



VR & AR-basierte neuropsychologische Forschung

HFDT Symposium 2025

24. Juni 2025, Lisa Berger (lisa.berger@uni-graz.at)



Über mich...



○ (Neuro-)Psychologin

○ XR-Enthusiastin

○ Haupt-Forschungsthemen

VR & AR im Bereich Neuropsychologie
& Neurofeedback, Cybersickness, User
Experience, Neurotechnologien
(STOA-Study & MemorAI-Projekt)

○ Doktorats-Thema:

“Advances in Augmented and Virtual
Reality-based Neurofeedback”



Relevance of Cognition and Emotion for Patient-Reported Quality of Life After Stroke in Working Age: An Observational Cohort Study

Daniela Pinter^{1,2*}, Simon Fandler-Höfler², Viktoria Fruhwirth^{1,2}, Lisa Berger^{1,2}, Gerhard Bachmaier³, Susanna Horner², Sebastian Eppinger², Markus Knehl², Christian Enzinger^{1,2,4} and Thomas Gatteringer^{2,4}

¹ Department of Neurology, Research Unit for Neuronal Plasticity and Repair, Medical University of Graz, Graz, Austria, ² Department of Neurology, Medical University of Graz, Graz, Austria, ³ Institute for Medical Informatics, Statistics and Documentation, Medical University of Graz, Graz, Austria, ⁴ Division of Neuroradiology, Department of Radiology, Vascular and Interventional Radiology, Medical University of Graz, Graz, Austria

Literature Review

Article

Full-text available

Controlling Virtual Reality With Brain Signals: Sex Differences in User Experience in a VR-Based Feedback in Neurofeedback Applications

November 2024 · [Applied Psychophysiology and Biofeedback](#)

DOI: [10.1007/s10484-024-09677-8](#)

License · [CC BY 4.0](#)

Silvia Erika Kober · Guilherme M de O. Wood · Lisa M. Berger



Think Tank
European Parliament

Home Research Events Infographics Sources Partners Audio podcasts

Research / Advanced search / The protection of mental privacy in the area of neuroscience - Societal, legal and ethical challenges

PAPER

Manipulating cybersickness in virtual reality-based neurofeedback and its effects on training performance

Lisa M Berger^{*}, Guilherme Wood¹ and Silvia E Kober²

Department of Psychology, University of Graz, Graz, Austria
^{*} Author to whom any correspondence should be addressed.

E-mail: lisa.berger@uni-graz.at

Keywords: virtual reality, cybersickness, neurofeedback, heart rate

Supplementary material for this article is available [online](#)

Article

Full-text available

Evaluation of a Newly Developed Smartphone Risk Factor Management in Young Patients Ischemic Stroke: A Pilot Study

January 2022 · [Frontiers in Neurology](#) 12

DOI: [10.3389/fneur.2021.791545](#)

License · [CC BY 4.0](#)

Viktoria Fruhwirth · Lisa M. Berger · Thomas Gatteringer · Daniela Pinter (née Gebauer)

Sex Differences in User Experience in a VR-Based Neurofeedback Paradigm

November 2021 · [Lecture Notes in Computer Science](#)

DOI: [10.1007/978-3-030-92182-8_11](#)

In book: Games and Learning Alliance

Lisa M. Berger · Guilherme M de O. Wood · Christa Neuberger

The protection of mental privacy in the area of neuroscience - Societal, legal and ethical challenges

Study - 24-07-2024

Brauchen wir die NRF-Neurorechte?

Lisa Berger · Petra Zandonella · Elisabeth Staudegger

Rechtsgebiete:
IP-Recht

Sammlung:
Tagungsband IRIS 2024

Zitiervorschlag: Lisa Berger / Petra Zandonella / Elisabeth Staudegger, Brauchen wir die NRF-Neurorechte?, in: Jusletter IT 24. April 2024

Influence of a placebo tDCS treatment on cybersickness and EEG-neurofeedback success

Lisa Maria Berger^a, Guilherme Wood^{a b}, Silvia Erika Kober^{a b}

Show more

+ Add to Mendeley Share Cite

<https://doi.org/10.1016/j.jbbr.2024.114917>

Get rights and content

Und

Open access

Article

Full-text available

Effects of virtual reality-based feedback on neurofeedback training performance—A sham-controlled study

August 2022 · [Frontiers in Human Neuroscience](#) 16:952261

DOI: [10.3389/fnhum.2022.952261](#)

License · [CC BY 4.0](#)

