

# Exploring Visuo-Tactile Embodiment in a Social Virtual Reality Setting with a Physical Wheelchair for Training Empathy Towards Social Disability Barriers

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## ABSTRACT

Interactions of personnel with patients in healthcare settings tend, as a norm, to be depersonalized and detached, failing to acknowledge that patients seek empathy from their caregivers. Experiential learning that allows trainees to understand the subjective experience of disability can be useful in the education of empathy, but disability is usually portrayed as a private impairment, and most scenarios fail to acknowledge its dimension of social construction. We plan to investigate the potential of an embodied VR experience, using a physical wheelchair as a controller in the VR space, to see whether visuo-tactile VR experiences with social barriers of disability enhance empathy in dutch medical students.

## KEYWORDS

virtual reality, visuo-tactile embodiment, empathy, wheelchair

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## 1 ON CROSS-REALITY AND THIS WORK

The term Cross-Reality (CR) is a classifier for system configurations, where combinations of computational elements such as sensors and actuators, virtual objects, and real objects such as tangible artifacts are placed in various forms of interplay, to create exchanges between the real and the virtual world [16]. As such, the design space for CR is potentially far more vast than Virtual-Reality (VR) or Augmented Reality (AR) systems.

Additionally, there are several exemplary implementations of VR and AR systems in domains such as industrial production or home entertainment, and significant support for developing new ones in terms of end-user-oriented, reasonably priced hardware and software. In contrast, compositions of hardware, software, and physical objects that could constitute CR systems, and possible applications for them, are more exploratory and experimental. To

the extent that they might make use of better-defined components of VR or AR systems, the extent to which they should be classified in categories different than CR can be debated.

Consequently, it may be sensible to regard VR, AR and CR systems collectively as existing on a multidimensional spectrum, their placement on which is determined by the degree to which they emphasize elements of these paradigms, rather than exclusively belonging to one.

This rest of this text discusses how a very small step could possibly be made, in a far bigger problem domain that relates to societal outcomes in the real world. Nonetheless, it does present a technical configuration that combines a physical object used for everyday mobility, a wheelchair, which is instrumented with sensors (rotary encoders) to feed information about movement into a virtual world, and through tactile actuators, to feed information from the virtual world back to the wheelchair operator, and hopefully these aspects place it on a part of the systems-characterization spectrum that is interesting to the XR-minded reader.

## 2 EMPATHY IS IMPORTANT FOR QUALITY HEALTHCARE, BUT STILL LACKING

Contrary to common assumptions, healthcare isn't necessarily empathetic. Mainstream thought in the 20th century viewed empathy as a "detached concern" within medicine, of purely intellectual form at best. Engagement with the patient's emotional needs is not necessarily viewed as a core aspect of care [3]. However, empathy in interactions with patients is increasingly seen as beneficial or even critical to the quality of care [26][25]. Patients also tend to appreciate doctors who demonstrate good empathetic skills, such as being interested in the patient's concerns, encouraging communication, and helping them with emotional problems [8].

As can be expected though, people cannot uniformly be capable of displaying empathy. The ways in which the empathy of medical students fluctuates during their years of training is a topic under constant investigation, and multiple studies find it to decline, especially during the phase of clinical training [13][12][11]. The possibility of individuals already starting from a low potential for empathy could be cause for worry as to what empathetic skills medical graduates might imbue their practice with. Things can potentially worsen as students transition into the workforce. They often enter overcrowded institutions, are exposed to experiencing depression and anxiety, and often find themselves in need of support [2]. The complexities of clinical practice tend to cause distress [4] and decrease empathy [19]. Given the importance of

empathy in the provision of healthcare, the topic of empathy training in healthcare trainees and personnel at all stages, is one of particular significance.

### 3 EXPERIENTIAL LEARNING SIMULATIONS CAN TRAIN EMPATHY FOR DISABILITY

Experiential modes of learning have shown hopeful promise in increasing empathetic ability [5]. In experiential learning, learners are not restricted to a passive role, but processes exist where learners are directly involved in the experience and reflect on it. Simulations can provide a pathway for experiential learning to occur. In the context of disability however, certain designs that disable participants have been criticized for focusing on negative experiences, and what people cannot do, rather than simulating a functional disability experience[6]. Unintentionally, they increase the perception of otherness in the disabled, and charge interactions with the disabled with feelings of anxiety and threat [6][24].

On the other hand, simulations can be used to explore the unique demands that disability places on the realm of experience, and responses to those demands. Such simulations allow reflection on the experience, demonstrate the relationships between the environment and individual, enable the participant to accept and see disability with compassion, and support positive change of attitudes [7].

