

SEE THROUGH MY EYES: A VR-BASED PEDAGOGICAL TOOL FOR UNDERSTANDING SENSORY EXPERIENCES IN RETAIL SPACES FOR THE NEURODIVERSE POPULATION

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Abstract

See Through My Eyes: A VR-Based Pedagogical Tool for Understanding Sensory Experiences in Retail Spaces for the Neurodiverse Population. This research presents the development of an immersive virtual reality simulation designed to educate neurotypical individuals about the sensory challenges neurodiverse people face in retail environments. The project leverages experiential learning to foster empathy and awareness by placing users in a first-person, quest-driven VR supermarket experience, enriched with dynamic sensory stimuli such as flashing lights, loud noises and environmental distractions, that mirror real-world sensory challenges. Grounded in a comprehensive literature review, and guided by inclusive design principles, the simulation was developed using Unity and deployed on a Meta Quest 3 headset. It integrates voice-over narration, and interactive coping mechanisms to enhance user engagement and emotional resonance. Technical validation through Black Box testing and user evaluations confirmed the experience's effectiveness in promoting understanding and empathy, with participants reporting increased awareness of neurodiverse perspectives. This work contributes to the field of educational technology by demonstrating how VR can be harnessed as a scalable, accessible tool for neurodiversity education. It lays the groundwork for future enhancements and broader applications in inclusive design training, public awareness campaigns and curriculum development.

Keywords: *Virtual reality, neurodiversity, sensory overload, empathy, inclusive design.*

1. Introduction

Neurodiversity encompasses a range of cognitive profiles, including autism spectrum conditions, ADHD, and dyslexia. For many autistic people, everyday public spaces present intense sensory demands—bright lighting, overlapping sounds, unpredictable movement, and smells—that can precipitate overload, avoidance, and reduced participation in community life. Supermarkets are an often-cited source of overstimulation due to visual clutter, refrigeration noise, crowds, and sudden events (ASDA, 2021; MacLennan, O'Brien, & Tavassoli, 2021; TESCO, 2021; University of Reading, 2024).

While initiatives such as 'quiet hours' have improved experiences for some shoppers, these interventions are typically limited in scope, temporality, and reach. Awareness campaigns further help, yet their passive format rarely affords embodied perspective-taking. In contrast, virtual reality (VR) can situate users inside an interactive first-person scenario, leveraging presence and spatial audio to translate abstract challenges into lived experience.

This paper presents See Through My Eyes, a quest-driven VR supermarket simulation designed to foster empathy and understanding of sensory overload among neurotypical users, and to explore how specific interaction and design choices influence educational outcomes (Herrera Id, Bailenson, Weisz, Ogle, & Zaki, 2018; Ventura et al., 2020). This paper includes articulated research questions, detail methodology and evaluation, present findings from technical validation and user testing, and discuss implications for inclusive design education. The focus is educational, not neuroscientific, centering on user-reported learning, empathy and usability in response to designed stimuli and coping strategies.

2. Research questions

RQ1: How can an immersive, first-person VR supermarket simulation foster empathy and understanding of sensory overload among neurotypical users?

RQ2: Which interaction and design elements—dynamic sensory triggers (auditory, visual, tactile, olfactory), coping items (headphones, sunglasses, gloves, scented handkerchief), timer-based stress, and voiceovers—most effectively support educational outcomes (clarity, presence, reflection)?

RQ3: How do participants report changes in empathy, immersion/presence and usability after engaging with the prototype, and what improvements do they suggest for future iterations?

3. Methodology

Design Principles: The simulation was structured around experiential learning and inclusive design. Users collect a randomized shopping list while navigating six areas (entrance/produce, dairy, frozen foods, bakery, miscellaneous, checkout). Each area embeds a distinct trigger aligned with real-world challenges: nausea (green tint and lens distortion for strong smells), cold (blue tint with haptics near freezers), flashing lights (strobe-like brightness and light behavior), and loud children (spatial audio with mild visual distortion). Voiceovers reduce reading load and anchor situational context (Cummings, Tsay-Vogel, Cahill, & Zhang, 2022; Jennett et al., 2008; Ventura et al., 2020).

