Chapter 13
VR/Technologies for Rehabilitation

Anthony Lewis Brooks

Abstract  Early on, Virtual Reality (VR) was linked to communication—even as ‘a combination of the television and telephone wrapped delicately around the senses’ [1]. VR Technologies are increasingly being adopted in the areas of (re)habilitation and therapeutic intervention healthcare treatments. VR applications that supplement traditional intervention are in human physical, cognitive, and psychological functioning medical treatment programs. Extended Reality (XR), incorporating applications beyond solely VR, with Augmented Reality (AR) and Mixed Reality (MR) applications are also being introduced. This chapter introduces via micro-review, four chapters under the theme VR/technologies for rehabilitation. It follows on from the previous and opening part of this book where ten chapters were introduced and micro-reviewed under the theme Gaming, VR, and immersive technologies for education/training. Specifically, the chapters are titled:—‘Game-based (re)habilitation via movement tracking’ [2]; ‘Case studies of users with neurodevelopmental disabilities: Showcasing their roles in early stages of VR training development’ [3]; ‘AquAbilitation: ‘Virtual interactive space’ (VIS) with buoyancy therapeutic movement training’ [4]; and finally, ‘Interactive Multisensory VibroAcoustic therapeutic intervention (iMVATi)’ [5].

Keywords  Virtual reality · Rehabilitation · Technologies · Autism · Participatory design · Games · Health

13.1  Introduction

We See Things not as They Are, but as We are— that is, We See the World not as It is, but as Molded by the Individual Peculiarities of Our Minds.

—G. T. W. Patrick (1890)
Virtual Reality (VR) technologies are increasingly being adopted in the areas of (re)habilitation and therapeutic intervention healthcare treatments. VR applications that supplement traditional intervention are in human physical, cognitive, and psychological functioning medical treatment programs. Extended Reality (XR), incorporating applications beyond solely VR, with Augmented Reality (AR) and Mixed Reality (MR) applications, are also being introduced. This chapter introduces four chapters under the theme ‘VR/technologies for rehabilitation’. It introduces by offering an opening cross-focused, and sometimes extended, ‘miniscule-review of the field’ by introducing these chapters that have been contributed by an international array of authors concerned about sharing their research to a wider audience across disciplines. Each paper’s author(s) acknowledgement citation and cross-reference herein align to use of their source text to create these snippets to overview and to introduce readership. Specifically, the chapters are titled:—‘Game-based (re)habilitation via movement tracking’ [2]; ‘Case studies of users with neurodevelopmental disabilities: Showcasing their roles in early stages of VR training development’ [3]; ‘AquA-bilitation: ‘Virtual interactive space’ (VIS) with buoyancy therapeutic movement training’ [4]; and finally, ‘Interactive Multisensory VibroAcoustic therapeutic intervention (iMVATi)’ [5]. Virtual Reality as a theme is interpreted to include across the spectrum from head mounted display (HMD) systems to non-HMD systems where computer-generated projections onto screens create the ‘virtual’ environment that is interacted with and experienced by participants. This second part, being themed as ‘VR/technologies for rehabilitation’, aligns with how the book contents are overall segmented into four parts with chapters being selected to each. Specifically, Part 1: Gaming, VR, and Immersive Technologies for Education/Training; Part 2: VR/Technologies for Rehabilitation; Part 3: Health and Well-Being; and Part 4: Design and Development.

What’s reality anyway? Just a collective hunch!—Jane Wagner/Lily Tomlin (Hamit 1993).

### 13.1.1 Game-Based (Re)habilitation via Movement Tracking [2]

The co-authors of this chapter are from Aalborg University in Denmark. The subjects in the studies of the chapter titled ‘Game-based (re)habilitation via movement tracking’ were 18 children (10 females and 8 males) between the ages of 5 and 12 years, mean age 7.66 years, in 20 gameplaying sessions conducted at two large Scandinavian hospitals: One being the regional hospital for south Denmark located in the city of Esbjerg (Denmark’s 5th largest city), and the other being the Swedish regional Halland hospital located in Halmstad (Sweden’s 19th largest municipality). The hospital staff who were co-researchers in the project and leading the actual sessions selected both subjects and control group participants. The facilitators involved at the hospitals were two play therapists and three doctors. The equipment set-up consisted of a motion-detecting camera interfaced to a popular game-playing entertainment platform with a selected game. The goal was to study
the potential of the set-up to motivate/promote the children’s’ movements and to
distract them from any medical procedures they were subject to.

