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Targeting of Convoy Vehicles is Not Disrupted by a Green Laser: Moving, Predictable Targets in Bright Lighting

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14. ABSTRACT

Protecting military convoys from sniper fire is a priority. A fielded green laser was evaluated for its capacity to interfere with the ability of a shooter to hit moving outdoor targets, both while the laser was on and again just after termination. We tested each subject???s ability to locate, identify, and hit a target using rifle-like armaments, during trials with or without laser exposure. Impairment was defined as fewer target hits during laser trials, compared to no-laser trials. Two trucks traveling in a convoy served as targets. Eight subjects shot during 14 trials. On laser-exposure trials, Target 1 was presented concurrently with the laser, and Target 2 was presented immediately after removal of both Target 1 and the laser. Target 1 & 2 accuracy on laser trials did not differ from no-laser trials. On non-exposure trials, no target accuracies differed. Shooter skill did not affect impairment. Under bright lighting conditions, shooting at moving (but predictable from extrapolation), brief-exposure targets, the maximum eye-safe green laser exposure did not impair targeting success while on the shooters eyes nor afterward. Perceptual mechanism and situational contributors to effectiveness are discussed.

15. SUBJECT TERMS

laser, shooting accuracy, impairment, human behavior, suppression

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The Problem

- Protecting military convoys from sniper fire is a priority.
- Soldiers would like to use non-injurious lasers in civilian settings to impair potential shooters to keep convoys safe.

Specific Objectives

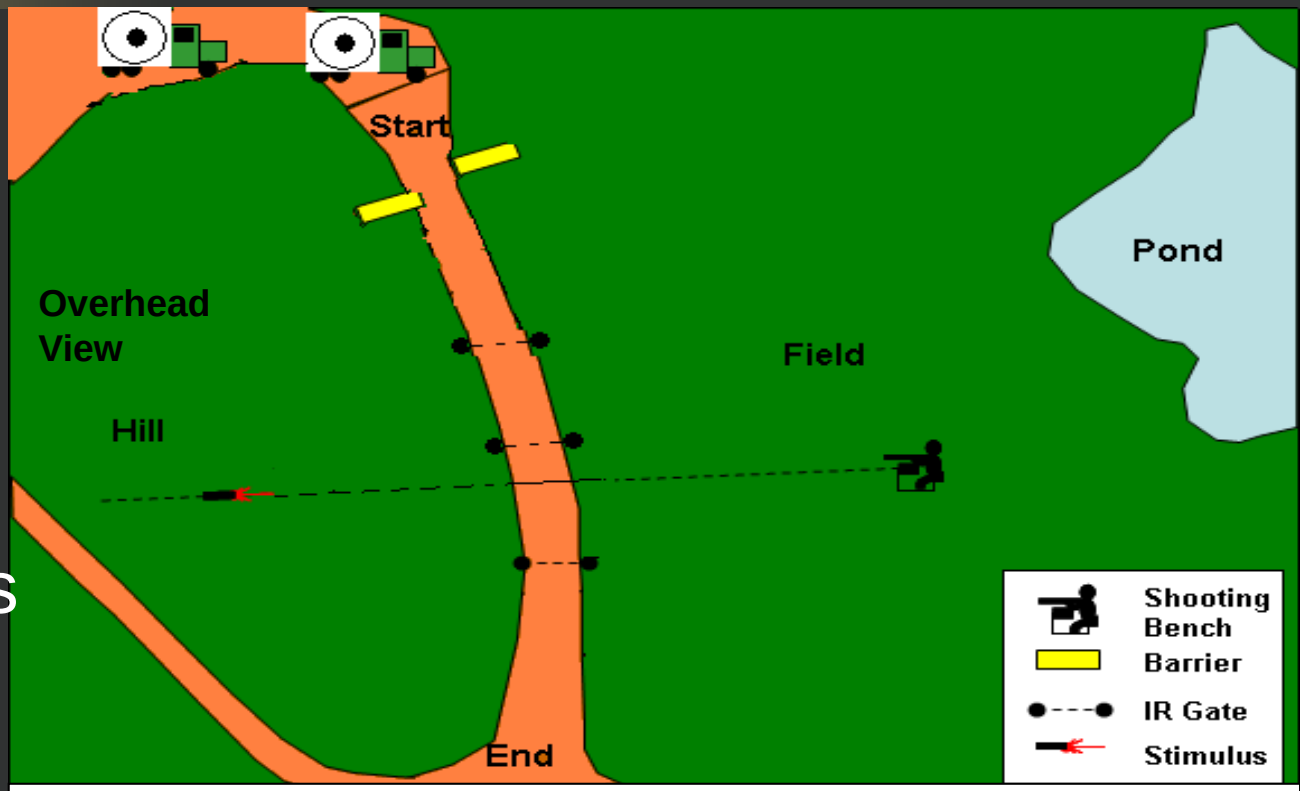
- Determine effectiveness of a green laser under eye-safe conditions against the ability of a shooter to hit a target.
- Test laser effectiveness
  - during laser exposure
  - immediately after laser exposure.

