

**MUNI**

# **Using immersive virtual reality in human sciences**

Kognice a umělý život 2018

**Mgr. Michal Sedlák, Ph.D.** candidate

Department of Psychology, Masaryk University in Brno

# Theory of immersive VR

# Virtual reality

- It is a computer-generated environment that can stimulate human senses

Non-immersive VR (non-iVR)



[1]

Immersive VR (iVR)



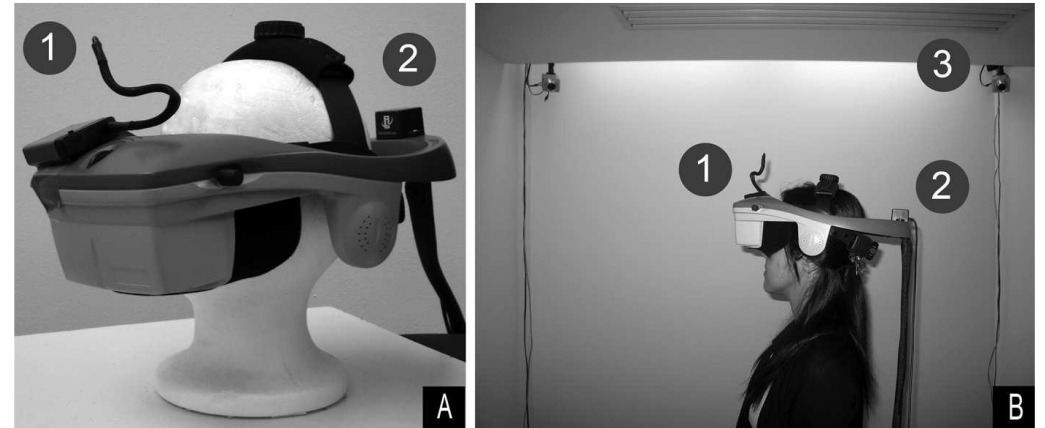
[2]

# Virtual reality in general

- Computer-generated environment
- Stimulates human senses
- Creates an impression of presence in a certain environment
- Offers human experience

Human experience [4] – Real experience  
– Hallucination  
– Virtual experience

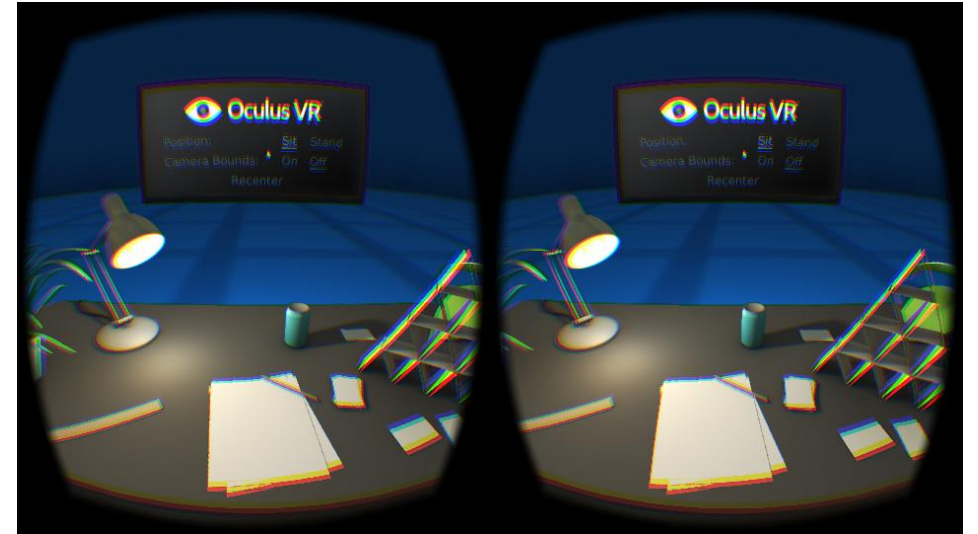
- 1992 – The idea of treating psychological problems with VR [5]



[3]

# Virtual environment

- Image displaying
  - Plus audio reproduction, etc.
- User motion capture
  - Keyboard and mouse
  - Headset
  - Controllers
  - Treadmill
- Displayed
  - Basic elements of the environment
  - Human characters [7]
    - Avatar
    - Embodied agent



[6]



[8]

# Important properties of immersive VR

- Interactivity
- 3D
  - Spatial depth perception
- 360°
  - Displaying
  - Motion



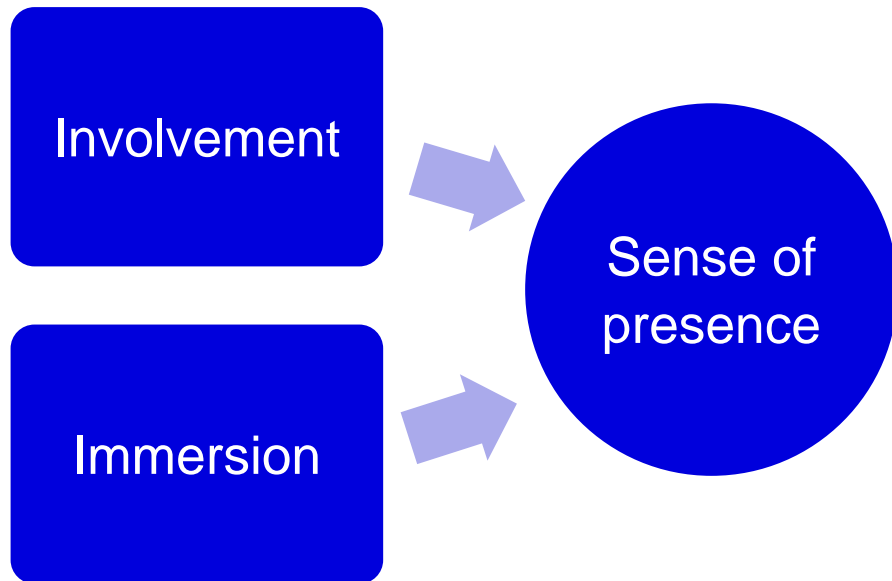
[9]



[10]

MUNI

# Psychological phenomena of immersive VR



## – **Personal presence**

- It is a sense that my avatar is an extended part of myself. I see my hand in the VR and I can move it.