Lisa M. Berger · Guilherme M de O. Wood · Silvia Erika Kober

le

Full-text available

User Experience in Neurofeedback Applications Using AR as Feedback Modality

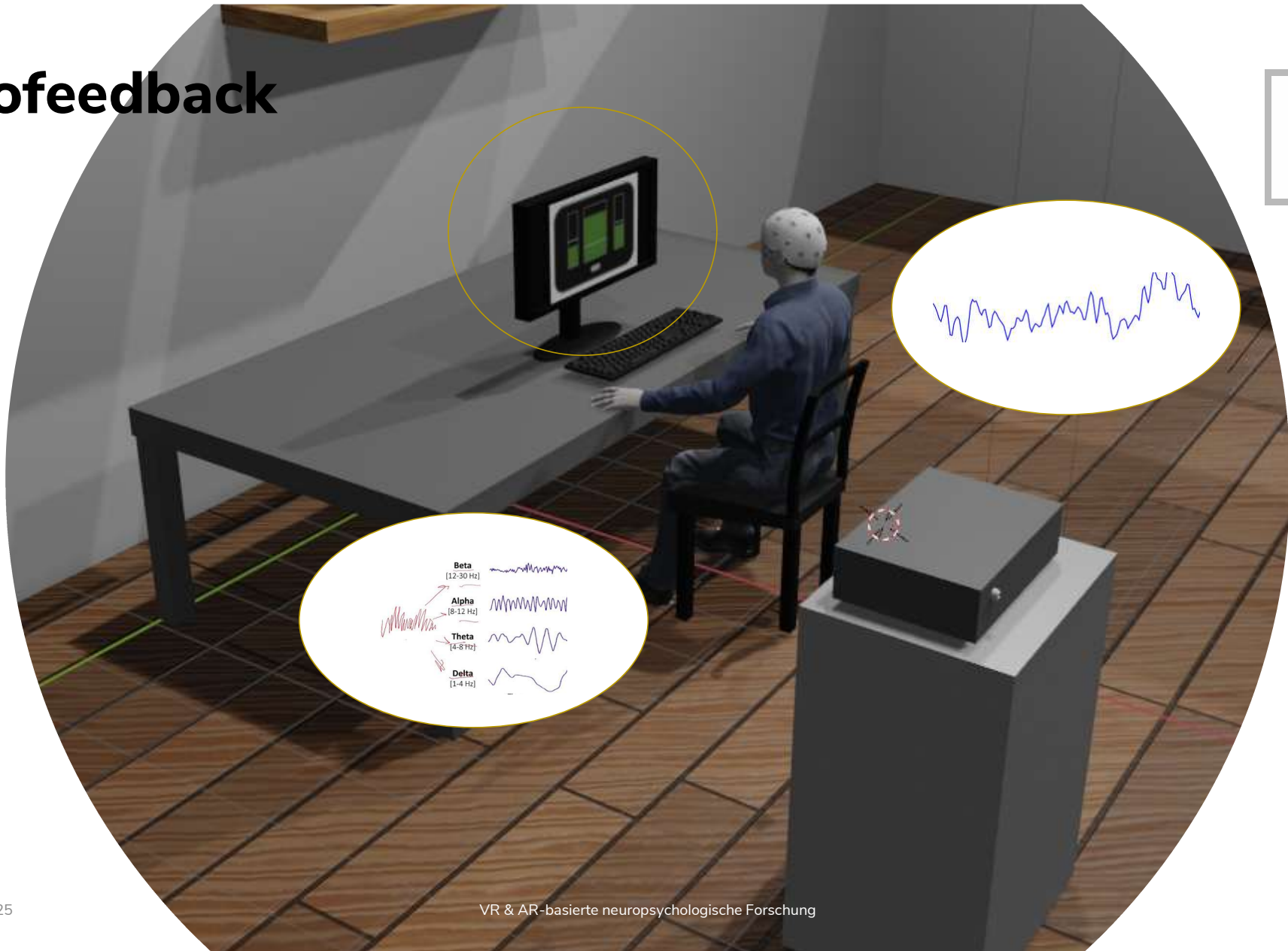
April 2024 · [Computers](#) 13(5):110

DOI: [10.3390/computers13050110](#)

License · [CC BY 4.0](#)

