RetreatVR: A Design Exploration of an In-Game Quiet Room for Virtual Reality Games for Neurodivergent People

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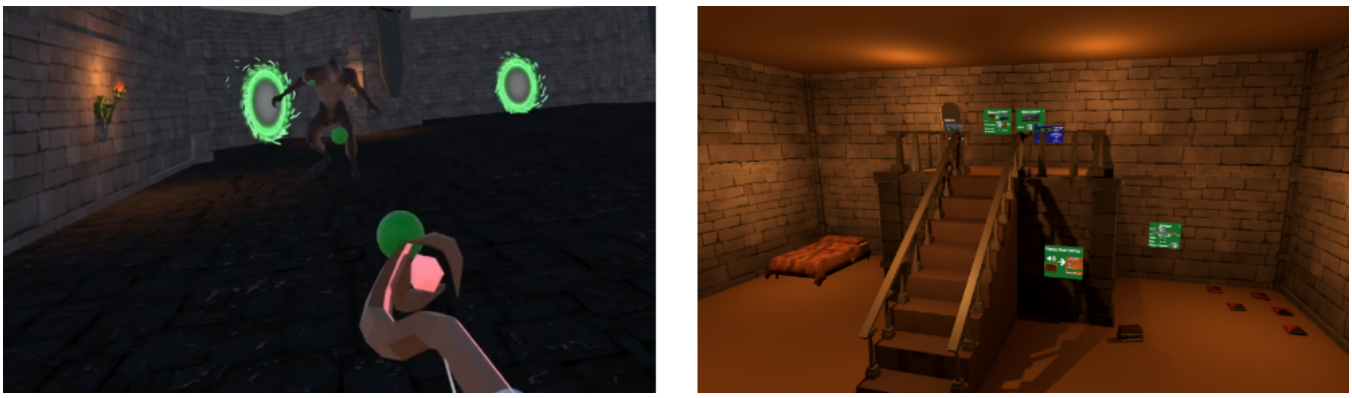

Figure 1: Screenshots of the VR game (left) and quiet room (right).

Abstract

Virtual Reality (VR) games are increasingly popular but often inaccessible to neurodivergent players due to sensory overload and limited options for self-regulation. Abruptly exiting VR in moments of overwhelm, e.g., by taking the HMD off, is not always a viable solution, as sudden changes in realities can add additional cognitive strain and disorient players. Drawing on established practices from physical quiet and sensory room design and informed by the PAS 6463:2022 guidelines, we designed and created a VR game prototype, RetreatVR, with a built-in, always available quiet room that offers opportunities for neurodivergent players to regulate in-game. Through the design exploration and a preliminary expert review, we collected insights into challenges and opportunities of transferring physical world guidelines for quiet rooms to the VR space.

Keywords

Virtual Reality, Game, Neurodivergence, ADHD, Autism, Quiet Room, Sensory Room, Self-Regulation

1 Introduction and Background

Virtual Reality (VR) technology is used in a growing number of use cases, e.g., work, education, or leisure [13]. VR games have been especially gaining popularity [14], partially because they offer highly immersive experiences [15], but like most VR applications, are still inaccessible to many people [1]. **Engaging with VR games can be straining on the body and the mind, in particular, for disabled and neurodivergent people** [9]. Neurodivergence describes the biological fact that some people neurologically process the world differently from a prescribed neurotypical standard [28]. Medical diagnoses that fall under this umbrella include, e.g., ADHD, Autism, or dyslexia. Design that centers neurotypical needs and preferences can cause challenges and access barriers for neurodivergent people [7, 9, 10], e.g., relating to sensory or cognitive processing, motor coordination, or social interactions. Breaks from ongoing action in VR can be necessary, for example, to prevent or reduce overstimulation for neurodivergent people [8]. However, breaks from VR immersion can introduce additional strain, and simply exiting VR is often not a suitable option [18]. In non-VR contexts, neurodivergent players have developed their own strategies for managing sensory demands, e.g., Autistic Minecraft players have created in-game spaces to withdraw from overstimulating environments [27]. These practices suggest that in-game spaces

for sensory relief could be a valuable accessibility strategy in VR games.

