

# NOVICE DRIVERS and HAZARD ANTICIPATION – IS THERE HOPE:

## BLIND INATTENTION OR INATTENTION BLINDNESS

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### Prior Young Driver Research Sponsors

- National Highway Traffic Safety Administration
- National Institutes of Health
- National Science Foundation
- AAA Foundation for Traffic Safety (Driver ZED)
- Link Foundation for Simulation and Training
- Governor's Highway Safety Bureau (RAPT)
- National Center for Injury Prevention and Control

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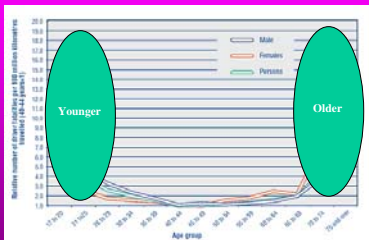
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### Novice and Older Drivers



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## Is There Hope?



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## Is There Hope?



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## The Novice Driver: The First Six Months

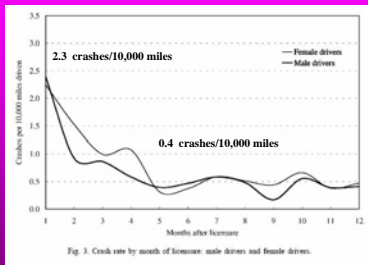


Fig. 3. Crash rate by month of licensure: male drivers and female drivers.

McCart A.T., Shabanova, V.I., and Leaf W.A. (2003). Driving experience, crashes and traffic citations of teenage beginning drivers. *Accident Analysis and Prevention*, 35, 311-320.

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### Why are Novice Drivers Crashing? Police Crash Reports

- Not over involved in alcohol related crashes
- Not over involved in speed related crashes (over 70 mph)

McKnight, J. A. and McKnight, S. A. (2003). Young Novice Drivers: Careless or Clueless. *Accident Analysis and Prevention*, 35, 921-925

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### Why are Novice Drivers Crashing? Police Crash Reports

- Failures to search appropriately (42.7%)
- Failures to pay attention (23.0%)
- Failure to adjust vehicle's speed appropriately (20.8%)

McKnight, J. A. and McKnight, S. A. (2003). Young Novice Drivers: Careless or Clueless. *Accident Analysis and Prevention*, 35, 921-925

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### The Three Major Problems for Novice Drivers

- Hazard Anticipation
  - Tactical
  - Strategic
- Attention Maintenance
  - Inside the vehicle
  - Outside the vehicle
- Speed Management

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### Tactical Hazard Anticipation

The diagram illustrates a driver's perspective on a road. A dashed line indicates the driver's current position. A yellow arrow labeled 'Launch Zone' points forward from the driver. A red arrow labeled 'Target Zone' points further ahead. A brown rectangle labeled 'House' is positioned on the right side of the road, representing a hazard. A small inset image shows a driver wearing a head-mounted display (HMD) looking forward.

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### Experiment 1 Can We Document the Problem? Failures of Tactical Hazard Anticipation

The diagram on the left is identical to the one on slide 10. The bar chart on the right, titled '813 Eyes on Front Edge of Track', shows the percentage of subjects with eyes on the front edge of the track for three age groups: Novice, Young, and Old.

Group	% Subjects
Nov	~0.1
Young	~0.3
Old	~0.5

Pradhan, A.K., Hammel, K.R., DeBattino, R., Noyce, D.A., Pollatsek, A. and Fisher, D.L. (January 2003). The Use of Eye Movements to Evaluate the Effects of Driver Age on Risk Perception in an Advanced Driving Simulator. Transportation Research Board Annual Meeting CD-ROM, TRB, National Research Council, Washington, D.C.

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### What Causes Failures of Tactical Hazard Anticipation

- Blind inattention (knowledge)
  - Don't recognize scenario has hidden threat
  - Don't recognize importance of tactical glance
- Inattention blindness (capacity)
  - Inexperience with the controls of the vehicle
  - Inexperience lane keeping

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## Experiment 2 Basic Training Effect: RAPT-1

- Create PC-based risk awareness training program
- Experimental group
  - PC training
  - Simulator evaluation
- Control group
  - Placebo training
  - Simulator evaluation
- Compare the performance of the two groups.

