Study of Novice Driver Hazard Perception Training

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Outline

- Background
- Literature Review and Conception Model
- Experiment Platform Preparation
- Simulation-Based Comprehensive Hazard Perception Training
- A Comparative Study: Simulation-Based Training vs Video-Based Training
- Conclusions
Background

Literature Review and Conception Model

Experiment Platform Preparation

Simulation-Based Comprehensive Hazard Perception Training

A Comparative Study: Simulation-Based Training vs Video-Based Training

Conclusions
Background

- Rapid motorization in China
  - The increase of automobiles
  - The increase of novice drivers
- Novice driver issue
- Perception training provided by driving schools is very limited
- More efficient training methods for driving safety are cried for to help novice drivers acquire necessary skills for safe driving quickly.
Background

Literature Review and Conception Model

Experiment Platform Preparation

Simulation-Based Comprehensive Hazard Perception Training

A Comparative Study: Simulation-Based Training vs Video-Based Training

Conclusions
Literature Review

- Hazard perception training
  - Fisher et al. (2002)
  - McKenna et al. (2006)
  - Ivancic and Hesketh (2000)

- Error management training
  - Frese et al. (1988)

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Conception Model

Whether the hazard perception training based on driving simulation is effective?

Experiment 1
To compare the training effectiveness of simulation-based and video-based training

Experiment 2
Background

Literature Review and Conception Model

Experiment Platform Preparation

Simulation-Based Comprehensive Hazard Perception Training

A Comparative Study: Simulation-Based Training vs Video-Based Training

Conclusions
Experiment Platform Preparation

- Why simulation
  - Scenario can be designed
  - Controllable
  - Repeatable
  - Safe and low cost

- Hardware & software

- Scenario library
  - Collect, screen, and realize
- Full-cab simulator
- Desktop simulator
- Background
- Literature Review and Conception Model
- Experiment Platform Preparation
- Simulation-Based Comprehensive Hazard Perception Training
- A Comparative Study: Simulation-Based Training vs Video-Based Training
- Conclusions
Simulation-Based Comprehensive Hazard Perception Training

- Three sections
  - Simulated driving (participation)
  - Feedback of own driving performance
  - Demonstration of safe behaviors
Participants and Equipment

Participants
- 32 Male, < 26 years
- Valid driver’s license
- Driving experience < 1000 km
- Trained group, 16; Untrained group, 16

Equipment
- Full-cab simulator
- Road hazard scenarios (8 pairs)
  - Near transfer (4 pairs)
  - Far transfer (4 pairs)
Near Transfer Scenarios
Far Transfer Scenarios

Training Scenario

Testing Scenario
Experiment Design

- **Independent variables**
  - Trained vs untrained
  - Near transfer vs far transfer

- **Dependent variables**
  - Hazard handling performance
  - Hazard anticipation
  - Mental workload
  - Speed control

<table>
<thead>
<tr>
<th>Scenario sequence</th>
<th>Untrained group</th>
<th>Trained group</th>
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<tbody>
<tr>
<td>1B, 2B, ..., 8B</td>
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<tr>
<td>8B, 7B, ..., 1B</td>
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</tbody>
</table>
**Procedure**

- Recruiting
- Grouping
- Trained group? (Y/N)
- Simulated driving
- Feedback
- Demonstration
- Practice
- Familiarity test
- Pass? (Y/N)
- Evaluation
- End

6 weeks later
Results

Untrained demo

Trained demo
Results - Hazard Handling Performance

<table>
<thead>
<tr>
<th>Scenarios</th>
<th>Performance Score</th>
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<tr>
<td>1B</td>
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<tr>
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<td>Far transfer</td>
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<td>Average</td>
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## Results - Hazard Anticipation

![Graph showing near transfer and far transfer](image)

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<th>Main and interaction effect</th>
<th>Mean square</th>
<th>F</th>
<th>p</th>
<th>$\eta_p^2$</th>
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<td>Far transfer vs. near transfer</td>
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<td>18.40</td>
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<td>Training $\times$ Transfer</td>
<td>0.22</td>
<td>0.46</td>
<td>0.503</td>
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</table>

![Graph comparing untrained and trained groups](image)
Results – Mental Workload

- Mental demand
- Physical demand
- Temporal demand
- Performance
- Effort
- Frustration
- Overall workload