Real-world quiet and sensory rooms can provide relief when overstimulated, and are used by neurodivergent people to take breaks and self-regulate [6, 12, 33]. Such rooms are made available in public spaces like universities [2], airports [4], conference venues [17], or schools [24], to give space to regulate in environments built for neurotypical processing of stimuli. The rooms are usually designed to be low-stimuli, i.e., intentionally minimizing sensory input through, e.g., muted colors, soft lighting, minimal clutter, or insulation from sound. Sometimes optional desirable sensory stimulation is made available in the rooms, e.g., through swings, lava lamps, music players, etc. [33]. Interestingly, previous work has also explored the use of VR as a way of delivering immersive video to increase relaxation in real-world quiet rooms [16], however, it has not yet been leveraged in the context of providing relief from overstimulation that occurs throughout the use of VR. Guidelines exist for the design of built environments that cater to neurodivergent needs, like the British Standards Institution's PAS 6463:2022 [3], which includes concrete recommendations and key considerations for the design of quiet rooms and other restorative spaces for neurodivergent people.

In our work, we explore **whether the concept of quiet rooms can be brought from the physical world into VR games**, allowing users to temporarily step out of potentially overstimulating VR experiences. Leveraging the characteristics of physical quiet rooms, we contribute a design exploration of what such rooms could look like when integrated into VR: We designed and prototyped *RetreatVR*, a VR game with a built-in quiet room that can provide relief if players are overstimulated by VR gameplay without having to exit the game or the VR environment altogether. A preliminary expert review with neurodivergent players and VR researchers shows that the concept is promising, but that the design of VR quiet rooms as well as the game-to-quiet room transition requires careful consideration in order to prioritize user autonomy without the creation of overwhelming interactions.

Overall, RetreatVR is a promising first step toward designerly solutions for access barriers of neurodivergent people to VR, highlighting the potential of in-game quiet rooms to provide relief from overstimulating VR game experiences without burdening players with the negative effects of a sudden exit from VR.

2 Design Rationale: Transferring Real-World Recommendations for Quiet Rooms to VR

To develop the design concept, two main areas of concern were considered: (1) guidelines of quiet room design in the physical world, according to PAS 6463:2022 [3], and (2) the design requirements and possibilities of a VR game. Additionally, prior work on VR accessibility for neurodivergent people influenced design decisions (e.g., [1, 8]). We began with the conceptual transfer of the PAS guidelines [3] to virtual space by mapping each spatial or sensory recommendation to a VR design affordance. This informed not just the appearance of the environment, but its structure, interactivity, and transition logic from the main game. Key themes from the guidelines were: Predictability and clarity in layout and navigation, control over sensory input, including lighting and sound, opportunities for privacy and withdrawal, a default low-stimulation environment, and optional stimulating elements that can provide soothing or grounding effects (e.g., tactile objects, ambient music). With some recommendations, the transfer was straightforward, e.g., "Provide optional sound on an individual basis" [3] can be easily achieved by adding a radio feature where players can select music and sound to play according to individual needs. Other recommendations required adjustment, e.g., "Provide shades to control daylight and outside views" [3] is not directly applicable to VR spaces where daylight is blocked out from view anyways. For the in-game environment this can be approximated, though, by implementing a possibility to get simulated outside views. In our case, we decided to include an outside balcony with a view of a blue sky in the prototype. We also want to note that for some recommendations with focus on olfactory sensation or haptics, no VR adaptation could be integrated, e.g., "Provide cool and warm objects to touch" [3]. Here, mainstream VR technology does not provide means to control this type of stimuli, but there is potential in exploring this avenue through integration of additional objects (see, e.g., [11, 19, 21, 32]) in the future.