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## Motivation for a New Training Program

- Changes in PC training
  - Existing programs: perspective views
  - Our program: plan views
- Changes in simulator evaluation
  - Existing evaluations: actual threats
  - Our evaluations: potential threats



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## RAPT-1

- PC-Based
- Pretest: Ten scenarios
- Training: Ten scenarios
- Posttest: Ten scenarios

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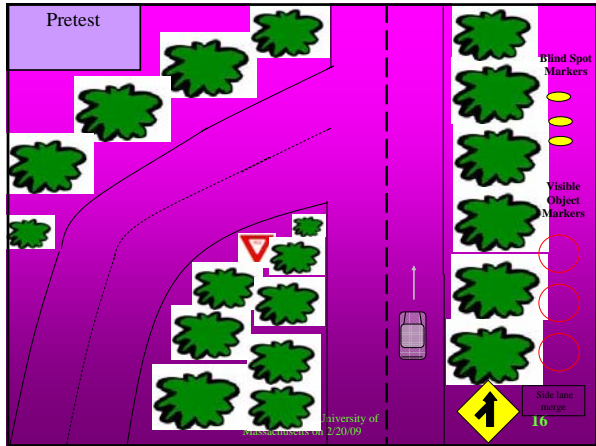
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### Training Program

- Three screens for each scenario
  - Subject Response Screen
  - Vision Obstruction Demonstration Screen
  - Answer Explanation Screen

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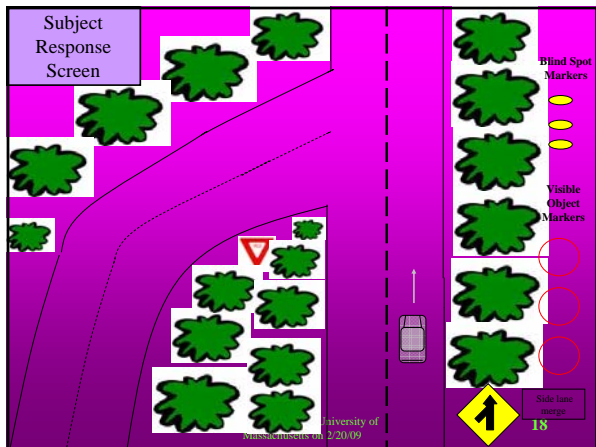
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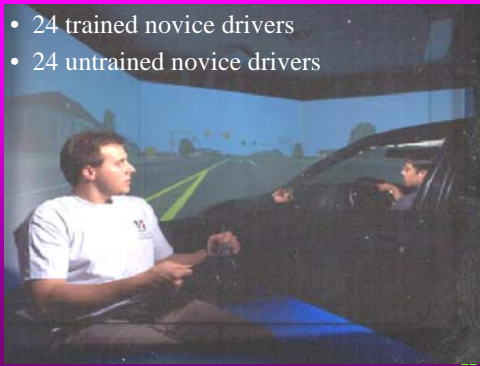
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### Driving Simulator Evaluation

- 24 trained novice drivers
- 24 untrained novice drivers



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### Eye Tracker



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### 16 Scenarios (10 Near and 6 Far Transfer)

Drive 1	Drive 2	Drive 3	Drive 4
Scenario 1	Scenario 5	Scenario 9	Scenario 13
Scenario 2	Scenario 6	Scenario 10	Scenario 14
Scenario 3	Scenario 7	Scenario 11	Scenario 15
Scenario 4	Scenario 8	Scenario 12	Scenario 16