## – **Environmental presence**

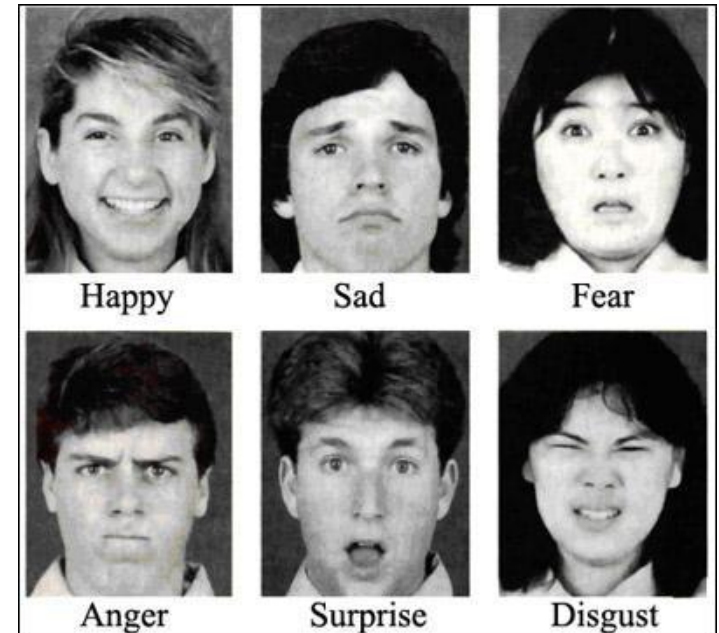
- It is a sense of being present in the virtual environment. Leaving tracks after walking, throwing shadow, moving objects.

## – **Social presence**

- It is a sense of sharing virtual environment with another person.

# VR and human sciences

- VR influences thoughts, emotions, & behavior
- The second "real world"
- Psychology of virtual reality
- Human responses
  - **Emotional** responses [13]
  - **Physiological** responses
    - Pressure, pulse, breathing, heat, cerebral activity, cortisol, ... [15]
    - *Cybersickness* [16,17]
  - **Behavioral** responses [3,18]



[14]



# Application of VR

- Game and experience use
- Therapeutic use
- Simulation use
- Training use
- Rehabilitation use
- Communication use
- **Relaxation** use (Research 1)
- **Educational** use (Research 2)



[19]