2.1 RetreatVR: A Design Prototype Integrating Quiet Rooms into VR Gaming

Here, we describe the resulting prototype, RetreatVR, shown in Figure 1 with a focus on gameplay, the quiet room, and the switch between the two. The prototype was implemented using Unity 6 [31] with the Meta XR All-in-One SDK 76.0.1 [26]. It was optimized for use with a Meta Quest 3 system [25]. Free templates and assets from the Unity Asset Store were used for some of the game elements.

2.1.1 Gameplay. RetreatVR features a tower-defense-like game with dark visuals in which players have to defeat monsters using a magic wand, with monsters spawning in waves from portals (see Figure 1). During each wave, more monsters have to be defeated, creating an atmosphere that is representative of VR games such as *In Death: Unchained* [29] or *Dungeons of Eternity* [23] in which players are continuously presented with stimuli, and need to engage throughout. Key player interactions include shooting magic bullets at monsters and dodging their attacks; the game can be played standing up or sitting down. Overall, when conceptualizing the game in which the quiet room would be integrated, care was taken to include some cognitive load and typical stressors, but not to overwhelm players completely in an effort to maintain safety for neurodivergent people. The gameplay is shown in the supplementary video figure.

2.1.2 Quiet Room. The final quiet room includes features that support **clarity and predictability** (a platform to overlook the whole room, posters with instructions, a fairy companion who explains interactions and the narrative, display of information on the game status on a "magic mirror" which doubles as a portal to the game dungeon), **control over sensory stimuli** (light: brightness, color, and warmth; music: three options of sound and volume control; the default on all being on low stimulation), as well as **sensory (inter)activities** (placing furniture to create a comfortable space, "sitting" on the ground, balcony to watch the sky, a radio to turn on). The room can be individually adapted, and settings can be saved

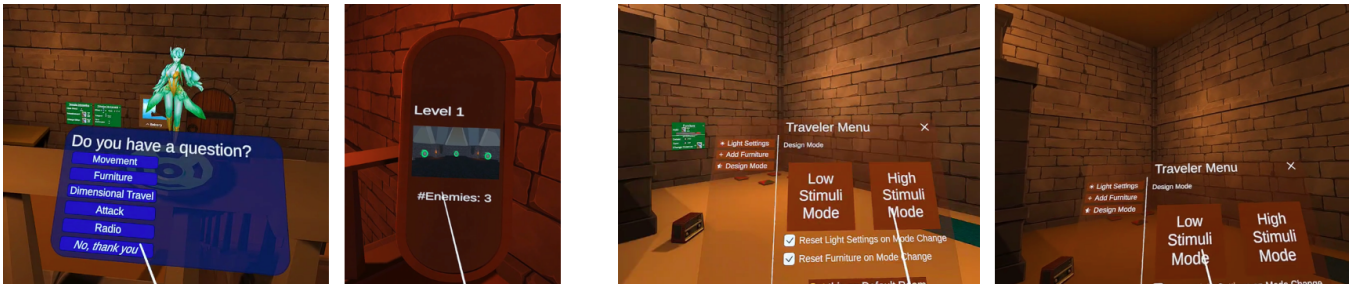

Figure 2: Key features of RetreatVR: (1) Fairy character guiding the player, (2) Mirror allowing preview of gameplay and game state, (3) high-stimuli mode, and (4) low-stimuli mode.

as individual default to cater to different sensory profiles as well as ad-hoc or fluid needs or preferences. RetreatVR also offers two preset default modes (low-stimuli and high-stimuli) to minimize the set up effort and address potential decision fatigue [20, 22]. Key features are shown in Figure 2 and the supplementary video figure.