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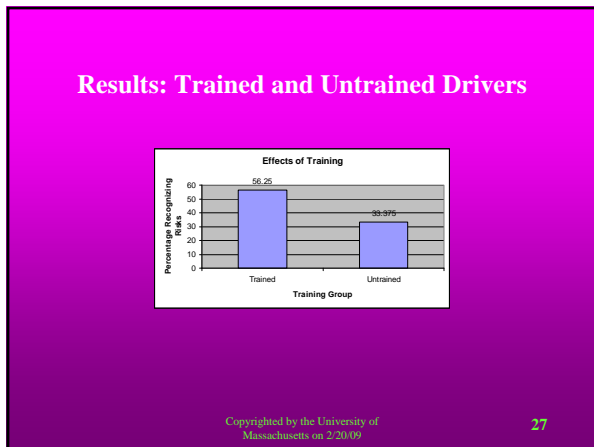
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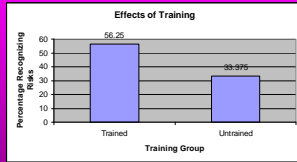
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### Experiment 2 Conclusions:

(2) PC Training Generalizes from Plan Views to Perspective Views



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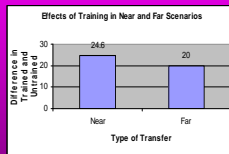
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### Experiment 2 Conclusions:

(3) Training Generalizes to Both Near and Far Scenarios



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### Experiment 2 Conclusions:

(4) Results are consistent with the hypothesis that novice drivers exhibit blind inattention

- Don't know where to look
- Do know where to look, just not importance of making a tactical glance

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### Experiment 3 Foreshadowing

- Why Experiment 3?
- Participants
  - 24 novice drivers between 16 and 17 years old (16.5 average age)
  - 24 experienced drivers between 40 and 50 years old (44.7 average age)

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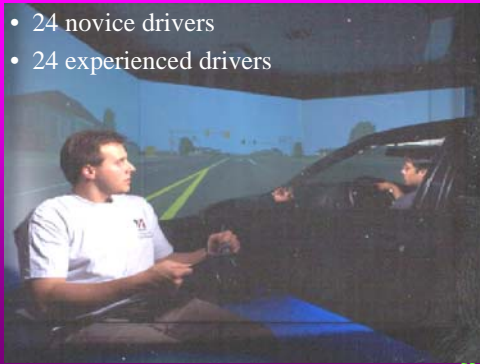
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### Driving Simulator Evaluation

- 24 novice drivers
- 24 experienced drivers



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### Eye Tracker



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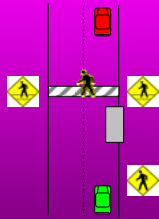
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## Scenarios



- Advance Cue: Pedestrian Ahead Sign
- Foreshadowing Element: Pedestrian
- Critical Area: Sidewalk

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## Results

	Probability of fixating critical region	Probability of Fixating Critical Region Given Foreshadowing was Fixated
Experienced	79.2%	94.7%
Novice	52.8%	61.4%
Difference	26.4%	33.3%

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## Experiment 3 Conclusions

- Poor tactical hazard anticipation of novice drivers replicated
- Reason for skill deficiencies not easily reconciled with inattention blindness hypothesis

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## Experiment 4 Duration of Training Effects

- Why Experiment 4?
- Participants
  - 32 drivers recruited from driving schools
  - Between 16 – 18 years old
  - All had learner's permit

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## Experiment 4: Method Duration of Training Effects

- Method
  - Half randomly assigned to training (RAPT-2)
  - Half assigned to placebo training
  - All drove simulator
    - 3 – 5 days after training for RAPT-2 group
  - All wore eye tracker

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## RAPT – 2 Training

- Pretest: 10 scenarios
- Training: Three – four screens used to teach each scenario
  - Subject response screen (all)
  - Vision obstruction screen (all)
  - Visualization screen (some)
  - Answer explanation screen (all)
- Posttest: 10 scenarios

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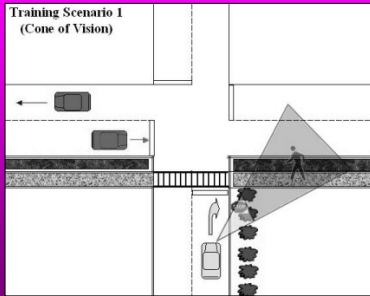
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## Training Vision Obstruction Demonstration Screen



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## Training Visualization Screen



