Enhancing Visual Scanning Skills in Adults with Hemianopia Through VR-based Visual Motor Games: A Scoping Review

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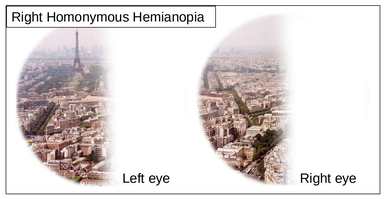
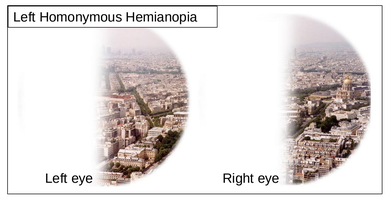
Introduction

- **Stroke and HH Prevalence**: Over 795,000 strokes occur annually in the U.S., with 30% of survivors developing homonymous hemianopia (HH), a condition causing vision loss in half the visual field, significantly impairing daily activities (CDC; Rowe, 2021).
- **Challenges in Treatment**: Only 15% of HH cases show spontaneous recovery, leaving many with lasting deficits, increased fall risks, and reduced quality of life. Current treatments remain limited.
- **Emerging Interventions**: Research highlights neural plasticity through targeted stimulation, though traditional repetitive visual training shows limited success (Sabel, 2017; Mansouri et al., 2018).
- **Compensatory Strategies**: Scanning techniques improve awareness, navigation, and safety, especially when combined with environmental or task-specific training (Brouwer et al., 2014; Schuett et al., 2017).
- **Potential of VR**: VR offers immersive, customizable environments for enhancing scanning, spatial awareness, and adaptive skills, presenting a promising tool for HH rehabilitation (Maples-Keller et al., 2017).





Methods

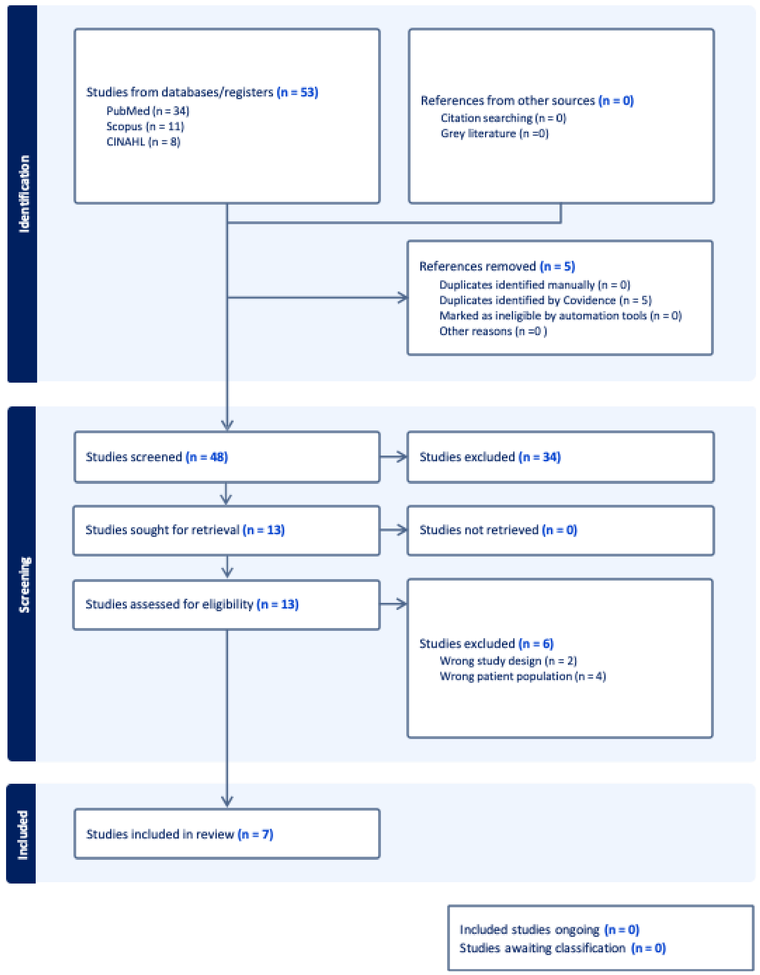
This scoping review followed the Arksey and O'Malley (2005) framework, enhanced by Levac et al. (2010) for rigor, and adhered to PRISMA-ScR guidelines. A systematic search of scientific databases identified studies from 2013–2023 focusing on VR or gaming interventions for visual rehabilitation in persons at least 6 months post-stroke with visual field loss.

Methods Cont.

Eligibility criteria excluded reviews, unrelated interventions, and non-stroke-related conditions. Covidence software facilitated study selection, with two independent reviewers screening **48** unique records, resolving discrepancies through consensus.

Results

Figure 1: PRISMA Flow Chart



Results Cont.

1. **Home-Based VR Rehabilitation:** Improved contrast sensitivity, reading speeds, and quality of life in two stroke patients (Daibert-Nido et al., 2021).
2. **Visual Perception Learning (VPL) Training:** VPL training led to improved Humphrey perimetry scores and motion processing in stroke patients with visual cortex damage (Choi et al., 2019).
3. **Salzburg Visual Field Trainer:** Expanded visual fields by 5.5°–10.5° and enhanced perceived field usability by 317%, helping those with visuospatial neglect (Leitner & Hawelka, 2021).
4. **Subjective vs. Objective Outcomes:** Subjective visual improvements reported, but objective tests (eye tracking, perimetry) showed no significant change (Leitner et al., 2023).
5. **Modified Visual Stimuli:** High-contrast stimuli improved detection in cortical blindness, suggesting AR goggles for hemianopia patients (Birnbaum et al., 2015).
6. **Audio-Visual Learning in VR:** VR-based tasks improved reaction times and brain activation in multisensory areas, highlighting VR's rehab potential (Alwashmi et al., 2024).
7. **VR Simulated Shopping Task:** A 14-day VR program improved visual scanning, visuospatial skills, and cognitive functions in stroke patients (Dehn et al., 2020).

Conclusion

Virtual reality (VR) training offers innovative solutions for visual rehabilitation, improving visual function, cognitive skills, and quality of life in stroke patients. Programs like the Salzburg Visual Field Trainer and techniques targeting non-cortical pathways show promise for conditions like homonymous hemianopia and cortical blindness. While VR enhances visual fields and broader cognitive abilities, discrepancies between subjective and objective outcomes highlight the need for standardized assessments. Future research should refine protocols, explore long-term effects, and integrate advanced technologies to optimize VR's potential in rehabilitation.

References