Results highlighted how the gameplay offered potentials in a healthcare setting
that align to the larger body of research the study was conducted within [6, 7].
The authors state that their hypothesis is that game playing using embodied user
interaction has evaluand potentials in therapy and thus significance in quality of
life research for the special needs community. Aligned to the cited work above,
the setup can be studied as a Virtual Interactive Space (VIS) where actions (free
gesture game-playing) are analysed and evaluated aligned with investigation goals.
The state of Presence commonly associated to virtual reality immersive experience
of ‘being there’ was questioned as a ‘sense state’ continuum aligned to the concept of
‘Aesthetic Resonance’. It can be argued that head mounted display’s (HMDs) used
with virtual reality optimise the experience of ‘presence’. However, in this research
(see also [8–11]) no HMDs were used, yet the participants could not have been more
engaged with the presented stimulus and interactions by the games and interactive
environments. Thus, this research targeted a participant experience that differed from
what is commonly referred to as ‘presence’.

Instead targeting (and achieving) an experience more aligned with Loomis [12]
who referred to it as “distal attribution” as an experience in which the user experiences
“being in touch with” the simulated or remote environment while fully cognizant of
being in the real environment in which the display is situated. Loomis [12] further
states that “True presence would occur when the observer has neither prior knowl-
dge nor sensory information signifying that he/she is using a virtual or teleoperator
display; when these conditions of cognitive and sensory equivalence fail to be met,
distal attribution is the more likely result” (p. 593). The authors herein state how
meeting such conditions aligned to Loomis [12] are likely never or rarely possible
and also that ‘fully cognizant’ is questionable achievable whereby cognizant linkages
tend to be fleeting in temporal variants - thus, Aesthetic Resonance is attributed and
argued [6–8].

Resulting in this work is an hybrid emergent model titled ‘Zone of optimized
motivation’ (ZOOM—see [6, 7, 13]). The authors present how subjective presence
has predominantly been investigated in respect of optimal user state in environments
and has been suggested as being increased when interaction techniques are employed
that permit the user to engage in whole-body movement. Situated presence is also
presented in this chapter as real users in a real place vs a controlled laboratory. The
goal being exploratory is thus implemented in a pilot study so as to define problem
areas to achieve preliminary data on potential of video games in therapy.

This chapter illustrates how tools such as the motion camera used herein have
potentials to decrease the physical and cognitive load in a daily physical training
regime where interactive games are adopted for use to supplement traditional ther-
apeuti interventions. Not all people can use traditional controllers, especially those
with certain dysfunction. However, it can be reflected that only recently have major
game platform corporates come forward to impact this field. This exemplified by
Microsoft and their Adaptive Controller, and Logitech with their switch kit to accom-
pany the controller—both companies aparently having departments with specific
focus on peripherals and games that can be accessible. Additionally, these companies are active in working closely with end-users and partners who have a mission statement to make games accessible and understand the potentials in the resultant healthcare and quality of life aspects that are alongside the feelgood factor of achievements and successes for a game player be be considered included. For example the video informing behind the adaptive controller and kit illustrates—and as the closing statement by ‘Logitech G’ (https://www.logitechg.com) vice president for gaming Ujesh Desai makes clear “we should have been doing this already”. This aligning to the author’s proposal for ‘inclusive gaming’ declined by major gaming platform contacts under guidance of the then secretary-general of The Interactive Software Federation of Europe (ISFE) around turn of the millennium.

13.1.2 Case Studies of Users with Neurodevelopmental Disabilities: Showcasing Their Roles in Early Stages of VR Training Development [3]