# Research 1

## Relaxation in VR

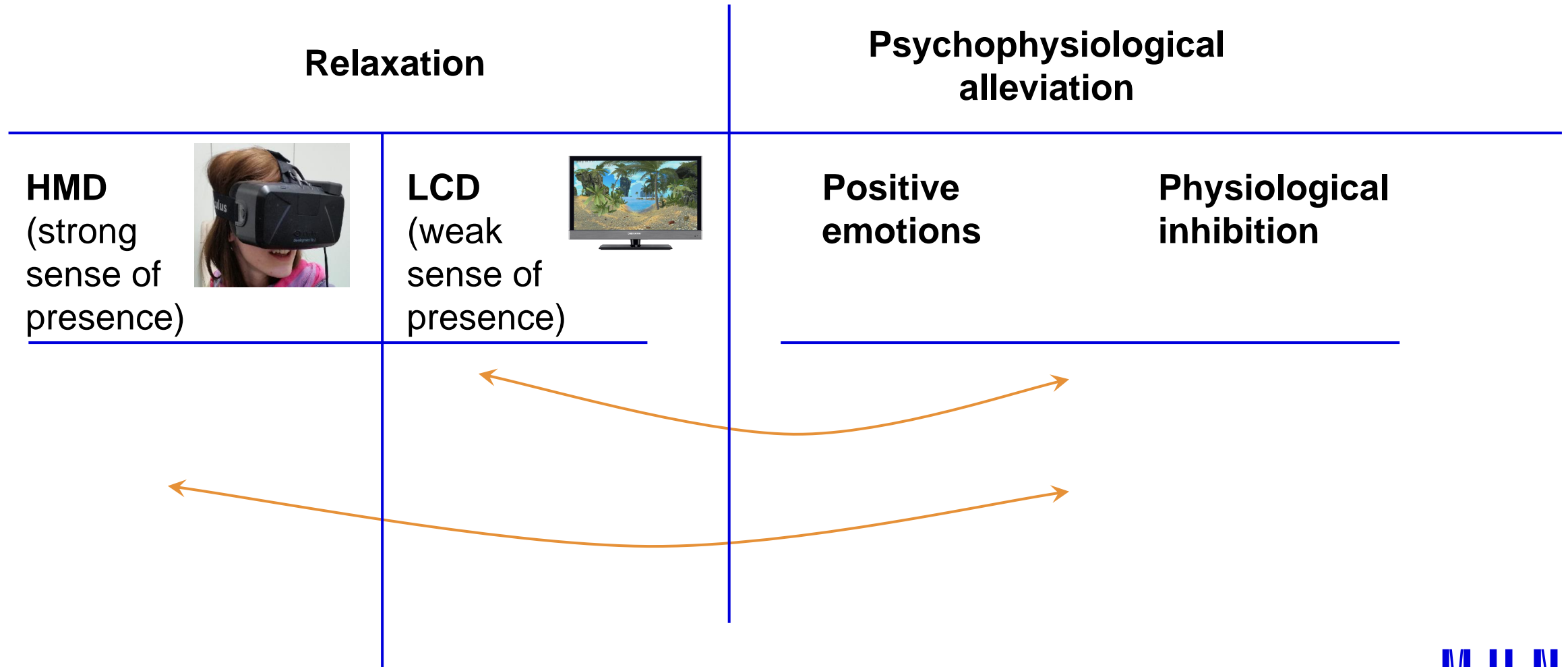


**Relaxation in immersive virtual reality**  
[between-subject experiment]

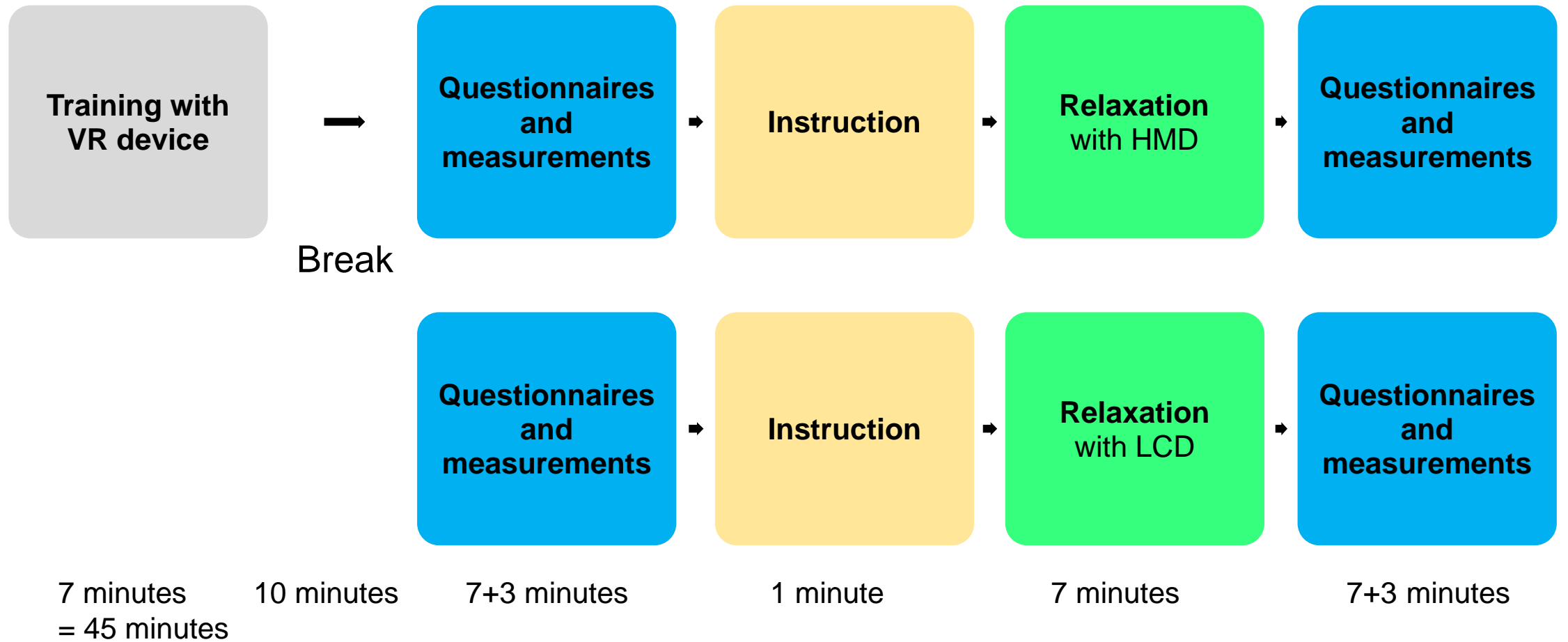
# Research goal

- In this research, we focused on the specific use of VR in psychology, and that is for **relaxation**, i.e., the induction of psychophysiological alleviation.
- The aim is to compare the effect of relaxation in immersive VR and non-immersive VR on psychophysiological alleviation. We compare the visualization of the relaxing scenery in the **HMD (head-mounted display)** with the **LCD display (liquid-crystal display)** and we monitor the effect on the degree of psychophysiological alleviation, on positive emotions and physiological inhibition.