Technical Implementation: The prototype was implemented in Unity for Meta Quest 3. Core systems included: (i) a quest manager generating two items per category; (ii) an XR item spawner and basket collector with automatic UI updates; (iii) a timer bar representing escalating stress and determining win/loss states; (iv) an effect manager applying post-processing, audio and haptics based on proximity to triggers; and (v) a radial equip menu for coping items that partially mitigated stimuli without fully eliminating their impact (Jennett et al., 2008).

Evaluation Design: The study employed two complementary strands. First, Black Box testing verified functional integrity of item interaction, trigger activation, coping items, voiceovers and game states. Second, user testing captured perceived usability, immersion/presence and empathy outcomes via a short survey administered after the experience. Ethical procedures covered information sheets, consent, confidentiality and freedom to withdraw (Cummings et al., 2022).

Participants & Procedure: Five adult volunteers (≥ 18 years) completed one session each using Meta Quest 3. After the session, participants rated usability (ease of navigation and item collection), immersion/presence, empathy/understanding and overall effectiveness. Open comments addressed impactful elements (e.g., loud noises, exit sequence) and improvement suggestions (clearer signage, stronger stimuli, control guidance).

4. Findings

Black Box Testing Results: Core mechanics behaved as intended. Shopping items could be picked up and deposited; the objectives list updated correctly; triggers produced aligned audiovisual/haptic effects; coping items reduced intensity and timer acceleration; and win/loss states fired appropriately. Two issues were noted: (1) the frozen-food voiceover could fail to trigger if users hugged walls outside the radius; and (2) the radial equip menu could visually overlap the objectives list when both were open (Cummings et al., 2022; Jennett et al., 2008; Jiang, Zhou, Sun, Chen, & Fung, 2025).

User Survey Results: Four out of five participants (80%) reported increased empathy/awareness of sensory overload after the experience. Immersion/presence ratings predominantly fell between 6 and 10 on a 10-point scale, indicating the environment felt believable and engaging. Usability feedback was mixed: several users acclimated quickly, while others reported initial confusion with controls and headset fit. The auditory trigger (children's noise) and the final exit sequence were most frequently cited as impactful.

Interpretation: Findings suggest that embodied perspective-taking in VR, coupled with clear objectives and coping mechanics, can support empathy-focused educational outcomes. Voiceovers appear to lower cognitive load and sustain presence, while the timer models the urgency often felt in overstimulating environments. Minor interface and trigger reliability issues underscore the importance of onboarding/tutorials and robust proximity checks to serve diverse user groups (Herrera Id et al., 2018).

5. Discussion

Educational Positioning: Although the prototype leverages sensory phenomena (e.g., strobing lights, loud audio, haptics), the research is squarely educational. Outcomes are framed as learning and empathy responses to designed interactions rather than as neuroscientific measurement. The work therefore contributes to practice-led educational technology research on empathy-building and inclusive design, complementing autistic-led perspectives and evidence-based guidance for sensory-considerate environments (Lee, Shin, & Gil, 2024; Ventura et al., 2020).

Design Implications: Structuring play around a manageable set of objectives and equippable coping items encourages reflective strategy use. Color-coded lists, clearer signage and a brief interactive tutorial can improve task flow and accessibility. Increasing NPC density and ambient stimuli (e.g., refrigeration hum) may heighten ecological validity for some users but requires careful balance to avoid overwhelming novice VR participants.

6. Limitations and future work

Limitations: The convenience sample (n=5) limits generalizability. Measures relied on self-report rather than validated scales or behavioral observation. Trigger radii and UI layering exposed edge-case usability issues. Environmental realism was intentionally simplified to prioritize core mechanics within time constraints (Herrera Id et al., 2018; Jennett et al., 2008).

Future Work: Expand participant pool and demographics; integrate validated presence and empathy instruments; add onboarding/tutorials and an in-experience control guide; enrich stimuli with crowds/NPC behavior and checkout interactions; and examine longitudinal effects including transfer to behavior (e.g., design recommendations, staff training).

7. Conclusion

See Through My Eyes demonstrates how an accessible, first-person VR simulation can communicate the lived challenges of sensory overload and scaffold coping strategies in an educational context. Technical validation and initial user feedback indicate promise for empathy-building and public awareness. With targeted refinements and broader evaluation, the approach can support inclusive design education and complement wider initiatives aimed at making retail and community spaces more sensory-considerate.

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