The Effects of Visual Realism on Training Transfer in Immersive Virtual Environments

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INTRODUCTION

Virtual simulations allow military personnel to train for real-world scenarios within 3D virtual environments (VEs). While the quality of a training simulation depends on a variety of hardware and software factors, it is unclear how such factors affect training effectiveness. This research focuses on investigating how display field of view (FOV), the viewing range that is visible at a time, and virtual scene complexity (the amount of detail and realism in the VE) affect the effectiveness of visual search training. The task involves visual scanning and the identification of weapon carriers in an urban environment.

Through controlled experimentation, this work evaluates the quality of participant scanning strategy and task performance on a threat-identification task after training with a head-mounted display (HMD). By varying FOV in different training conditions, this experimentation provides empirical evidence of how different display characteristics affect training. Additionally, controlling the amount of scene complexity allows an investigation of the level of detail needed for the virtual world. As creating realistic VE is more difficult and costly than developing simple environments, it is important to understand whether the level of realism affects training for different tasks.

APPARATUS & METHOD

Apparatus
An nVisor SX111 HMD was used to display the environment. This HMD features dual SXGA displays (one per eye), each with a resolution of 1280x1024 pixels. The total horizontal FOV of the HMD is 102°, and the total vertical FOV is 64°. Head-tracked viewing was enabled by tracking the participants’ head movements with a wired InterSense IS-900 head tracker. Participants used a wireless wand to control a virtual crosshair and select targets in the environment.

Method
We trained participants in a visual scanning strategy to efficiently search for threats in an urban environment. Controlling a cursor to visually demonstrate viewing, participants scanned building windows and streets for people holding weapons. Participants trained and practiced in an HMD with a given combination of level of FOV and scene complexity. After practicing with the experimental viewing constraints, participants completed the task again with the highest level of fidelity (the highest levels of FOV and complexity). Scanning performance was evaluated by counting the number of threats that were correctly identified. To evaluate training transfer, scanning strategy was assessed by a team of video coders to judge how well participant strategies matched the instructed strategies.

PRELIMINARY RESULTS

Performance
Preliminary results suggest that varying the FOV has minimal impact on overall performance. Varying the scene complexity does appear to have a slight impact on performance, with participants in the low complexity condition finding fewer threats than the medium and high complexity conditions.

Mean Hits by FOV

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<thead>
<tr>
<th>FOV</th>
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<tr>
<td>Low</td>
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Mean Hits by Complexity

<table>
<thead>
<tr>
<th>Complexity</th>
<th>Mean Hits</th>
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<tbody>
<tr>
<td>Low</td>
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Strategy
Preliminary results suggest that participant scanning strategy is strongly impacted by the training conditions. Participants who train in the medium and high scene complexity conditions develop more efficient visual scanning patterns than those in the low condition. Results also suggest an interesting interaction between FOV and scene complexity, as the poorest strategy results are seen in the condition with high FOV and low scene complexity. This suggests that training environments that are too simplistic lead to inefficient strategies and bad habits.

These images show example views of the environment in the different levels of field of view.

These images show example views of the environment in the different levels of scene complexity.

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