The authors of this next chapter are truly an international team:- Yurgos Politis, who is affiliated to Michigan State University and University College Dublin, in Dublin, Ireland; Nigel Newbutt, who is affiliated to The University of the West of England, located in Bristol, United Kingdom; Nigel Robb, who is affiliated to The University of Tokyo, Japan; Bryan Boyle, who is affiliated to The University College of Cork, in Ireland; Hug-Jen Kuo, who is affiliated to The California State University, in Los Angeles, USA; and Connie Sung, who is affiliated to Michigan State University, in Michigan, USA. In this chapter the multi-national group of co-authors reflected on two projects (as case studies) that enabled disabled groups to be involved in designing and influencing technology used by them. Reflections are also on the process, limitations, barriers and actual involvement of the user groups. Keywords of these case studies include: Virtual Reality (VR), Augmented Reality (AR)/Mixed Reality; User Experience Design; Participatory Design; Case studies; Accessibility; Game design and development. The chapter opens with a clear statement of intent aligned with how user involvement in the design/creation of products and services has become more participatory in nature and the role of the users has evolved from being influencers of just the final outcome (testing a prototype) to influencers of the development and design process; from being tasked with the standardization of products/outcomes to being actively involved in their customization to meet individuals’ needs and preferences; and from being mere participants to having a relationship with the designers/developers. There has therefore been a shift to products being “designed by” the customers where they are actively involved in all phases of the development process of their product (cf). This aligns with this group’s other chapter in this volume where specifically individuals with autism are involved in PD design

1see https://www.logitechg.com/en-us/products/gamepads/adaptive-gaming-kit-accessories.943-000318.html.
The authors state how development and design process of products or services should enable specific user groups to achieve certain goals with effectiveness and productivity (ISO/IEC 25,010:2011; standardization of software products and software-intensive computer systems). They add by stating how the process can benefit from user involvement because users can offer a different point of view: In other words, to do some ‘out of the box’ thinking of their own that may provide inspiration for the future of development/design. However, as they then state and exemplify with related literature, there are inherent challenges in such participation that needs to be meaningful. The authors challenge the typical top-down design approach by their position on participants contributing to the design, and they introduce a recent initiative to impact Participatory Design with neurodiverse populations (mainly ASD and dyslexia) that has emerged based on the Diversity for Design (D4D) Framework [14]. This framework they inform advocates for design approaches that focus on the strengths of the participants, rather than overcoming weaknesses: Emphasising that the D4D framework is a blueprint for technology designers on how to engage with neurodiverse populations through a PD approach. The authors summarise and present the two main headings of the framework. In this chapter they state how, as far as they are aware, there exists a D4D Framework applied to the development of PD features for ASD and Dyslexic populations, however, there isn’t one developed for people with intellectual disabilities. Thus, the chapter presents two case studies addressing the practicalities of working with people with autism/ID (intellectual disability) in the early stages of Virtual Reality (VR) development. The first case study looks at users’ preferences regarding VR hardware, while the second considers user-involvement in designing the training content for carrying out a task of their choosing. The two case studies in combination examine how users with neurodevelopmental disabilities can influence decisions in the early stages of VR training development.

The first reported case study was focused on engaging users in the potential of virtual reality opportunities for learning in schools having the goals to (a) learn about device preference (VR HMD) for young autistic people; (b) understand issues related to sensory and physical reactions, as well as levels of comfort and enjoyment of using VR HMDs; and (c) learn from the co-researchers ways that VR could be used in schools. Forty three participants took part between the ages of six and sixteen years-of-age with a mean age of twelve, with a male to female ratio being twenty eight to fifteen. Full details of the first case study is presented in the chapter by the co-authors.

The second case study focused upon investigating a participatory design approach to co-create training materials on a daily living task for young adults with Intellectual Disabilities. In this study, a group of young adults with Intellectual Disabilities (IDs) led the creation of training guidelines on how to carry out a daily living task. The study was of (a) obstacles faced during the Participatory Design process; (b) barriers that the participants and researcher had to overcome in order to create guidelines that are effective; and (c) reflective account (by the researcher) that reflects on the whole process; developing a list of recommendations for best practice. The authors
state that the long-term objective is to enable the participants in enhancing their lives, by being able to live independently and being able to secure lasting and meaningful employment. The participants in the second case study were attending a programme at an Irish Higher Education Institute (HEI) in Dublin, Ireland that was organised in partnership with a Service Provider for people with IDs. The authors decided that a focus group methodology was most appropriate. Six participants were involved with four being male and two female having an age range between early twenties and early forties having a variety of diagnoses of Kabuki syndrome, Williams syndrome, Downs Syndrome and general intellectual disability. Full details of the second case study is also presented in the chapter by the co-authors.

The authors [3] conclude that the two case studies considered two neurodiverse populations (autistic people and people with ID) and they summarise with identifying the Guidelines for Best PD Practice with these populations that has emerged resulting from their research that they posit should be tested further to inform on inclusive design that can impact inclusive well-being to advance the field aligned to the title of this volume.

