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# ARTICLE INFORMATION

**Title**

**WheelSimPhysio-2023 dataset: physiological and questionnaire-based dataset of immersive multisensory wheelchair simulator from 60 participants**

*The article title must include the word ‘data’ or ‘dataset’.*

**Authors**

**Debora P. Salgadoa,b,\*, Eduardo L. M. Navesb, Yansong Qiaoa, Sheila Fallon, PhDa**

*Please list all authors (first name(s) - last name) and mark the corresponding author with \*.*

**Affiliations**

**a Technological University of the Shannon Midlands Midwest – Athlone Campus, Athlone, Ireland**

**b Federal University of Uberlandia, Uberlandia, Brazil**

*Please include the full postal address of each author’s institution.*

**Corresponding author’s email address and Twitter handle**

**Email:** [**d.psalgado@reserch.ait.ie/A00257244@student.tus.ie**](mailto:d.psalgado@reserch.ait.ie/A00257244@student.tus.ie)

**Twitter: @deborasal**

*Please use your institutional email address. If you have one, please also add your Twitter handle here.*

**Keywords**

**HRV; EDA; EEG; Blinks; Cognitive Load; Arousal; XR; Assistive Technology**

*Include 4-8 keywords, separated by semi-colons. Please do not repeat words used in your title.*

**Abstract**

*The abstract should be 100 to 500 words long and describe the data collection process, the dataset, and its reuse potential. It should not provide conclusions or interpretations.*

This data paper presents a unique multimodal dataset collected from a comprehensive study using a wheelchair training simulator. The study was designed to compare user experiences and performance under two distinct display conditions: a conventional monitor display and a virtual reality (VR) headset. Participants engaged in a series of navigational tasks in a simulated environment, first using the standard display and then the VR headset. It was collected data from total of 58 participants.

The dataset includes physiological data - Heart Rate Variability (HRV), Electrodermal Activity (EDA), Acceleration (ACC), Skin Temperature, Heart Rate (HR), and Blood Volume Pulse (BVP) - collected during both experiments. Additionally, for the standard display condition, more detailed data comprising Electroencephalography (EEG) and eye-tracking metrics were recorded to provide insights into cognitive load and visual attention patterns.

System metrics captured from the simulator provide an objective performance report, including task completion times, error rates, and navigation efficiency. This is complemented by post-experiment questionnaires, which gathered subjective responses on user experience, perceived difficulty, and simulator sickness symptoms.

This dataset is valuable for researchers and practitioners in the fields of assistive technology, human-computer interaction, and rehabilitation. It offers a comprehensive view of how different display technologies influence the user experience in wheelchair simulation training. The data allows for in-depth analysis of physiological responses, cognitive engagement, and subjective perceptions, providing a foundation for future research on effective wheelchair training methodologies and the potential benefits of VR in rehabilitation settings.