2.1.3 Transitioning between Game and Quiet Room. The transition between game and quiet room is contextualized via gameplay and narration: The backstory explains that the player's character accidentally got trapped in a dungeon, but was helped by a fairy companion who brought them to a magic safe room – *the quiet room*. When preparing **entry into the game world from the quiet room**, an image of the dungeon can be viewed through a mirror (see Figure 2), and it can be accessed by interacting with it. Thereby, the player retains control over entry into the game world while allowing foreshadowing of in-game action. Once the mirror is accessed, the screen fades to black and players are teleported to the starting point in the game dungeon, with a countdown indicating the (re-)start of an enemy wave. In contrast, **entry into the quiet room from the game world** can be triggered by pressing the upper of two buttons on top of both controllers, the *Y* and *B* button, resulting in an immediate removal from the game world. If the player presses the buttons to get teleported to the quiet room, the game freezes and the screen fades to black. The fade then disappears and the player finds themselves on the platform inside the quiet room, where the game state will once more be foreshadowed via the mirror. A whole cycle of transitioning is shown in the supplementary video figure.

2.2 Preliminary Expert Review

Three neurodivergent persons, having ADHD, Autism or both, and two VR experts with experience in VR development and accessibility consented to participate in a preliminary expert review to assess the utility and evaluate the design of the prototype. Each expert explored the prototype for about 20 minutes in a lab setting. Feedback was gathered via a thinking-out-loud protocol throughout interaction, as well as a post-experience semi-structured interview that focused on the current iteration of the prototype as well as potential future features. Feedback was analyzed using template analysis, a flexible form of thematic analysis that starts with a set of a priori codes and allows iterative refinement during coding [30], with special focus on how well the concept of physical quiet rooms was transposed to VR, where design opportunities lay, and as how useful the quiet room was perceived. The coding process was carried out by the second author in conversation with the other authors of this work. Key findings suggest that **VR quiet rooms can serve a similar purpose as real-world quiet rooms**. Here, the utility of the quiet room was generally viewed positively, and potential use cases mirror those of the physical world: In situations of overstimulation and to prevent overwhelm, the quiet room was considered a useful feature. The experts highlighted further opportunities to add more sensory activities to the room. Furthermore, while customizable lighting and music options were appreciated and found useful, managing a multitude of options was considered overwhelming in itself and might lead to decision fatigue. Simpler presets and optional "advanced settings" were suggested as an alternative. Additionally, **the expert review identified the transition from game to quiet room as a key design challenge**: In the prototype, leaving the stressful game situation via fade-to-black was considered too slow. Here, future research is necessary to lessen immersion after triggering change to quiet space to reduce stress and overwhelm, and to balance the risk of unwanted stimulation resulting from sudden changes, while at the same time giving users autonomy over their experience.

3 Discussion

Through our demo, we contribute a design exploration of bringing real-world quiet rooms to VR. Here, we reflect on the design of RetreatVR, and we outline opportunities for future research.

3.1 Potential and Limitations of In-Game VR Quiet Rooms

The translation of PAS 6463:2022 [3] to VR provides a structured framework for designing predictability, sensory control, and low-stimulus withdrawal spaces in a medium where such accommodations are rare. Importantly, the quiet room complements, rather than replaces, dynamic gameplay. It gives players control over when and how they pace and distance themselves from action in gameplay. Here, in-game VR quiet rooms show a high potential to increase accessibility for neurodivergent people. There are some key aspects of quiet room design that cannot be transferred to VR, though: Sensory activities that stimulate the haptic and olfactory senses cannot be provided by mainstream VR technology. Additionally, regulating activities that require movement in the physical space, like pacing or lying down, are difficult to offer in VR without compromising

safety of the player. At the same time, some aspects of physical spaces that limit the design of quiet rooms do not apply to VR, opening up new design opportunities. For example, an audiovisual sensory activity in the physical world is tightly limited by the available technology to provide the stimulus, e.g., a television, stereo, lava lamp. In VR, designing audiovisual stimuli is almost limitless and sensory activities therefore can be designed in grander scales and with much more flexibility and adaptability.