13.1.3 AquAbilitation: ‘Virtual Interactive Space’ (VIS) with Buoyancy Therapeutic Movement Training [4]

The title of the next chapter is ‘AquAbilitation: ‘Virtual interactive space’ (VIS) with buoyancy therapeutic movement training’. The author is Anthony Lewis Brooks who is affiliated under Aalborg University, Denmark.

The author makes clear that buoyancy aided movement-training is not new, however, he believes that buoyancy aided movement-training with direct audiovisual virtual reality feedback is novel. The background to the concept is that it was inspired from the author’s studies during the early 1990s that investigated his concept of ‘Antigrav’ (extended as ‘Anti Gravity’) aligned to concepts associated to weight and weightlessness, this under his larger body of research titled SoundScapes [7]. An inspiration to this work was from a meeting in Conférences CYPRES, Mouvement et Comportement, Ecole d’Art d’Aix en Provence (trans: ‘Movement and Behavior, Aix en Provence Art School, France’) in March 1995, with French dance choreographer and producer Kitsou Dubois. The author was presenting on the hypothetical potentials of weight and weightless art for individuals and groups who were considered as being handicapped across all ages and including balance training and gesture control for aged and disabled. The concept being to inquire how physical handicapped may use forces and counter-forces to express themselves creatively whilst exploring their own bodies—thus, to have a sense of their bodily ownership toward a freedom of movement to the best of a person’s ability. Dubois presented examples of her dance and movement experiments based upon her concept ‘microgravity’—https://vimeo.com/132641050—The following is from Kitsou Dubois, Gravité Zéro, 1994 from ‘Compagnie Ki’ Productions site-
Gravité Zéro: Artistic Description

The unique experience of dancing in weightlessness resulted in a first show: “Gravity Zero” visualises how it feels to fly. The fear of falling ingrained in the memory of the body is overcome by the freedom apparent in the floating movement and by the release of a body no longer weighed down. The dream of flight has come true!

A poetic space has come into being in “Gravity Zero”, and it conveys to the spectator the way it feels to fly. The video is unobtrusively present; it is both the trace and the memory of our dream come true.

The first part of the performance is based on phenomena of unsteadiness which make us realise how fragile our earthly verticality is. Our references to up and down are muddled by the use of the inclined plane where some of the dancers appear upside-down.

In the second part, we have the mirror effects combined with the body movements resulting from zero gravity: fluidity which makes it hard to notice the supports, continuous motion and no feeling of falling or sudden stops. The dancers are gliding and dancing on the floor and the audience sees them flying through space!

This led to the author’s explorations in Contact Improvisation Dance is a form of improvised dancing that has been developing internationally since 1972. It involves the exploration of one’s body in relationship to others by using the fundamentals of sharing weight, touch, and movement awareness. In 1996 ten art performances with international contact improvisation mixed ability dance companies at Arken Museum for Modern Art (MoMA) under The European Culture Capital Copenhagen Kulturby, and performances at the Cultural Paralympics in the Rialto Theatre Atlanta exposed the author to top movement performers including bungee dancers that challenged gravity. Such exposures left a lasting impression on the author and his research.

Within facilities available to disabled communities in Scandinavia are special pools. It was in one of these pools at the Lund University Hospital, in Lund, Sweden that the proof-of-concept reported in the chapter was initiated when the author was based there under a European project based upon his research. The chapter overviews the AquAbilitation research concept and how it associated to creation of a Virtual Reality, games, and human behaviour interaction complex titled SensoramaLab. Social-cultural perspectives of the research are shared alongside the fieldwork that informed the practical aspects of the research. Testing was done with the goal of learning from users and therapists what could be an optimal solution.