# SPECIFICATIONS TABLE

|  |  |
| --- | --- |
| **Subject** | Human-Computer Interaction  Neuroscience: Cognitive  *Please select a subject area from the list available at* [*DIB* categories](https://www.elsevier.com/__data/assets/excel_doc/0012/736977/DIB-categories.xlsx). |
| **Specific subject area** | User’s Quality of Experience Evaluation, Virtual Reality for wheelchair training, Physiological data (HRV, EDA, Eye-tracking, EEG, Head-pose), Performance Report (Number of commands, collisions and time completions), Post-Experience Assessments (IPQ, SUS, SAM, NASA-TLX, SSQ).  *Briefly describe the specific subject area. Max 150 characters (without spaces).* |
| **Type of data** | *Please list your type(s) of data and data formats. Delete any description from the lists that does not apply. If your data type is not featured, please manually add it.*  Raw Data:   * Physiological Data: .csv * Synchronized Data (EEG and Simulator): .xdf and .csv * Simulator (Performance Report): .txt and .csv * Metadata: .txt * Questionnaires: .csv   Processed/Filtered Data:   * Physiological Data: .csv * Synchronized Data: .csv and .json * Questionnaires: .csv * Metadata: .json |
| **Data collection** | *Briefly describe how the data were collected. Please provide information on instruments you used (e.g., microscope, mass spectrometry, specific hardware or software etc., including relevant make/model details) as well as on methods used for collecting data or inclusion/exclusion criteria. You may also describe how the data were normalized. In case of questionnaires, please briefly describe the sources used to derive the question items. Max 600 characters (without spaces).*  It was conducted two types of experiments with the simulator:  First experiment was collected data from 24 participants in single trial each (breaking into three phases, baseline (resting), test, post-experience assessment (answering the questionnaires).  Second experiment, fully immersive using VR-headsets, |
| **Data source location** | *Please mention where the data were collected (e.g.  geographical coordinates) or where the data are stored (typically your affiliation).*  Institution: Technological University of The Shannon (Previously named Athlone Technology Institution)  City/Town/Region: Athlone, Co. Westmeath  Country: Ireland |
| **Data accessibility** | ***Please note:*** *All raw data referred to in this article must be made publicly available in a data repository prior to publication. Please indicate here where your data are hosted (the URL must be working at the time of submission and editors and reviewers must have anonymous access to the repository):*  Repository name: WheelSimPhysio dataset  Data identification number: *(or DOI or persistent identifier)*  Direct URL to data:  Instructions for accessing these data: |
| **Related research article** | *If your manuscript supports a related research article, please cite this article here. If your manuscript is not related to a research article, please delete this entire row. You should* ***list only one article here****. Please upload a copy of your related research article to your submission.*  Experiment 1:  Experiment 2:  Both Experiments: |

# VALUE OF THE DATA

*This section states why these data are of value to the scientific community. Please* ***provide between 3 and 6 bullet points*** *and answer at least the questions below (delete the questions afterwards). Each bullet point should be a maximum of 150 words long, and should not include conclusions or inferences:*

* Why are these data valuable?
* How can these data be reused by other researchers?
* **Comprehensive Understanding of User Experience:** The data is of interest to researchers who are conduction research combing VR with psycho-physiological data. The dataset provides a holistic view of how users interact with and respond to the VR environment, integrating objective performance metrics with subjective perceptions and physiological responses. This comprehensive approach offers deeper insights than any single data type could provide on its own.
* **Advancement in VR Technology and Application:** The findings from such a dataset can inform the development of more immersive, user-friendly, and effective wheelchair training simulation and other VR-simulator systems. It can lead to improvements in VR/Simulation design, usability, and functionality, benefiting industries such as gaming, education, healthcare, and training simulations.
* **Contribution to Multidisciplinary Research:** The dataset is valuable for researchers across various fields, including psychology, human-computer interaction, ergonomics, and neuroscience. It offers a rich source of information for studies on human behavior, cognition, emotional response, and physiological reactions in simulated environments.
* **Innovation in Methodology:** The dataset demonstrates the effectiveness of using multimodal approaches in research, showcasing how different types of data can be integrated to provide a more nuanced understanding of complex phenomena.
* **Insights into Human-Computer Interaction:** The data provides valuable insights into how humans interact with digital environments, which is crucial for the design of future technologies. Understanding these interactions helps in creating more intuitive and natural user interfaces.
* **Potential for Personalization and Adaptive Systems:** By understanding the varied responses of users to VR environments, developers and researchers can create adaptive VR systems that adjust to individual users’ needs and preferences, enhancing the overall experience and effectiveness of VR applications.

# BACKGROUND

*Please describe your original motivation and context behind compiling this dataset. For example, briefly include information on the theoretical or methodological background against which you generated the data. Do not make concluding, interpretive, or otherwise inferential statements about the dataset. In case your data article is related to an original research article, please briefly describe how the data article adds value to the published article (Max. 200 words).*

In compiling this dataset, our primary motivation was to explore the effectiveness and user response to different display modalities in wheelchair training simulators, a tool increasingly used in rehabilitation and assistive technology. The theoretical backdrop of this study is grounded in the principles of human-computer interaction and the psychology of learning and adaptation in simulated environments. Wheelchair training simulators offer a safe, controlled setting for skill development, but the impact of display technology on user experience and learning outcomes is not thoroughly understood.