### 4 SIMULATIONS OF DISABILITY IGNORE ITS SOCIAL DIMENSION

Promising as simulations of disability may be for teaching empathy, scenarios of disability tend to focus on personal deficits (impairments), ignoring the picture of disability in social settings, where disability becomes an impairment by way of social construction, through such mechanisms as lack of opportunity, and discrimination[14]. Such social attitudes can become more limiting than physical impairments [18].

However, experiential simulations that do explore disability in society, can provide insight into disability, not presented simply as a private affair, but allow the participant to become aware of social dimensions like bias, stereotyping, labeling, and interaction strain [1]. Even briefly enacted, these experiences allow the participant to learn more about themselves and the social construction of disability, and “truly gain some insight about what it means to live in society with a disability rather than simply to live in one’s physical environment with a disability”

### 5 A VISUO-TACTILE VR WHEELCHAIR EXPERIENCE AS A TOOL FOR TEACHING EMPATHY

Virtual Reality (VR) can be a medium for experiential learning scenarios [9], where empathy can be fostered and inspired[23]. This makes VR a promising tool for exploring scenarios that involve disability [20]. Embodiment is an important design element in VR experiences that target empathy [22]. According to Kilteni et al[15], the Sense Of Embodiment has an underlying structure consisting of three sub-components: sense of self-location (SoS), sense of agency

(SoA), and sense of body ownership (SoB). SoB increases by degrees of sensory correlations, between biological movement and perceived stimulation on an avatar’s body, through visuo-tactile sensory correlations.

The question of whether there are gains from exposing healthcare students to social barriers that result from disability, for the purpose of teaching empathy, by means of a visuo-tactile VR wheelchair experience has not been investigated. Our particular purpose is to examine how a sense of disabled agency, through visuo-tactile disabled embodiment, in settings with social barriers within a VR/wheelchair experience, affects Dutch healthcare students’ empathy. The question to answer is: What are the effects of disabled visuo-tactile embodiment, compared to disabled non-visuo-tactile embodiment, on empathy for disabled people, from a Dutch non-handicapped healthcare student’s point of view?

We base the effort on the following hypotheses:

- (1) The Sense of Embodiment has a positive effect on empathy within VR.
- (2) Higher sense of agency decreases personal distress.
- (3) Tactile feedback correlated with visuals positively affect the sense of presence.
- (4) Higher sense of presence correlates with higher empathy levels.

#### 5.1 Materials

In scenarios of disability that involve the use of a wheelchair, using the wheelchair as the actual controller for navigating the VR environment can be a powerful agent of embodiment. The primary stimuli considers a VR wheelchair experience, inspired by Hao[10]. Additional stimuli will be provided by means of controllers, to allow for tactile feedback in relation to visuals. The wheelchair will be lifted from the ground, to allow rotation of the wheels without moving in physical space, and rotary encoders placed on the wheels will translate wheel rotation into movement within VR. Head Movement is tracked, to change the VR viewport accordingly.

Social constraints are simulated based on the conditions by Pivik et al. [21] and Barney[1]. These will include The attitudinal barriers, such as comments an interactions from virtual people, exemplifying attitudes [1] like:

- (1) interaction strain
- (2) rejection of intimacy
- (3) generalized rejection authoritarian benevolence

#### 5.2 Method

We plan to conduct a randomized, between-subject research design, to evaluate disabled agency effects in VR. The independent variable will be the visuo-tactile interaction scenario. Two mediated conditions will differentiate the degree of agency. In one condition, visuo-tactile correlations will be present, allowing interaction with the environment and giving greater independence to the user. In the other condition, visuo-tactile correlations are absent, causing dependency only on the social environment, emphasizing social constraints and barriers. The dependent variables are Empathy, Sense Of Embodiment, and its sub-components (SoS, SoA, and SoB).

We will enlist participants from students in healthcare studies in Groningen, the Netherlands. Initially, levels of empathy will be evaluated through a chosen questionnaire (such as the Empathy Quotient[17]). After randomized exposure to stimuli (visuo-tactile or non visuo-tactile) surveys will be conducted to measure SoE, and how the students' empathy was impacted. Although empathy measures have been criticised in literature over time, but reliability and validity have been justified.

## 6 CONCLUSION

Studies exploring effects of disabled embodiment in social settings within VR are scarce. Investigations of the effect on empathy of a disabled visuo-tactile embodiment in a disabled sense of agency resulting from social barriers, have not been conducted. Filling this gap can be potentially useful in the development of XR-based experiential learning materials that can enrich the curricula of studies that aim to train healthcare professionals.

In this position paper we have laid out the problem and attempted to chart an initial experimental course of action, that might still need to be iterated on. We invite participants to the Cross Reality Workshop to offer their reflections and helpful criticism regarding the above, especially with regard to overlooked aspects and pitfalls of the approach.

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