The aquatic Virtual Interactive Space built upon the author’s earlier work presented at the World Congress for Physical Therapy (WCPT) in Yokohama [8]. However, the research targets a participant experience that differs from ‘Presence’ or ‘Telepresence’—a state that many researchers of Virtual Reality target, i.e. experiencing “being in” the computer-generated virtual environment (i.e. the qualia of having a sensation of being in a real place—[15]). Loomis [12] proposed instead of Presence this engagement being as “distal attribution”, in which the user experiences “being in touch with” the simulated or remote environment while fully cognizant of being in the real environment in which the display is situated. Loomis, from a psychological perspective, states that “True presence would occur when the observer has neither prior knowledge nor sensory information signifying that he/she is using a virtual or teleoperator display; when these conditions of cognitive and sensory equivalence fail
to be met, distal attribution is the more likely result” (p. 593). This chapter’s author suggests that such a situation, where prior knowledge nor sensory information signifying that he/she is using a virtual or teleoperator display, is arguably not achievable. Aligned, it is reflected that user engagement and experiences of being in touch (via interacting) with elements of the non-HMD simulated environment while partialy cognizant of being in the real environment led to targeted outcome behaviour in the immersive environment—that in a way aligns with Slater’s definition of presence as ‘virtual place illusion and plausibility that lead to realistic behaviour in the immersive environment’. However, given an acquatic environment safety issue considerations are prevalent for future instances of the research where HMDs are planned to be introduced. A hypothesis of such an environment is that an engaged state would be achieved, sufficient to realise the targeted outcomes but with participants still partialy cognizant of being in the real environment necessitated through the safety to prevent drowning or related accidents. It is anticipated that such engaging experiences maybe more intense that non-HMD. However, additionally considered are the safety and well-being of participants that are improved through non-HMD (issues that include eye damage, nausea and dizziness through HMD use as well as other blue-light screen use\(^2\)). Biocca and Levy [1], p. 130 inform how HMDs can potentially spread bacterial infections or head lice among users and take some time to put on and adjust to the individual. Covid-19 pandemic disinfecting of a HMD between-users is similarly relevant!

To conclude, as stated, water-based treatment for wellness is not new and buoyancy aided movement-training is introduced in this chapter in the form of the history of Hydrotherapy to lay foundation to the titled concept ‘AquAbilitation’. The author informs on use of technology to create the setup and to analyse participant interactions. The concept emerged from reflecting from the author’s field work where it was clear, that following immersion in water, individuals with profound and severe dysfunctions were different in sessions where gesture-based motion sensors were mapped to auditory feedback (later including visuals and robotic devices) that stimulated their movements. Thus, the author’s non-aquatic environments positively supplemented traditional therapeutic intervention in sessions within a treatment program. To combine water immersion with multimedia feedback (including Virtual Reality) that gives direct feedback to a participant was an obvious next step. The design of the ideal setup is shared where different technologies are proposed to advance the field and this is targeted as future research if a sponsor was to be realised. Images of known pools with projection facilities are also shared to exemplify what could be an ideal setting to further the research towards significant societal impact.

\(^2\)https://laserfitlens.com/vision-risk-from-long-term-exposure-to-screens-of-electronic-devices/.
13.1.4 *Interactive Multisensory VibroAcoustic Therapeutic Intervention* (iMVATi) [5]

The final chapter in this part is titled ‘Interactive Multisensory VibroAcoustic Therapeutic Intervention’ by the same author as the previous chapter, namely Anthony Lewis Brooks from Aalborg University, Denmark. In this case, stimulus is in the form of haptic/tactile vibrations (alongside auditory and visuals, thus multimedia) as direct feedback instead of water against the participant’s body and direct auditory and visual feedback. In this was the holistic body of research SoundScapes includes auditory, visuals, robotics, water against body stimulus, bouyancy stimulus, as well as haptic/tactile feedback. SoundScapes thus advances towards an array of selectable interfaces as well as an array of selectable content stimulus such that flexible modular tailorable adaptable interactive environments are able to be personalised to a participant profile and targeted outcome from the participant experience. The participant experience was targeted to be entertaining, fun and playful and optimally beneficial such that therapeutic targeted goals were approached under a strategy to supplement traditional intervention.

This chapter discusses and describes the setup, including the use of a vibroacoustic chamber containing low frequency speakers that were receiving filtered auditory signals from a sonic amplifier. The sounds that are amplified originated from a sound synthesizer with each tone triggered via human movement within a sensing zone. The sensed moving by the participant is directly manipulating sonic feedback that communicate where the movement was made—useful in the case of handicapped as sense of proprioception can be dysfunctional. Thus, a form of communication with the self is established, a causal feedback loop of cause and effect. Further, this is referred to by the author as ‘closing the afferent efferent neural feedback loop’ as what is subsequently sensed as sonic feedback by the brain (afferently), resulting from an initial motion, leads to a firing of synapses from the brain to efferent motoric pathways to initiate following motion with the sensing space. In line with Within the SoundScapes body of research that this chapter is under, communication is thus between a participant and a represented projected self, not necessarily as a replicant humanoid but rather as an interacting ‘form’ of data assemblage that can be referred to as multimedia—to stimulate in a multi-sensory fashion: This a given due to the selectable options available to manipulate sourced forward-input-to-system sensed human data (feed-forward) routed into computer-based contemporary mapping and scaling software. Biocca’s Cyborg’s Dilema text (1997) that followed his keynote of the same title at the International Cognitive Technology Conference in August, 1997 in Aizu, Japan, is considered aligning to this representation of the self as a communication form.