Lisa M. Berger · Guilherme M de O. Wood · Silvia Erika Kober

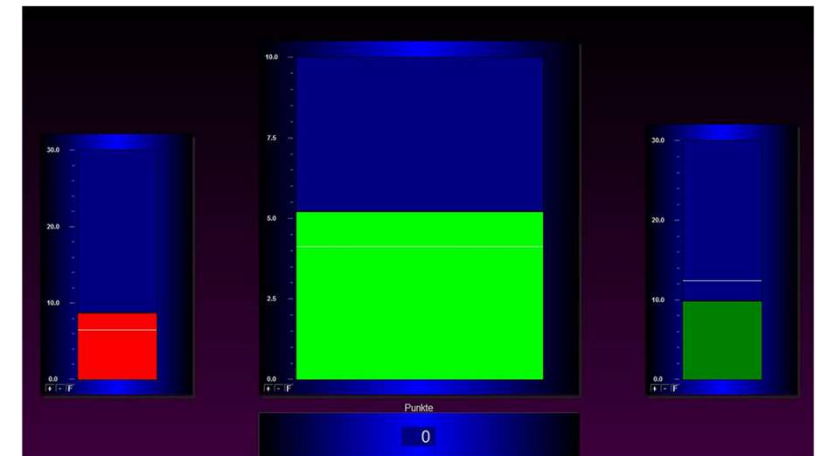
Neurofeedback



Neurofeedback (Marzbani et al., 2016)



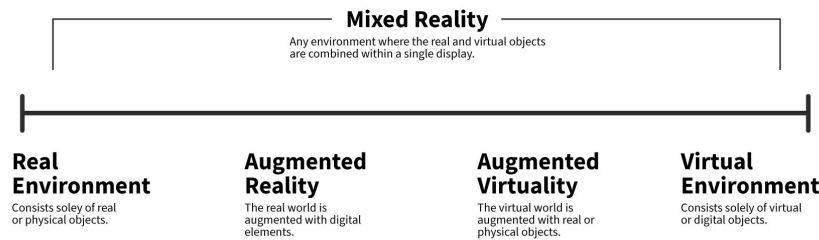
- Hirnaktivität normalisieren
 - ADHS
 - Schlaganfall
 - Multiple Sklerose
- Hirnaktivität bei Gesunden verbessern (“Neuroenhancement”)
- 30% der Nutzer:innen “non-responder” (Thompson, 2018)
- Traditionelle Paradigmen eher langweilig (Kober et al., 2024)



Virtual vs. Augmented Reality (VR & AR)



Mixed Reality



Reality – Virtuality Continuum

(Milgram & Kishino 1994; Skarbez et al., 2021)

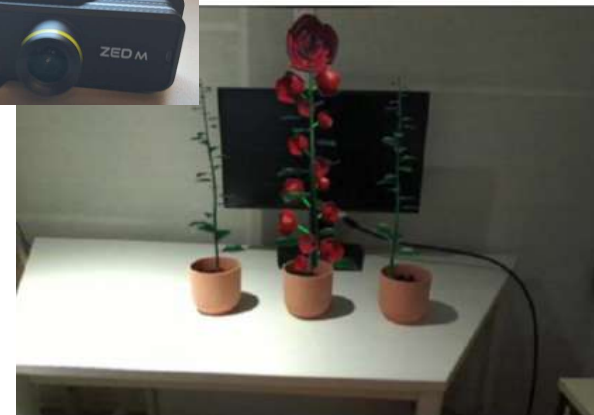
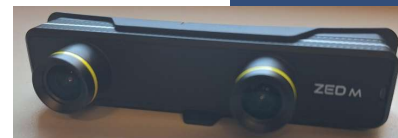
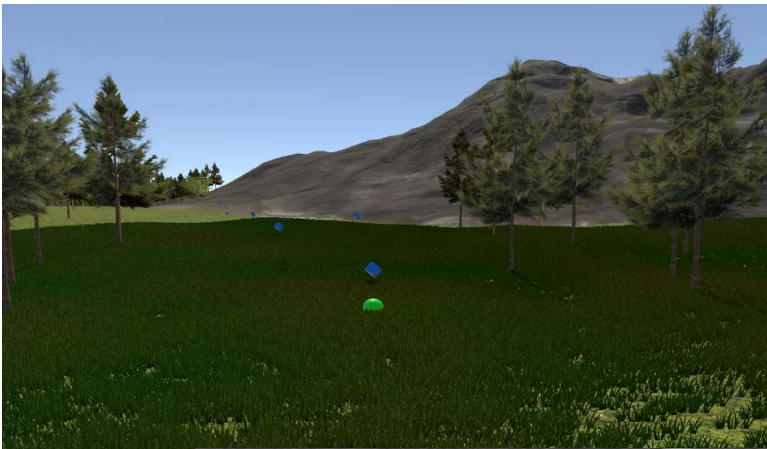
Unterschiedliche Teile eines Kontinuums