# Independent and dependent variables



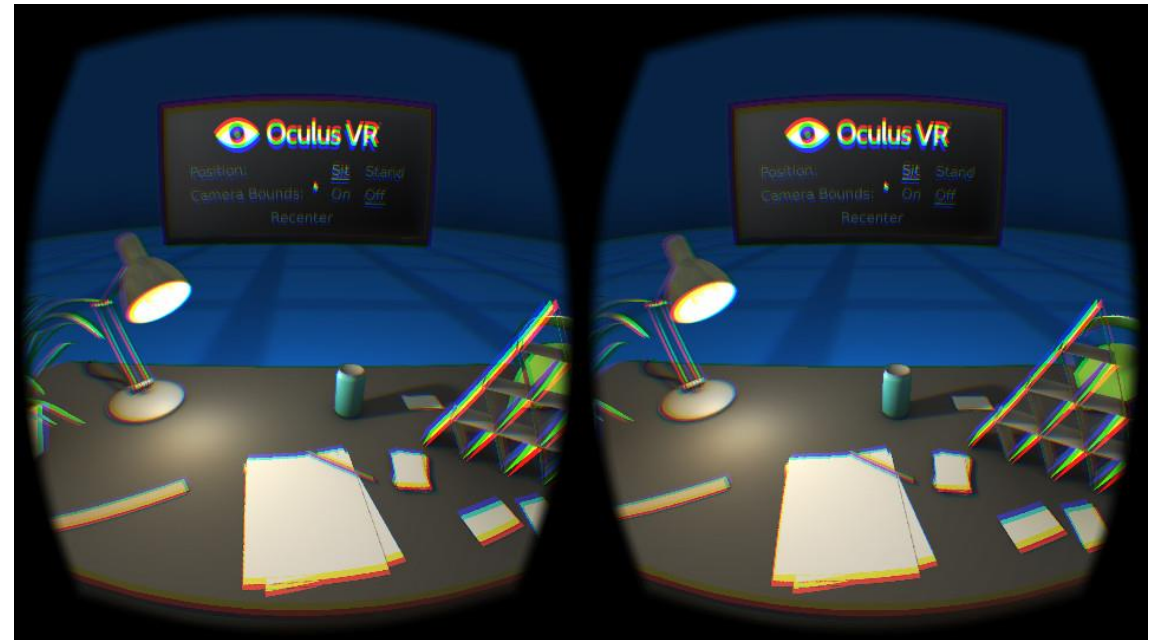
# Procedure



# Procedure

## Step 1 – Training with VR device

- Training with VR device comprises of presence in a neutral virtual environment in iVR.
- If the experience of working with new technology will have some effect (*novelty effect*), its impact as an intervening variable will be minimized by training.
- In addition, the sensitivity of the participant to the occurrence of *cybersickness* was assessed. If a participant would have felt nausea, he would be excluded from the research sample.



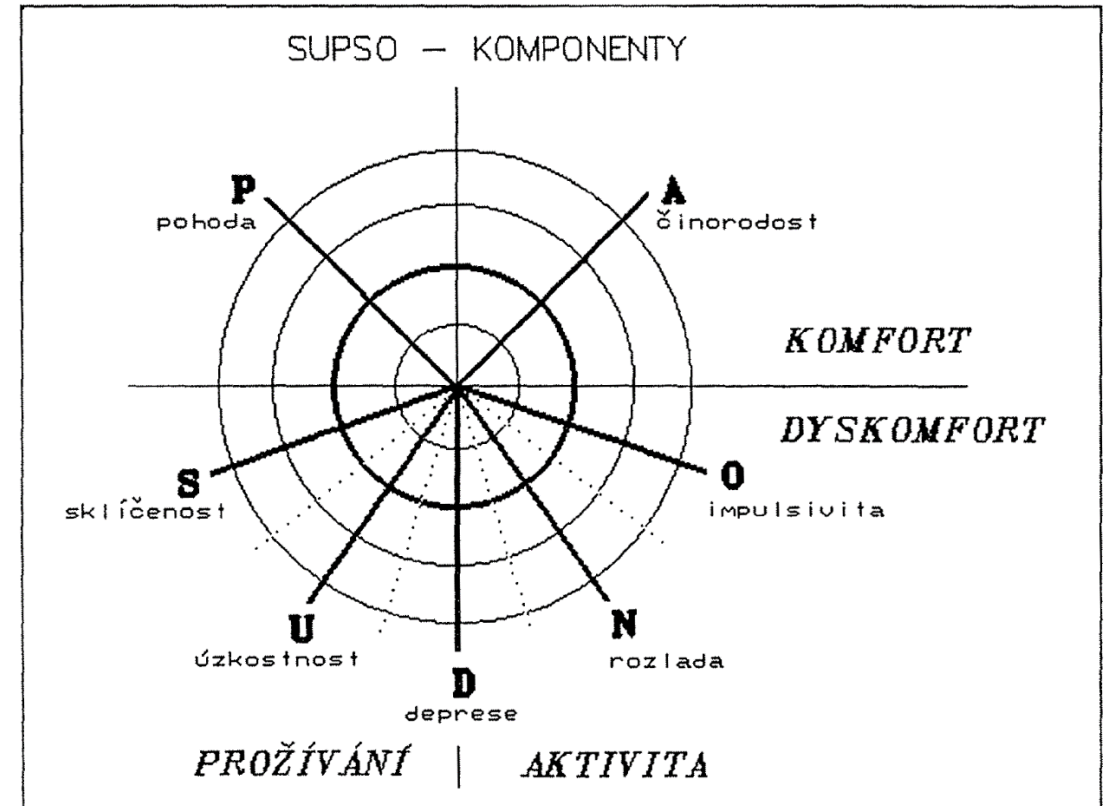
[6]

# Procedure

## Step 2 – Questionnaires and measurements (pretest)

### *Psychological questionnaires*

- **Postihování a hodnocení subjektivních prožitků a stavů (SUPSO)**
  - Allows the assessment and evaluation of current subjective experiences and states
- **State-Trait Anxiety Inventory (STAI)**
  - Allows the assessment and evaluation of anxiety as the current psychological state and its distinction from anxiety as a permanent personality trait



[20]



# Procedure

## Step 2 – Questionnaires and measurements (pretest)

### *Physiological measurements*

- **CNAP<sup>®</sup> Monitor 500**
  - Non-invasive continuous monitor of arterial blood pressure and heart rate
  - Using this monitor we recorded the mean blood pressure and heart rate of the participants
  - The obtained data served as an indicator of physiological alleviation, pointing to a degree of psychological alleviation



[21]

# Procedure

## Step 3 – Instruction

- Participants received instructions on how to behave in a virtual reality, what possibilities they have for interaction with the environment, and what options they have for viewing the virtual environment. The information about duration of relaxation session and instruction to relaxation was told to them.
- Subsequently, the headphones were put on the participant's head, the virtual reality headset was turned on (or the eye opening instruction for the non-immersive VR group) and the relaxation scenery was launched, including the accompanying narrative breathing exercise.

# Procedure

## Step 4 – Relaxation



VS.



# Procedure

## Step 5 – Questionnaires and measurements (posttest)

- The participants repeatedly filled out the same questionnaires as before relaxation session and they subjected to physiological measurements again.