The participant lies upon the vibroacoustic chamber to be able to feel the vibration and differences in frequencies that they themselves trigger via movements within three 3-dimensional volumetric space infrared sensors with data configuration rings as an onion in cross-section. The research also used linear ultrasound and planar CCD and CMOS sensors so that pros and cons of each sensor profile can be fitted to
therapist’s desired movement for the patient to target optimal benefit and progression in training and optimal patient experience for the patient as they creatively express through triggering the multimedia by motion. Studies were conducted at an institute for children and adolescence having special needs being diagnosed with profound dysfunction. Biofeedback relative to the research is introduced in the chapter as well as the methodology, which were typically case studies aligned to a mixed methods approach using both qualitative and quantitative analysis (e.g. [16]). The chapter further informs on the author’s emergent model for intervention titled Zone of Optimised Motivation (ZOOM [6, 7, 13])—a methodology to optimise a patient experience and a strategy for improved facilitator intervention using technology in a session and including assessment and evaluation post session towards next-session redesign under an iterative progressive treatment program.

The chapter informs how the design of the Virtual Interactive Space (VIS), i.e. the environment, where the VibroAcoustic Therapeutic (VAT) setup was established at the Swedish school (Emaljsskolan in Landskrona) built upon related work designing sensor-based multimedia interactive spaces [17, 18]. Close working and social relationship with the teachers led to an optimal situation for the research to be conducted in-situ—that is where the children and adolescence were comfortable and attended daily with staff that they knew who introduced the researcher and tasks. Content was selected to stimulate each individual knowing the various interfaces and the preferences of the children and adolescence—as informed by staff: For example low frequency oscillator synthesiser sounds from a Moog Taurus 3 foot pedalboard matched the vibroacoustic chamber. Such a pedalboard could also be physically pressed by such participants and this is an aspect presented for future inquiry in this field where foot pedals (such as the Moog was intended to be used by its designers) to change the multimedia (primarily the sounds and images) could be an expansion of the research in this chapter. Further, the chapter explains an intended direction where larger VAT platforms are envisaged for use to intensify vibrations and aligned to test differences between valve amplifiers and solid-state amplifiers in the process chain (testing envisaged by deaf and blind who may be more sensitive to haptic feedback stimulus). The work in progress is however limited to space requirement of a designated room for the research to flourish and advance the associated fields including the questioning of (alternative) communication potentials via creative expression as a channel that can potentially stimulate other pathways of stimuli that may be dysfunctional following damage e.g., in brain injury such as stroke. In this way a stroke patient could hear, see and/or feel their movements of a limb in space to train that limb despite their sense of that limb is diminished. Similarly, in such training, a stroke patient can hear, see and/or feel where their torso is in relation to their sensing of balance that is dysfunctional via the feedback that can be selected to match the patient and the sensing of data fine tuned to the individual needs and therapist goal from intervention. The chapter informs how feed-forward and feedback data can be manipulated to realise an optimised patient experience of (re)habilitation.
13.2 Conclusions

In concluding this second part of the book, that has presented a brief introduction review of each chapter and its author(s) positioning, VR technologies for rehabilitation content chapters are presented. It is anticipated that scholars and students will be inspired and motivated by these contributions to the field of Technologies of Inclusive Well-Being towards inquiring more on the topics. The third part of this book follows the four chapters herein this second part—it is themed ‘Health and well-being’—enjoy.

Acknowledgements Acknowledgements are to the authors of these chapters in this part of the book. Their contribution is cited in each review snippet and also in the reference list to support reader cross-reference. However, the references are without page numbers as they are not known at this time of writing. Further information will be available at the Springer site for the book/chapter.