- VR & AR fesselnde Möglichkeit um Hirnaktivität rückzumelden
- Höhere Trainingsmotivation bei Schlaganfall-Patient:innen (Kober et al., 2016)
- AR fesselnder als traditionelle Trainingsparadigmen (Mercier-Ganady et al., 2014)

Neurofeedback & VR/AR



Überblick (Berger et al., 2024a, 2024b & 2025)



- VR-Feedback führt zu besserer Neurofeedback-Leistung als 2D Feedback (Berger et al., 2022)
- Cybersickness kann Nutzererfahrung negativ beeinflussen, v.a. Frauen sind betroffen
- Cybersickness sollte kontrolliert werden in VR-basierten Neurofeedback-Trainings
 - Placebo funktioniert nicht gut
 - Einstellungen in VR anpassen
- AR hat positiven Einfluss auf Nutzererfahrung

Noch nicht alles...



- Virtuelle Realität bei Personen mit funktionellem Tremor
- Virtuelles bouldern
- AI-gestützte virtuelle Avatare



Anything capable of being imagined will one day be made reality.
- Jules Verne



Referenzen



- Berger, L. M., Wood, G., Neuper, C., & Kober, S. E. (2021). Sex Differences in User Experience in a VR EEG Neurofeedback Paradigm. In F. de Rosa, I. Marfisi Schottman, J. Baalsrud Hauge, F. Bellotti, P. Dondio, & M. Romero (Eds.), *Games and Learning Alliance* (pp. 111–120). Springer International Publishing.
- Berger, L. M., Wood, G., & Kober, S. E. (2022). Effects of virtual reality-based feedback on neurofeedback training performance—A sham-controlled study. *Frontiers in Human Neuroscience*, 16, 952261.
- Berger, L. M., Wood, G., & Kober, S. E. (2024). Influence of a placebo tDCS treatment on cybersickness and EEG-neurofeedback success. *Behavioural Brain Research*, 465, 114917. doi: 10.1016/j.bbr.2024.114917
- Berger, L. M., Wood, G., & Kober, S. E. (2025). Manipulating cybersickness in virtual reality-based neurofeedback and its effects on training performance. *Journal of Neural Engineering*. doi: 10.1088/1741-2552/adbd76
- Berger, L. M., Wood, G., & Kober, S. E. (2024). User Experience in Neurofeedback Applications Using AR as Feedback Modality. *Computers*, 13(5), 110. doi: <http://dx.doi.org/10.3390/computers13050110>
- Kober, S. E., Reichert, J. L., Schweiger, D., Neuper, C., & Wood, G. (2016). Effects of a 3D Virtual Reality Neurofeedback Scenario on User Experience and Performance in Stroke Patients. In R. Bottino, J. Jeuring, & R. C. Veltkamp (Eds.), *Games and Learning Alliance* (pp. 83–94). Springer International Publishing.
- Kober, S. E., Wood, G., & Berger, L. M. (2024). Controlling Virtual Reality With Brain Signals: State of the Art of Using VR-Based Feedback in Neurofeedback Applications. *Applied Psychophysiology and Biofeedback*. Advance online publication. <https://doi.org/10.1007/s10484-024-09677-8>

Referenzen



- Marzbani, H., Marateb, H. R., & Mansourian, M. (2016). Neurofeedback: A Comprehensive Review on System Design, Methodology and Clinical Applications. *Basic and Clinical Neuroscience*, 7(2), 143–158. <https://doi.org/10.15412/J.BCN.03070208>
- Mercier-Ganady, J., Lotte, F., Loup-Escande, E., Marchal, M., & Lecuyer, A. (2014). The Mind-Mirror: See your brain in action in your head using EEG and augmented reality. In *2014 IEEE Virtual Reality (VR)* (pp. 33–38). IEEE. <https://doi.org/10.1109/VR.2014.6802047>
- Milgram, P., & Kishino, F. (1994). A Taxonomy of Mixed Reality Visual Displays. *IEICE Transactions on Information and Systems*, 77, 1321–1329. <https://api.semanticscholar.org/CorpusID:17783728>
- Skarbez, R., Smith, M., & Whitton, M. C. (2021). Revisiting Milgram and Kishino's Reality-Virtuality Continuum. *Frontiers in Virtual Reality*, 2, Article 647997, 1–8. <https://doi.org/10.3389/frvir.2021.647997>
- Thompson, M. C. (2019). Critiquing the Concept of BCI Illiteracy. *Science and Engineering Ethics*, 25(4), 1217–1233. <https://doi.org/10.1007/s11948-018-0061-1>