3.2 Opportunities for Future Research Addressing the Temporary Reduction of Sensory Stimuli in VR

Our design exploration indicates that applying real-world strategies to manage sensory overload has potential to provide temporary reduction of sensory stimuli in VR, addressing the needs of neurodivergent players. Based on our exploration through RetreatVR as well as the expert review, we identified three key opportunities for future work: **(1) Choosing the right amount of customization options for VR quiet rooms.** The expert review showed that additional customization options could add to mental load. Here, future work should explore efficient ways of adjusting the space (e.g., setting it up before starting the game rather than making adjustments at runtime), and control options for customization features that gradually reveal complexity to users. **(2) Creating autonomy-preserving mechanisms for the game-to-quiet room transfer.** Our work suggests a need for a quick transfer from game world to quiet room. Future work should explore how to provide exit experiences that do not further burden users (akin to those when exiting VR altogether [18]), and how to reduce the risk of cybersickness [5] when making rapid transitions. **(3) Studying the impact of VR quiet rooms on presence, immersion, and overall experience in VR.** Our work has not yet contributed a user study examining the effects the quiet room has on key factors of VR experience. Here, an exploratory, qualitative methodological approach could be used to guide future design decisions. From there, quantitative assessments of the player experience should be focused to understand the generalizability of the findings.

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References

[1] Craig Anderton, Chris Creed, Sayan Sarcar, and Arthur Theil. 2025. Asleep at the Virtual Wheel: The Increasing Inaccessibility of Virtual Reality Applications. In *Proceedings of the CHI Conference on Human Factors in Computing Systems (CHI '25)*. ACM Press, Yokohama Japan. doi:10.1145/3706598.3713558 (In Press).

[2] Tor Alexander Bruce, Eve Champney-Smith, Satu Eleftheropoulou, Tom Nicholson, Mark Lambert, and Barry Hill. 2025. The WISE Room: An innovative multisensory space for self-regulation and immersive support for neurodivergent students. *British Journal of Special Education* (May 2025), 1467–8578.70020. doi:10.1111/1467-8578.70020

[3] BSI. 2022. PAS 6463:2022. Design for the Mind – Neurodiversity and the Built Environment – Guide. doi:10.3403/30411154

[4] Rafael Teixeira De Castro, Mariana Miranda Batista, and Maria Eduarda Santos Andrada. 2025. Airport accessibility for neurodivergent passengers: a global survey of initiatives and its implications. *Revista Brasileira de Pesquisa em Turismo* 19 (Feb. 2025), 3077. doi:10.7784/rbtur.v19.3077

[5] Eunhee Chang, Hyun Taek Kim, and Byounghyun Yoo. 2020. Virtual Reality Sickness: A Review of Causes and Measurements. *International Journal of Human–Computer Interaction* 36, 17 (Oct. 2020), 1658–1682. doi:10.1080/10447318.2020.1778351

[6] Marc-André Clément, Keven Lee, Melissa Park, Anabel Sinn, and Natalie Miyake. 2022. The Need for Sensory-Friendly "Zones": Learning From Youth on the Autism Spectrum, Their Families, and Autistic Mentors Using a Participatory Approach. *Frontiers in Psychology* 13 (June 2022), 883331. doi:10.3389/fpsyg.2022.883331

[7] Jazmin Collins, Woojin Ko, Tanisha Shende, Sharon Y Lin, Lucy Jiang, Andrea Stevenson Won, and Shiri Azenkot. 2024. Exploring the Accessibility of Social Virtual Reality for People with ADHD and Autism: Preliminary Insights. In *The 26th International ACM SIGACCESS Conference on Computers and Accessibility*. ACM, St. John's NL Canada, 1–5. doi:10.1145/3663548.3687134