By comparing traditional monitor displays with immersive VR headsets, we sought to generate data that could elucidate differences in physiological responses, cognitive load, and user engagement between these modalities. The inclusion of physiological measures (HRV, EDA, ACC, Temperature, HR, BVP), EEG, and eye-tracking in the first experiment, and system performance metrics and post-experience questionnaires in both, provides a comprehensive, multimodal view of the user experience.

This dataset complements an original research article that focused on the behavioral outcomes of these modalities in wheelchair training. The data article extends the value of our research by offering a granular view of the physiological and cognitive underpinnings of these outcomes, thereby providing a resource for further research in this evolving field.

# DATA DESCRIPTION

*This section describes your dataset. Refer to all the data folders, subfolders, and files in the repository individually, irrespective of whether they relate to raw or analyzed data, and make sure that the reader can follow the structure of your dataset.*

*Please use visual aids (such as tables, graphs, or figures with captions) to familiarize the reader with your dataset, but* ***do not offer background, interpretations, or conclusions****.*

# EXPERIMENTAL DESIGN, MATERIALS AND METHODS

*This section describes how you acquired the data. Provide a complete description of the experimental design and methods used to acquire these data. For example, include all code (files) and software used for data analysis or data generation, and describe tools, instruments, and experimental conditions.*

*It is important that this section is as comprehensive as possible. There is no character limit, and you may use illustrative figures or tables; however, please* ***do not offer background, interpretations, or conclusions****.*

# LIMITATIONS

*Describe any limitations related to the data described in this article. These could be any problems you faced during data collection or curation, limited quality or size of dataset, data biases, etc., but* ***should not include limitations of analysis conducted or interpretation*** *(Max. 200 words).*

*If there are none, please write ‘None’ or ‘Not applicable’.*

When discussing the limitations of the data described in the wheelchair training simulator study, several key points need to be considered:

1. \*\*Sample Size and Diversity:\*\* The representativeness of the data may be limited if the sample size was small or lacked diversity in terms of age, gender, disability type, and prior experience with wheelchairs and VR technology. This limitation could affect the generalizability of the findings.

2. \*\*Equipment and Technology Specificity:\*\* The data is derived from specific types of VR headsets and wheelchair simulators. Different equipment or newer technology might yield different results, limiting the applicability of the data to only similar setups.

3. \*\*Physiological Data Complexity:\*\* The interpretation of physiological data such as HRV, EDA, and EEG can be complex and influenced by numerous extraneous factors beyond the scope of the experiment, such as individual differences in stress responses or ambient conditions during testing.

4. \*\*VR-Induced Symptoms:\*\* Some participants might have experienced discomfort or simulator sickness due to the VR headset, which could have influenced their performance and physiological responses, thereby introducing a confounding variable.

5. \*\*Eye-Tracking and EEG Data Limitations:\*\* These measures were only collected for the standard display condition. The absence of these data in the VR condition limits the ability to directly compare cognitive load and visual attention across both display modalities.

6. \*\*Subjective Data Subjectivity:\*\* The responses to post-experiment questionnaires are subjective and can be influenced by individual differences in perception, memory recall, and the ability to articulate experiences, which might not accurately reflect the actual experience or performance.

These limitations should be taken into account when interpreting the data and considering its implications. They also provide directions for future research to address these gaps and enhance the understanding of the use of VR in wheelchair training.

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*Data in Brief’s* [*Guide for Authors*](https://www.elsevier.com/journals/data-in-brief/2352-3409/guide-for-authors) *contains detailed information on the ethical guidelines with which all authors must comply. In addition, we ask you to complete the relevant statement(s) below. Please delete those which are not relevant for your data.*

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***Please also make sure to cite your dataset in the data repository.***