T-264

**SUPSO**

Pohlaví: M - 2      datum a hodina vyplnění: \_\_\_\_\_  
 Jméno a příjmení: \_\_\_\_\_ datum narození: \_\_\_\_\_  
 Místnost: \_\_\_\_\_ skupina: \_\_\_\_\_

ZAZNAMENÁTE V KAŽDÉ KOLONCE STUPŇ PROŽITÍ ANI DANÉHO POCITU ČI STAVU:

OBYKLĚ       ZA OBDOBÍ .....       ZA POSLEDNÍCH 24 HODIN

	VĚCÍ NE	OBČAS (MÁM)	ZPRÁVĚLA (STRÁNE)	ČASTO (MĚ)	NEUSTÁNĚ NEJDE
SPROUDĚNÍ					
ENERGICKY					
NALADENÍ					
ROZMRZELÝ					
OSTRANĚNÍ					
NAPĚTÍ					
SMUTNOST					
SMĚL					
ČINOVNOST					
VYMRZENÍ					
NEPOURADNĚNÍ					
PERFIDNOST					
NEJISTY					
NEKONFORMNÍ					
DROBĚ NALADĚNÍ					
TEMPERAMENTNÍ					
VEŠKÉ NE OVLÁDNUTÍ					
NEKOMPROMISNÍ					
CHROBNÝ					
LÁSKAVĚ NALADĚNÍ					
PRACOVNĚ					
BLUDNÝ					
PROBĚH					
VĚRNÝ					
NEKONFORMNÍ					
VYČERPANÝ					
PRÁVNĚ ANI OPRÁVNĚNÝ					
ORANŽOVÝ					

NEVYPLŇUJTE: P A D N D U S BEMA      KJ      AP

BRANÝ MĚK  
 PROSTOR  
 VÁŽNÝ MĚK

© C. MAJL, 2004  
 © Psychologička, s.r.o., Brno, 2004  
 © Psychologička, s.r.o., Brno, 2004

[20]

**STAJ**  
X 1

Převzato a měno: \_\_\_\_\_ Věk: \_\_\_\_\_  
 Povolání: \_\_\_\_\_ Deníky číslo: \_\_\_\_\_

**INSTRUKCE**

Nikdy si neodpovězte na žádné otázky, které jsou vyžadovány v tomto testu. Prohlédněte si pozorně každý výrok a rozhodněte se, zda je pravda, nebo nepravda. Všechny výroky jsou pravdivé. Při každém výroku máte možnost:

**ANO SA CITTIE PRAVE TERAZ**

	Všech ne	Leze možno	Doře	Všech
1. Som šťastný, pokojný	1	2	3	4
2. Som bezstarostný	1	2	3	4
3. Som napjatý	1	2	3	4
4. Som veselý	1	2	3	4
5. Cítím se dobře	1	2	3	4
6. Som v pohodě	1	2	3	4
7. Bujím se nezapomínám	1	2	3	4
8. Cítím se spokojený	1	2	3	4
9. Mám pocit úlevy	1	2	3	4
10. Cítím se pohotově	1	2	3	4
11. Dívám se do	1	2	3	4
12. Som veselý	1	2	3	4
13. Som veselý	1	2	3	4
14. Cítím, že by som měl něco udělat	1	2	3	4
15. Som spokojený	1	2	3	4
16. Som spokojený	1	2	3	4
17. Mám veselý	1	2	3	4
18. Som pohotovější a cítím se „rychlejší a silnější“	1	2	3	4
19. Som šťastný	1	2	3	4
20. Cítím se připravený	1	2	3	4

© Psychologička a diagnostička 1997, s. p., Bratislava, 1997

[22]

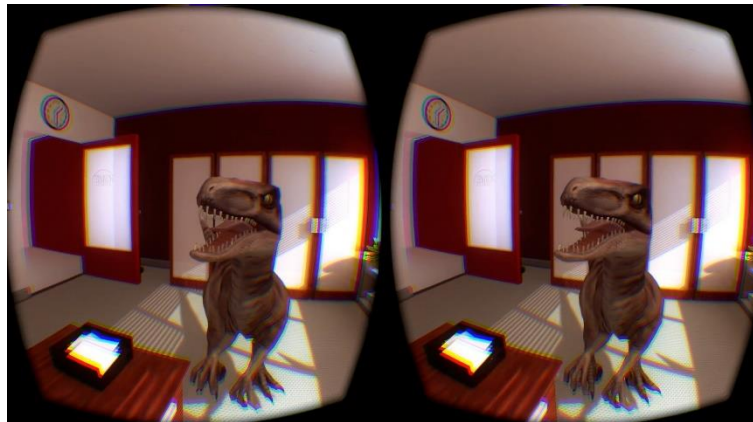
# Procedure

## Reward for participants

- Participants were thanked for the research participation and were given the opportunity to try an entertaining application on Oculus Rift device as reward. This has been done also with effort to motivate them to take part in the further research.



[23]



[24]



[9]