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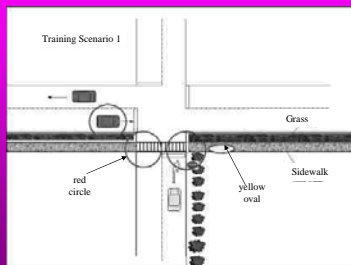
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## Training Answer Screen



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## Evaluation of RAPT-2 Training

	Before		After
Overall	44.3	→	70.5
Circles	39.3	→	66.3
Ovals	52.2	→	81.1

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## Driving Simulator



- 16 scenarios
  - 10 similar to training (near transfer)
  - 6 not similar to training (far transfer)
- Simulator evaluation
  - Trained: 3-5 days after training
  - Untrained: not applicable

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## Eye Tracker ASL 5000



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### Simulator Results: Comparing Immediate and Delayed

- Overall → Delayed Immediate ←
  - Trained (52.1%)
  - Untrained (28.1%)
- Near Transfer
  - Trained (51.8%)
  - Untrained (28.8%)
- Far Transfer
  - Trained (53.1%)
  - Untrained (27.1%)

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### Experiment 4 Conclusions: Duration of Training Effects

- Training effects endure
  - observed at an average of four days after training was delivered
- Training effects show no evidence of decay
- Advantages of training program
  - Takes little time (less than one hour)
  - Can be graded automatically
  - Can be downloaded off the web

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### Experiment 5 Field Study

- Why Experiment 5?
- Participants
  - 24 young drivers recruited from University community
  - Between 18 – 21 years old
  - All had solo license for at least one year

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## Experiment 5: Method Field Study

- Method
  - Half (12) assigned to training (RAPT-3)
  - Half (12) assigned to no training
  - All drove in car on open road in surrounding community with a certified driving instructor
  - All wore eye tracker (ASL Mobile Eye)

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## PC Training (RAPT-3)

- Pretest (10 scenarios)
  - Each scenario a sequence of 5-12 slides
  - Pictures of real scenarios: once every 3 s
  - Mouse click
- Training (10 scenarios)
  - Sequence
  - Plan view
- Posttest (10 scenarios)

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**RAPT – 3 Training: Explanatory Slides**

A diagram showing a road layout. A car is on the left side of the road, a bicycle is in the middle, and a pedestrian is on the right. There are green bushes and a yellow shaded area. A blue line indicates a path or boundary.

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### PC Training Results

- Pretest: 32.4% correct
- Posttest: 80.6% correct

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### Field Eye Tracking

- Road in a driving school car with a driving instructor in the front seat
- Course
  - through downtown Amherst and surrounding communities
  - scenarios unfolded as the driver navigated the vehicle on the open road

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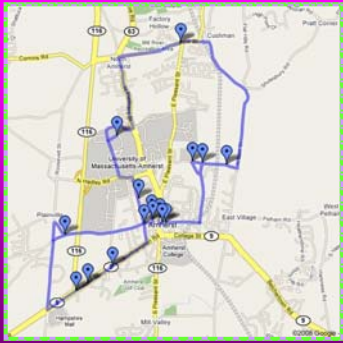
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### Field Route



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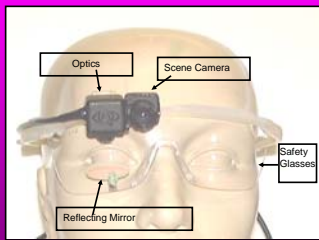
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### Field Eye Tracker ASL Mobile Eye



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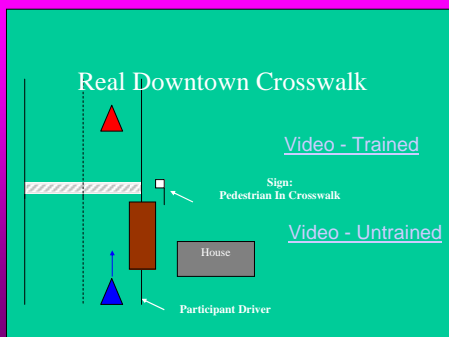
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### Field Study: Eye Tracker Data



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### Experiment 5 Results: Field Study