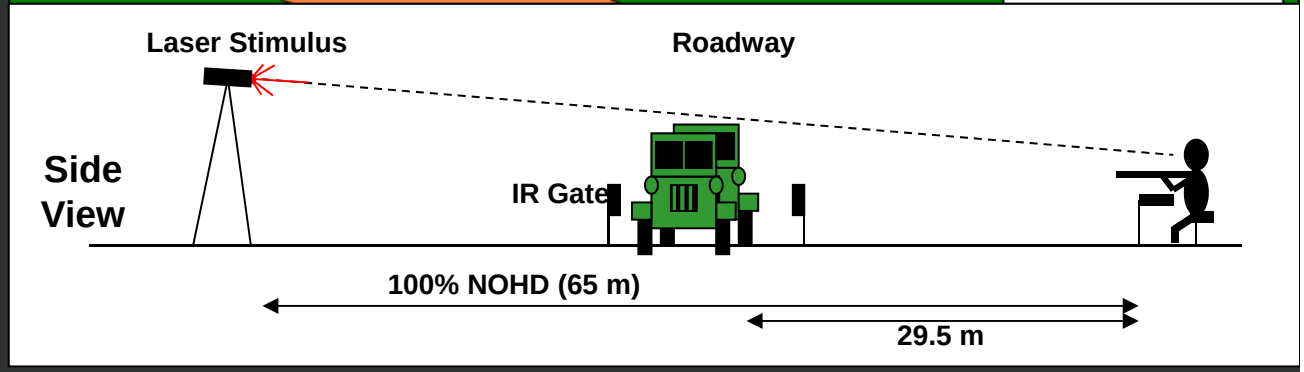
General Method

- Test human volunteers
  - shooting outdoors
  - under daytime lighting
  - at moving convoy vehicles
- Compare shooting accuracy
  - laser-exposure trials vs. non-laser trials

Convoy Test-Bed Layout

- Laser shines over trucks, across road to shooter
- Two convoy trucks serve as targets
- Each target is available for ~1.4 sec





The Laser

- B.E. Meyers GBDIII-C Laser

- Laser shone on shooter's face on some trials

Convoy Targets in Range

- Shooter view
- Truck targets closely spaced
  - 1.4 sec apart
- Laser on tripod above Target 1
  - Sitting on parked truck
  - Shines over first target

Convoy Targeting Area

- Convoy targets are visible upon approach
- Shots allowed when targets are between white reflector posts
- Pink dot on forward truck's target: Hit