# Research environment and conditions



# Research environment and conditions



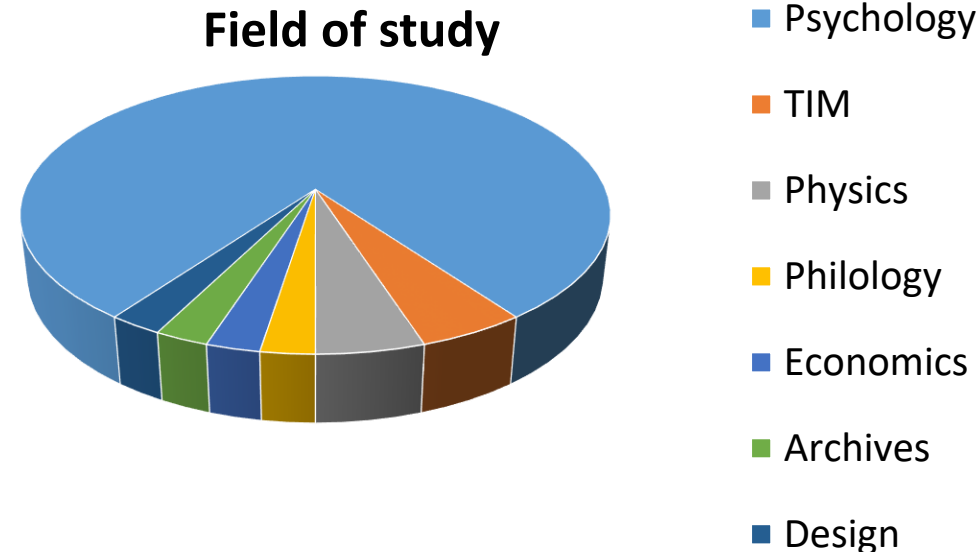
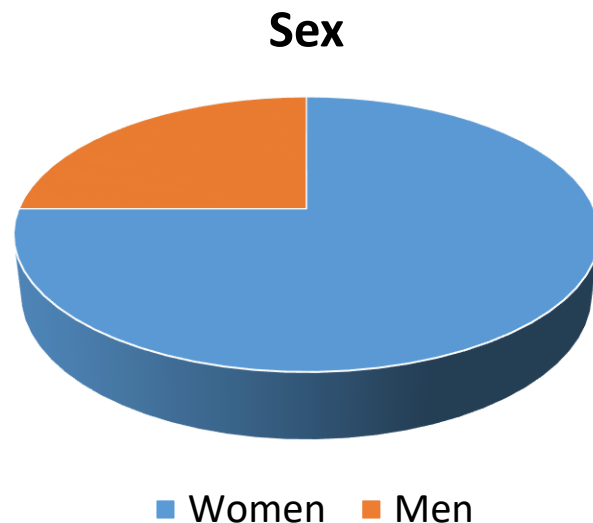
# Research environment and conditions



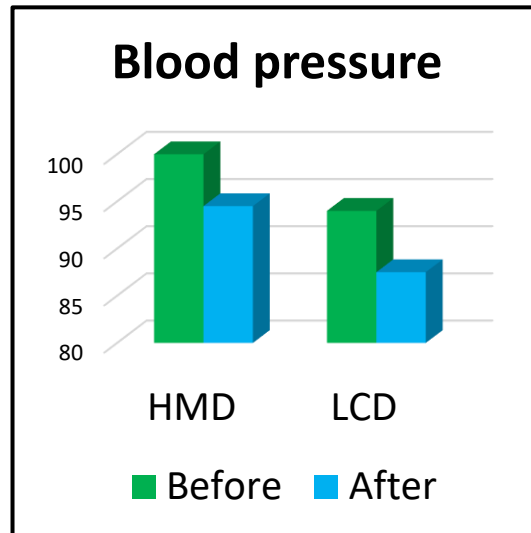
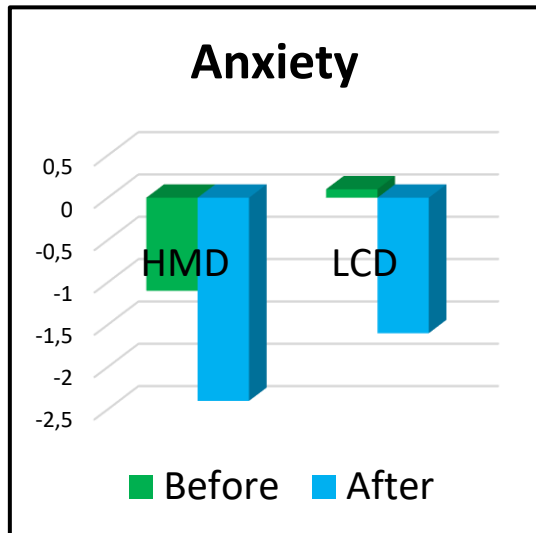
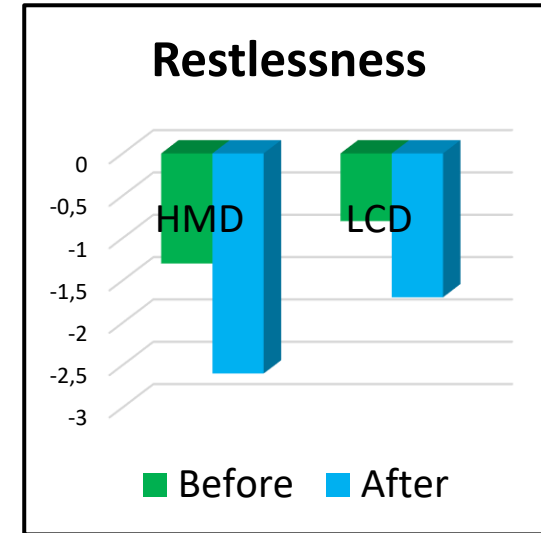
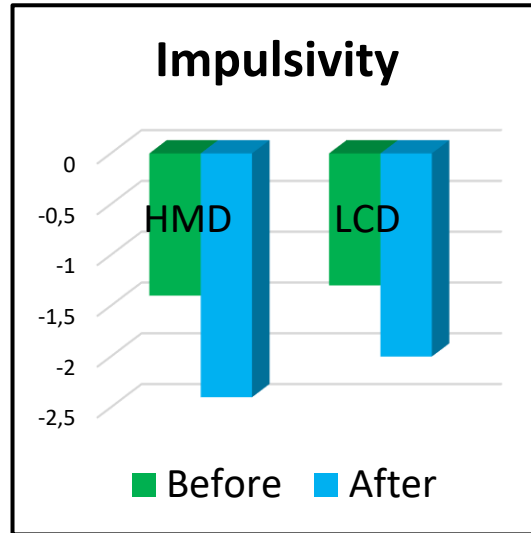
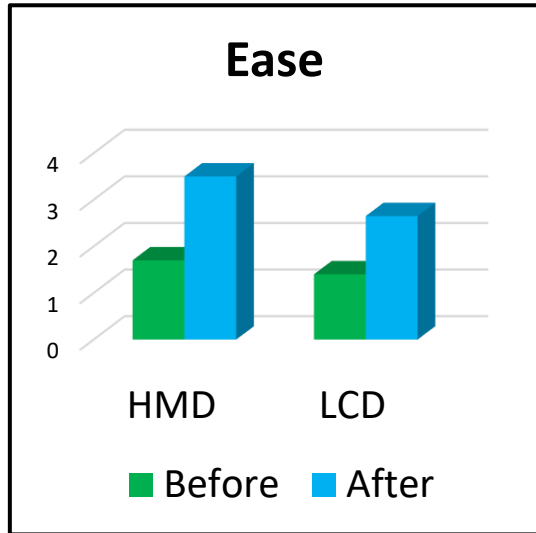