[8] Chris Creed, Maadh Al-Kalbani, Arthur Theil, Sayan Sarcar, and Ian Williams. 2024. Inclusive AR/VR: Accessibility Barriers for Immersive Technologies. *Universal Access in the Information Society* 23, 1 (March 2024), 59–73. doi:10.1007/s10209-023-00969-0

[9] Chris Creed, Maadh Al-Kalbani, Arthur Theil, Sayan Sarcar, and Ian Williams. 2024. Inclusive Augmented and Virtual Reality: A Research Agenda. *International Journal of Human–Computer Interaction* 40, 20 (Oct. 2024), 6200–6219. doi:10.1080/10447318.2023.2247614

[10] John Dudley, Lulu Yin, Vanja Garaj, and Per Ola Kristensson. 2023. Inclusive Immersion: A Review of Efforts to Improve Accessibility in Virtual Reality, Augmented Reality and the Metaverse. *Virtual Reality* 27, 4 (Dec. 2023), 2989–3020. doi:10.1007/s10055-023-00850-8

[11] Cathy Mengying Fang, Ryo Suzuki, and Daniel Leithinger. 2023. VR Haptics at Home: Repurposing Everyday Objects and Environment for Casual and On-Demand VR Haptic Experiences. In *Extended Abstracts of the 2023 CHI Conference on Human Factors in Computing Systems*. ACM, Hamburg Germany, 1–7. doi:10.1145/3544549.3585871

[12] Kristi Gaines, Angela Bourne, Michelle Pearson, and Mesha Kleibrink. 2016. *Designing for Autism Spectrum Disorders*. Routledge, New York. doi:10.4324/9781315856872

[13] Ayah Hamad and Bochen Jia. 2022. How Virtual Reality Technology Has Changed Our Lives: An Overview of the Current and Potential Applications and Limitations. *International Journal of Environmental Research and Public Health* 19, 18 (Sept. 2022), 11278. doi:10.3390/ijerph191811278

[14] Grand View Research Inc. 2024. Virtual Reality In Gaming Market Size | Industry Report, 2030. https://www.grandviewresearch.com/industry-analysis/virtual-reality-in-gaming-market

[15] Tuomas Kari and Mehmet Kosa. 2023. Acceptance and Use of Virtual Reality Games: An Extension of HMSAM. *Virtual Reality* 27, 3 (Sept. 2023), 1585–1605. doi:10.1007/s10055-023-00749-4

[16] Shoko Kimura, Ayaka Fujii, Kenichi Ito, Keisuke Kitagawa, and Yoshinori Natsume. 2024. Experiment of Inclusive Quiet Room as a Chilling Out Space in a Media Art Exhibition. Queensland University of Technology, ISEA International, Meanjin (Brisbane). doi:10.5204/book.eprints.256296

[17] Shoko Kimura, Kenichi Ito, Ayaka Fujii, Rihito Tsuboi, Kazuki Okawa, Hibiki Kojima, Keisuke Kitagawa, and Yoshinori Natsume. 2023. Inclusive Quiet Room For Building an Inclusive Society. In *ACM SIGGRAPH 2023 Emerging Technologies*. ACM, Los Angeles CA USA, 1–2. doi:10.1145/3588037.3603420

[18] Jarrod Knibbe, Jonas Schjerlund, Mathias Petraeus, and Kasper Hornbæk. 2018. The Dream is Collapsing: The Experience of Exiting VR. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*. ACM, Montreal QC Canada, 1–13. doi:10.1145/3173574.3174057

[19] Marilia Karla Soares Lopes, Belmir Jose De Jesus, Olivier Manuel Rosanne, Susanna Pardini, Lora Appel, Christopher Smith, and Tiago Henrique Falk. 2024. Stop to Smell the Virtual Roses: A Mixed-Methods Pilot Study on the Impact of Multisensory Virtual Reality Nature Experiences on Feelings of Relaxation. *Frontiers in Virtual Reality* 5 (Dec. 2024), 1451704. doi:10.3389/frvir.2024.1451704