Experiment Method

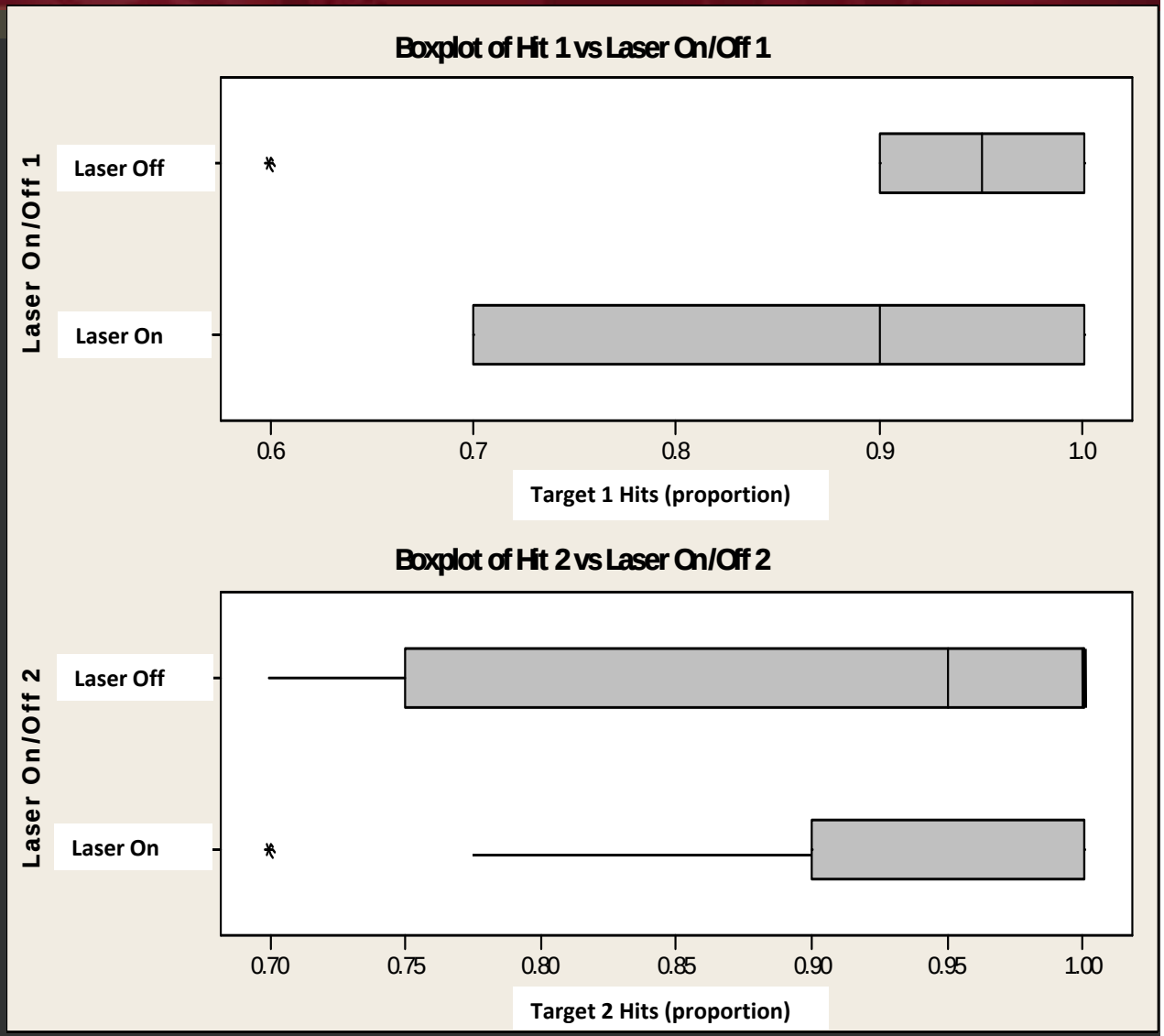
- 8 healthy subjects with good eyesight participated as shooters
  - Subjects were trained to criterion on shooting task with an FN-303 less-lethal launcher
  - On each trial, subjects shot at targets mounted on two moving convoy vehicles
  - Trucks were closely following one another

Experiment Method

- Experiment consisted of 14 trials consisting of two targeting opportunities each, for 28 total targeting opportunities.
  - 7 of the 14 trials began with laser exposure during Target 1 presentation; no laser was presented during the other 7 trials
  - For each laser trial, a subject was exposed to the laser for the duration that the first target was in range and available to be hit.
  - The laser appeared to originate from immediately above Target 1 (0.5° visual angle)
  - When the first target had passed, the laser was terminated simultaneously and immediately the second target was available to be hit.

The Results

- Medians and quartile boundaries for hit rates
- On laser-exposure and non-exposure trials
- For the first target (top plot) and second target (bottom plot) in each



Results: During Laser

Shooting While Laser Is On Eyes:

Question:

Does the laser interfere with hitting the target while it is on the eyes?

Findings:

- Hit percentages for Target 1 when laser was on did *not* differ from hit percentages when laser was off.
  - 95% vs. 90% difference was not reliable
  - [Kruskal-Wallis test $H_{1,15}$= 0.45, p=.502]

Results: After Laser

Shooting After Laser is Turned Off:

Question:

Does the laser cause residual interference with targeting after it ends?