# Population and research sample

- The population is composed of adults of Slovak and Czech nationality who have common experience with interaction with technologies (computer work and common types of imaging systems such as LCD displays). The research sample included 40 people, 30 women (75%) and 10 men (25%). The mean age of the participant was 22.83 years ( $sd = 2.037$ ). All participants were students, 32 were from psychology (80%), 2 from theory of interactive media (5%), 2 from physics (5%), and one from the field of study of philology, economics, archives, and design.



# Results



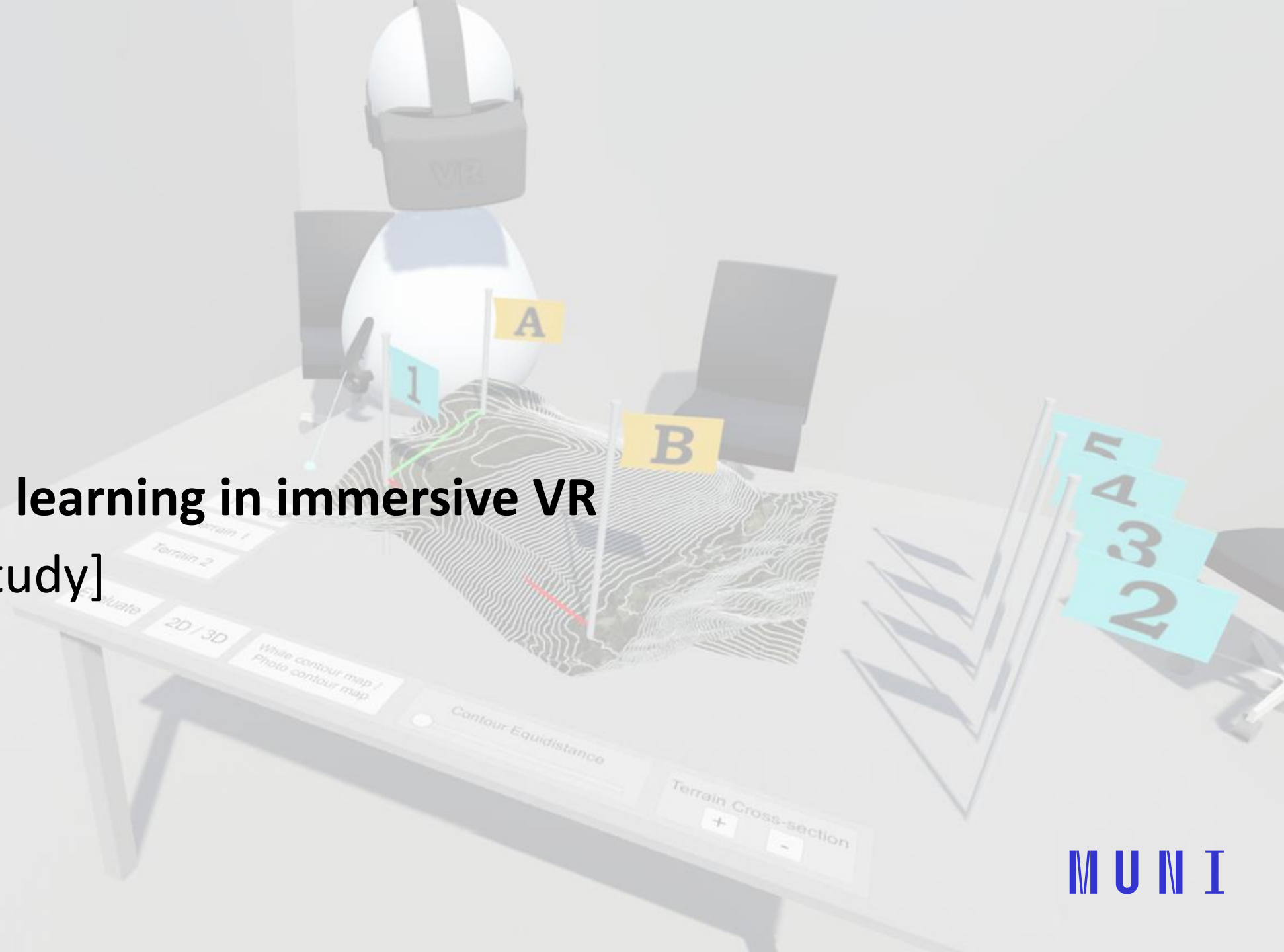
# Conclusion

- We discovered significant effects of individual relaxations on psychophysiological alleviation – in particular increasing ease and decreasing impulsivity, restlessness, anxiety, and blood pressure. From this we conclude that **application of immersive VR for relaxation is effective** in this case. Comparing the degree of psychophysiological alleviation of participants **between relaxation in immersive VR and non-immersive VR revealed no significant difference.** [\[25\]](#)