References

1. Biocca, F., Levy, M.R.: Communication Applications of Virtual Reality. Erlbaum (1995)
2. Brooks, A.L. & Brooks, E.I.: Game-based (re)habilitation via movement tracking. In Brooks et al. (eds) Recent Advances in Technologies for Inclusive Well-Being. Intelligent Systems Reference Library 196, (2021). https://doi.org/10.1007/978-3-030-59608-83
3. Politis, Y., Newbutt, N., Robb, N., Boyle, B., Kuo, H.J., Sung, C.: Case studies of users with neurodevelopmental disabilities: Showcasing their roles in early stages of VR training development. In Brooks et al. (eds) Recent Advances in Technologies for Inclusive Well-Being. Intelligent Systems Reference Library 196, (2021). https://doi.org/10.1007/978-3-030-59608-83
4. Brooks, A.L.: AquAbilitation: ‘Virtual interactive space’ (VIS) with buoyancy therapeutic movement training. In Brooks et al. (eds) Recent Advances in Technologies for Inclusive Well-Being. Intelligent Systems Reference Library 196, (2021). https://doi.org/10.1007/978-3-030-59608-83
5. Brooks, A.L.: Interactive Multisensory VibroAcoustic therapeutic intervention (iMVATi). In Brooks et al. (eds) Recent Advances in Technologies for Inclusive Well-Being. Intelligent Systems Reference Library 196, (2021). https://doi.org/10.1007/978-3-030-59608-83
6. Brooks, A.L.: Intelligent Decision-Support in Virtual Reality Healthcare & Rehabilitation. Studies in Comput. Intell. 326, 143–169 (2011). https://doi.org/10.1007/978-3-642-16095-0
7. Brooks, A.L.: SoundScapes: the evolution of a concept, apparatus and method where ludic engagement in virtual interactive space is a supplemental tool for therapeutic motivation (2011). https://vbn.aau.dk/files/55871718
8. Brooks, A.L.: Virtual interactive space (V.I.S.) as a movement capture interface tool giving multimedia feedback for treatment and analysis. In: Proceeding of World Confederation for Physical Therapy (1999)
9. Brooks, A.L.: Ao Alcance de Todos Música: Tecnologia e Necessidades Especiais., Casa da Musica. Proc. 7th ICDVRAT with ArtAbilitation, Maia, Portugal, 2008. Reading University, UK (2008). https://vbn.aau.dk/ws/portalfiles/portal/41580679/Porto_Workshop_2008_paper.pdf
10. Brooks, A.L., Hasselblad, S.: Creating aesthetically resonant environments for the handi434 capped, elderly and rehabilitation: Sweden. In: Proceedings of 6th International Conference on Disability, Virtual Reality and Associated Technologies, pp. 191–198 (2004)
11. Brooks, A.L., Hasselblad, S., Camurri, A., Canagarajah, N.: Interaction with shapes and sounds as a therapy for special needs and rehabilitation. In: Proceedings of 4th International Conference on Disability, Virtual Reality, and Associated Technologies, pp. 205–212. Veszprém, Hungary (2002)

12. Loomis, J.M.: Presence and Distal Attribution: Phenomenology, determinants, and assessment. In: Proc. SPIE 1666 Human Vision. Visual Processing and Digital Display III, 590–594 (1992)

13. Brooks, A., Petersson, E.: Recursive reflection and learning in raw data video analysis of interactive ‘play’ environments for special needs health care. Healthcom (2005b). IEEE https://ieeexplore.ieee.org/document/1500399

14. Benton, L., Vasalou, A., Khaled, R., Johnson, H., Gooch, D.: Diversity for design: a framework for involving neurodiverse children in the technology design process. In: Proceedings of CHI (2014)

15. Slater, M.: Place illusion and plausibility can lead to realistic behaviour in immersive virtual environments. Philos. Trans. Royal Soc. 364, 3549–3557 (2009). https://doi.org/10.1098/rstb.2009.0138

16. Yin, R.K.: Case Study Research and Applications: Design and Methods (6th edn.) Sage (2017)

17. Brooks, A.L., Petersson, E.: Play therapy utilizing the Sony EyeToy®. In: Slater, M. (ed.) Annual International Workshop on Presence (8th) pp. 303–314 (2005)

18. Brooks, A.L., Sorensen, C.: Communication Method and Apparatus. Patent US 6(893), 407 (2005)