<table>
<thead>
<tr>
<th>Component</th>
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Results – Speed Control

Average speeds in the three 30-m intervals prior to the crosswalk in Scenario 4B
Summary

- The proposed comprehensive training method is effective in promoting hazard handling performance and hazard anticipation.
- Acquired skills during training can be transferred to other situations.
- The trained group not only exhibited a better performance in hazard scenarios, but also responded to potential hazards much earlier.
- Background
- Literature Review and Conception Model
- Experiment Platform Preparation
- Simulation-Based Comprehensive Hazard Perception Training
- A Comparative Study: Simulation-Based Training vs Video-Based Training
- Conclusions
A Comparative Study: Simulation-Based Training vs Video-Based Training

- SEMT: Simulation-based error management training
- VGET: Video-based guided error training

<table>
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<tr>
<th></th>
<th>Error management training</th>
<th>Guided error training</th>
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<tr>
<td>Systematicness</td>
<td>Low</td>
<td>High</td>
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Participants and Equipment

- **Participants**
  - 32 Males, < 26 years
  - Valid driver’s license
  - Did not participant in experiment 1
  - Driving experience < 2000 km
  - SEMT,16; VGET,16 (No significant difference)

- **Equipment**
  - **SEMT**
    - Desktop simulator for training
    - Full-cab simulator for testing
  - **VGET**
    - Video clips for training
      - Error video (unsafe)
      - Errorless video (safe)
    - Full-cab simulator for testing
Experiment Design

- Independent variables
  - Simulation vs video
  - Near transfer vs far transfer

- Dependent variables
  - Hazard handling performance
  - Hazard response distance
  - Mental workload
  - Metacognition
  - Intrinsic motivation
  - Driving confidence

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<th>Scenario sequence</th>
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<td>8B, 7B, ..., 1B</td>
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Experiment Design

Equal error exposure
### Experiment Design

**Number for participants committing errors in SEMT**

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</tbody>
</table>
Procedure

1 week later

Training

- Recruiting
- Grouping
- Wait
- SEMT finished?

Test

- Practice
- Familiarity test
- Pass?

Experiment design for VGET group according to the result of SEMT training

VGET training
Results

Number of participant failures for each test scenario

Scenarios

Number of participant failures

- SEMT
- VGET
Results

Hazard handling performance score

- SEMT > VGET
  \( F(1,30) = 4.14, \ p = 0.05 \)
- The difference was slightly greater for far transfer scenarios than for near transfer scenarios, \( p > 0.05 \)
Results

Hazard response distance

- Speed
- Steering wheel
- Gas pedal
- Brake pedal

Trigger Response:
\( t_1 = 362.01 \), \( t_2 = 364.37 \)

Time (sec)

Response distance (m)

Scenarios

- SEMT
- VGET
Results

- Mental workload
  - Effort, Frustration
    - SEMT < VGET, \( p \leq 0.05 \)

- Metacognitive activities
  - SEMT: \( M=4.16, SD=0.41 \)
  - VGET: \( M=3.93, SD=0.37 \)
  - \( t(30) = 1.70, p < 0.05 \)

- Intrinsic motivation
  - SEMT: \( M=6.19, SD=0.61 \)
  - VGET: \( M=5.35, SD=0.87 \)
  - \( t(30) = 3.15, p < 0.005 \)

Driving confidence
Summary

- SEMT is more effective than VGET in improving hazard handling in terms of total errors, performance score, response distance under the premise of equal exposure to errors.
- SEMT is more helpful in increasing metacognitive activities and intrinsic motivation.
- SEMT seems more effective than VGET in bringing confidence to an appropriate level.
- Background
- Literature Review and Conception Model
- Experiment Platform Preparation
- Simulation-Based Comprehensive Hazard Perception Training
- A Comparative Study: Simulation-Based Training vs Video-Based Training
- Conclusions
Contributions

- A comprehensive hazard perception training program was proposed, and the training effectiveness was evaluated. It not only provides trainees with hazard perception knowledge, but also allows them to practise dealing with road hazards.

- To study the role of error-making in driving training, the simulation-based SEMT and traditional video-based VGET training methods were compared under the premise of equal exposure to errors. The results can provide guidelines for future training program design.

- A scenario library special for typical hazards on urban road in cities of China was established. That is an important supplement to previous scenario libraries of other countries.
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