- Overall                      Field
  - Trained                      (60.6%)
  - Untrained                    (31.8%)
- Near Transfer
  - Trained                      (72.7%)
  - Untrained                    (34.6%)
- Far Transfer
  - Trained                      (46.0%)
  - Untrained                    (28.1%)

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### Experiment 5 Conclusions: Field Study

- Untrained young drivers (18-21)
  - Still have much to learn
  - 31.8 % of the potential hazards
- Trained young drivers (18-21)
  - Perform much like experienced drivers
  - 60.6 % of potential hazards

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### Experiment 6 Simulator Comparison with Field Study

- Why Experiment 6?
- Participants
  - 24 drivers recruited from University community
  - Between 18 – 21 years old
  - All had solo license for at least one year

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## Experiment 6: Method Simulator Comparison with Field Study

- Method
  - Half randomly assigned to training (RAPT-3)
  - Half assigned to no training
  - All were evaluated on the driving simulator
  - All wore eye tracker (ASL Mobile Eye)

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## PC Training (RAPT-3)

- Pretest (10 scenarios)
  - Each scenario a sequence of 5-12 slides
  - Pictures of real scenarios: once every 3 s
  - Mouse clicks
- Training (10 scenarios)
- Posttest (10 scenarios)

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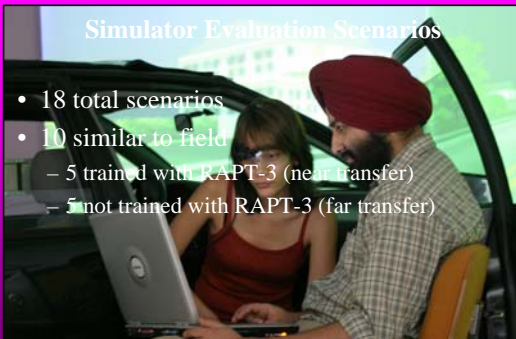
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## Simulator Evaluation Scenarios

- 18 total scenarios
- 10 similar to field
  - 5 trained with RAPT-3 (near transfer)
  - 5 not trained with RAPT-3 (far transfer)

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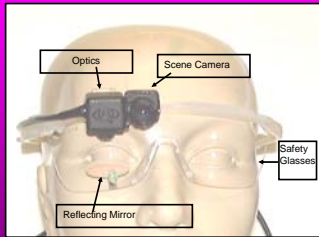
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## Simulator Eye Tracker ASL Mobile Eye



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## Simulator Results

	Simulator	Field
• Overall		←
– Trained	(77.4%)	
– Untrained	(40.0%)	
• Near Transfer		
– Trained	(77.4%)	
– Untrained	(35.7%)	
• Far Transfer		
– Trained	(76.8%)	
– Untrained	(44.2%)	

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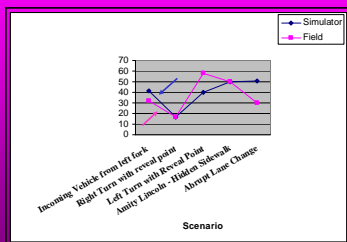
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## Simulator and Field Comparison: Individual Scenario Training Effects



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**Experiment 6 Conclusions:  
Simulator and Field Comparison**

- Overall Analysis:
  - Overall, the size of the training effects in the field is slightly smaller than it is in the simulator, especially on the far transfer scenarios
- Individual Scenario Analysis:
  - Taken scenario by scenario the sizes of the training effects in the field and on the driving simulator are similar to one another many cases

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**Summary: Novice Drivers**

- Blind Inattention or Inattention Blindness
- Hazard Anticipation
  - Young drivers can be trained to anticipate hazards
  - The effects are as strong
    - One week later as they are immediately after training
    - In the field as they are in the simulator and
    - When trained with a simple PC as when trained with a more advanced driving simulator \*
  - Evaluations of training effects in the field mirror those of evaluations done on a simulator

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**Limitations**

- Duration of Training Effects
  - There is no evidence that the effects of hazard anticipation training will extend over the full six months
- Motivation to Apply Training
  - There is no evidence that trained drivers will apply what they have learned when they are not being observed
- Crash Reduction
  - There is no evidence that crashes will be reduced just because drivers better anticipate hazards

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