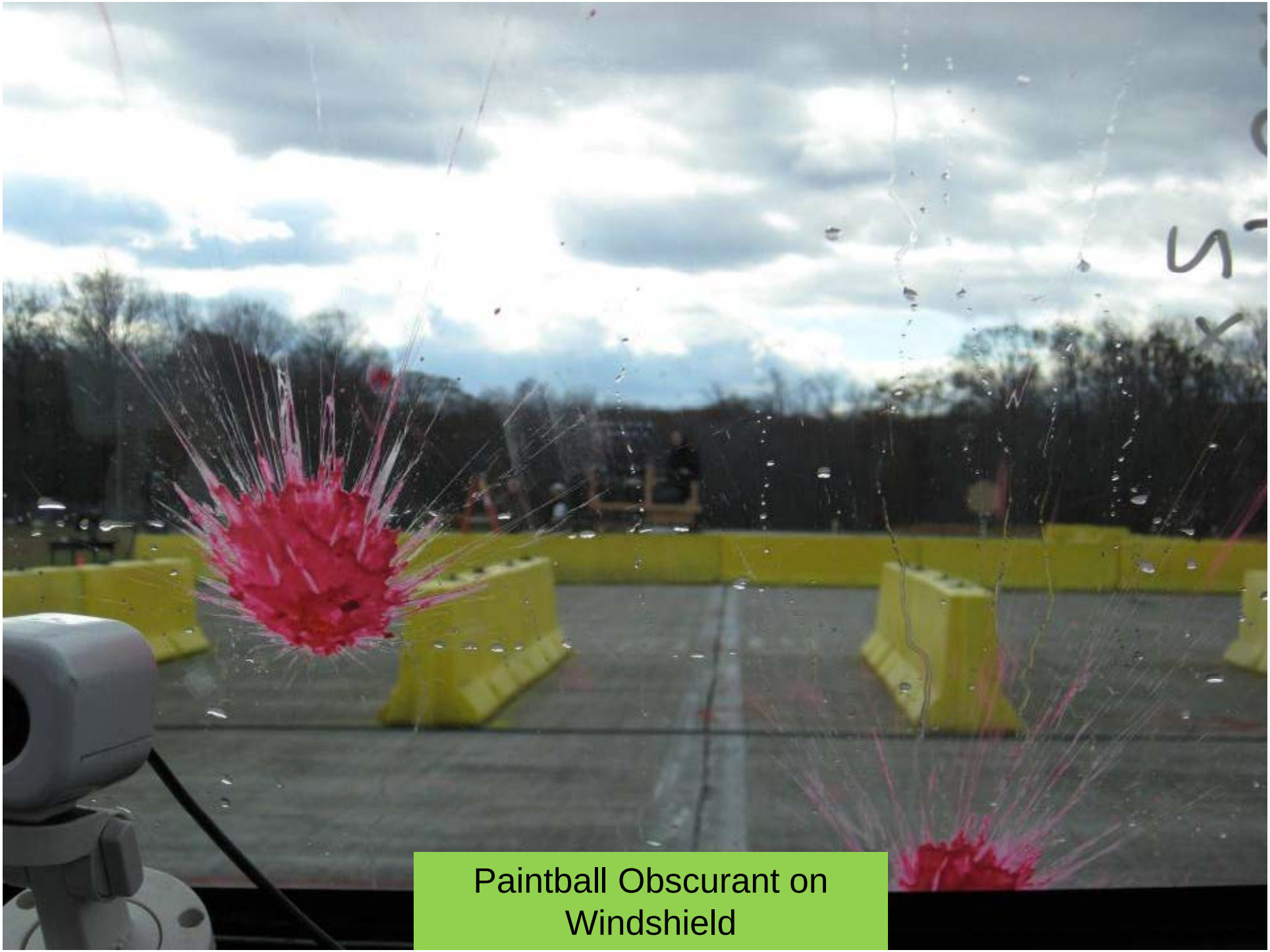
Findings

- No driver stopped
- No driver hesitated upon entering serpentine
- No driver slowed down while navigating the serpentine
- Positive correlation between number of paintballs that hit the windshield and the time to drive through serpentine

Correlation Between Paintball Hits and Time Through the Serpentine





Paintball Obscurant on Windshield

Conclusions

Controlled Laboratory Testing:

- Can provide the required data for Modeling and Simulation of entry control points
- Identifies critical factors
- Identifies important associations and causal relations among factors
- Provides reality-based numerics for input into programs
- Provides reality-based algorithms for architectures