[20] Lydia Luke, Isabel C.H. Clare, Howard Ring, Marcus Redley, and Peter Watson. 2012. Decision-making difficulties experienced by adults with autism spectrum conditions. *Autism* 16, 6 (Nov. 2012), 612–621. doi:10.1177/1362361311415876

[21] Naga Sai Surya Vamsy Malladi, Viktorija Paneva, and Jörg Müller. 2023. Feel the Breeze: Promoting Relaxation in Virtual Reality using Mid-Air Haptics. In *2023 IEEE International Symposium on Mixed and Augmented Reality Adjunct (ISMAR-Adjunct)*. IEEE, Sydney, Australia, 322–327. doi:10.1109/ISMAR-Adjunct60411.2023.00070

[22] Athanasia M. Mowinckel, Mads Lund Pedersen, Espen Eilertsen, and Guido Biele. 2015. A Meta-Analysis of Decision-Making and Attention in Adults With ADHD. *Journal of Attention Disorders* 19, 5 (May 2015), 355–367. doi:10.1177/1087054714558872 Publisher: SAGE Publications.

[23] Othergate. 2023. Dungeons of Eternity. https://www.othergate.com/ [Game].

[24] Giyoung Park, Upali Nanda, Lisa Adams, Jonathan Essary, and Melissa Hoelting. 2020. Creating and Testing a Sensory Well–Being Hub for Adolescents with Developmental Disabilities. *Journal of Interior Design* 45, 1 (March 2020), 13–32. doi:10.1111/joid.12164

[25] Meta Platforms. 2023. Meta Quest 3. https://www.meta.com/quest/quest-3/ [Virtual reality system].

[26] Meta Platforms. 2024. Meta XR All-in-One SDK (Version 76.0.1). https://developer.oculus.com/documentation/unity/meta-xr-sdk-overview/ [Software development kit].

[27] Kathryn E. Ringland, Christine T. Wolf, LouAnne E. Boyd, Mark S. Baldwin, and Gillian R. Hayes. 2016. Would You Be Mine: Appropriating Minecraft as an Assistive Technology for Youth with Autism. In *Proceedings of the 18th International ACM SIGACCESS Conference on Computers and Accessibility*. ACM, Reno Nevada USA, 33–41. doi:10.1145/2982142.2982172

[28] Anna Stenning and Hanna Bertilsdotter Rosqvist. 2021. Neurodiversity Studies: Mapping Out Possibilities of a New Critical Paradigm. *Disability & Society* 36, 9 (Oct. 2021), 1532–1537. doi:10.1080/09687599.2021.1919503

[29] Superbright. 2020. In Death: Unchained. http://superbrig.ht/ [Game].

[30] Gillian Symon and Catherine Cassell. 2012. *Qualitative Organizational Research: Core Methods and Current Challenges*. SAGE Publications, Inc., 1 Oliver's Yard, 55 City Road London EC1Y 1SP. doi:10.4135/9781526435620

[31] Unity Technologies. 2024. Unity (Version 6). https://unity.com/ [Computer software].

[32] Nadine Wagener, Alex Ackermann, Gian-Luca Savino, Bastian Dänekas, Jasmin Niess, and Johannes Schöning. 2022. Influence of Passive Haptic and Auditory Feedback on Presence and Mindfulness in Virtual Reality Environments. In *Proceedings of the 2022 International Conference on Multimodal Interaction*. ACM, Bengaluru India, 558–569. doi:10.1145/3536221.3556622

[33] Valerie Watchorn, Maddison Cartledge, Cathryn Grant, Anna Walker, and Isaac Hale. 2025. "A Calm Space to Reset": Perceptions of Sensory Rooms in Australian Public Buildings. *Archnet-IJAR: International Journal of Architectural Research* (May 2025). doi:10.1108/ARCH-10-2024-0453