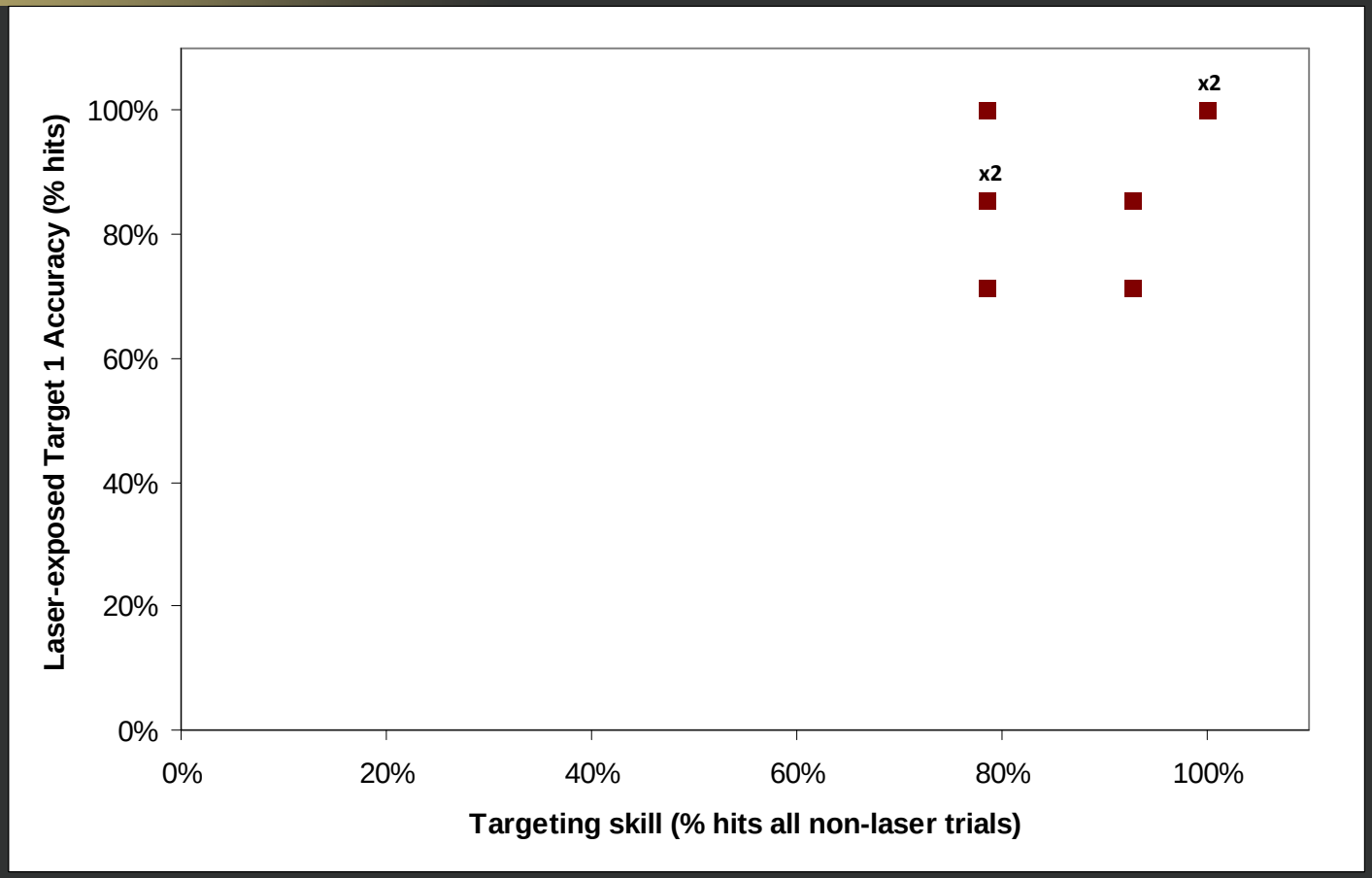
Findings:

- Hit percentages after the laser did not differ from no-laser trials. There is no residual effect.
  - 95% vs. 100% difference was not reliable
  - [Kruskal-Wallis test $H_{1,15}$= 0.34, p=.558]

Results: Task Difficulty

- On non-exposure trials:
  - Targeting success for the first target and the second target were identical (95% hits).
  - Suggests that the difficulty of the two targeting tasks was similar.
  - Any difference in targeting accuracy between the two targets on the laser-exposure trials cannot be attributed to differential difficulty.

Results: Shooting skill



- Skill was not related to laser effectiveness
  - predicted less than 6% (R^2=.056) of the variance

Discussion: Predictability

- Predictability of the target location may have kept the laser from interfering with targeting.
  - Trucks moving at constant speed could be anticipated prior to laser onset.
  - In another experiment (Short et al., 2007), static targets were presented for a similar duration but in an unpredictable manner, and the same green laser was highly effective

Discussion: Ambient Light

- Alternatively, the relevant feature may be high level of ambient light during task
  - Therefore laser had low temporal contrast
  - Light-acclimated (2782 lux ± 306 SEM) subjects would have low sensitivity
  - Same laser was highly effective in dim light, laboratory targeting test (Short et al., 2007)