# Research 2

## Education in VR

# Collaborative learning in immersive VR [qualitative study]

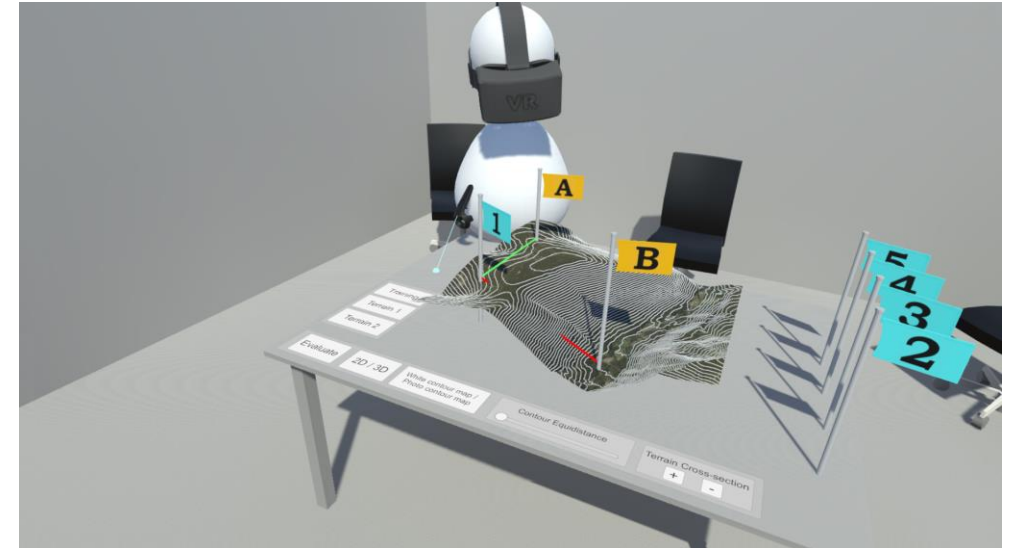


# Advantages of education in immersive VR

- Virtual classes
  - Overcome limitations of a specific time and space
- Experimental space [26]
  - Simulation of experiments
  - New possibilities
- Learning through experience
  - Realistic human experience

# Application

- Developed in the HCI lab [27]
- Characteristics
  - Education
  - Visualization tools
  - Collaboration
  - 2 participants collaborate
  - Immersive VR
  - Geography tasks
  - Contour lines
- Studied by our research team [28]



# Research approach

- Qualitative research
  - Small sample examined
  - Various data used
  - Random events also evaluated
  - Creative analysis
- Idiographic case study approach
  - In-depth and detailed examination of each case (participant)
- Interpretative phenomenological analysis (IPA)
  - IPA is not a prescriptive methodology; there is no definitive way to do qualitative analysis
  - The analysis process is cyclic (iterative)



# IPA

**= Interpretative Phenomenological Analysis** [29,30]

- Psychological research approach that originated in the early 90s
- Authored by Jonathan A. Smith, a professor of psychology at Birkbeck University of London
- Explores the "lived experience" of a person and the meaning he attributes to it
  - By exploring individual personal experiences of individuals, it seeks to understand certain events or processes (phenomenon)

# Results (emerged themes)

## – Thankfulness for collaborator

- Lost without a collaborator
- Verification and consensus with collaborator

## – Excitement from boring maps

- Finally seeing what contour line looks like in real life
- Learned skill for working with maps

## – Communication as a challenge

- No face and invisible emotions
- Limited gesticulation through controllers
- Having an intangible body

## – Cognition in two realities

- Where are my legs?
- Immersion and involvement in the artificial world
- Amazement from return to objective reality

# References

- [1] Figure retrieved from <https://longmontcomputer.com/>
- [2] Figure retrieved from <https://medium.com/ghvr/what-is-reality-fb3a2f69d35d>
- [3] Fox, J., & Bailenson, J. N. (2009). Virtual Self-Modeling: The Effects of Vicarious Reinforcement and Identification on Exercise Behaviors. *Media Psychology*, 12(1), 1–25.
- [4] Lee, K. M. (2004). Presence, Explicated. *Communication Theory*, 14(1), 27–50.
- [5] Alcañiz, M., Botella, C., Baños, R., Perpiñá, C., Rey, B., Lozano, J. A., ... & Gil, J. A. (2003). Internet-Based Telehealth System for the Treatment of Agoraphobia. *CyberPsychology & Behavior*, 6(4), 355–358.
- [6] Figure retrieved from <http://cdn.cnetcontent.com/c2/b7/c2b70e9c-786d-464c-898e-d7526281dac4.pdf>
- [7] Bailenson, J. N., & Blascovich, J. J. (2004). Avatars. In W. S. Bainbridge (Ed.), *Berkshire Encyclopedia of Human-Computer Interaction: Volume 1* (pp. 64–68). Berkshire Publishing Group.
- [8] Figure retrieved from <https://hackernoon.com/ behold-the-next-generation-vr-technology-part-3-avatars-a761239f6b2d>
- [9] Figure retrieved from [https://dionosvr.files.wordpress.com/2014/10/sightline\\_2.jpg](https://dionosvr.files.wordpress.com/2014/10/sightline_2.jpg)

# References

- [10] Figure retrieved from <https://www.youtube.com/watch?v=jpNxXg3HXXw>
- [11] Witmer, B. G., & Singer, M. J. (1998). Measuring Presence in Virtual Environments: A Presence Questionnaire. *Presence: Teleoperators and Virtual Environments*, 7(3), 225–240.
- [12] Heeter, C. (1992). Being There: The Subjective Experience of Presence. *Presence: Teleoperators and Virtual Environments*, 1(2), 262–271.
- [13] Riva, G., Mantovani, F., Capideville, C. S., Preziosa, A., Morganti, F., Villani, D., ... & Alcañiz, M. (2007). Affective Interactions Using Virtual Reality: The Link between Presence and Emotions. *CyberPsychology & Behavior*, 10(1), 45–56.
- [14] Figure retrieved from <https://ocw.mit.edu/courses/brain-and-cognitive-sciences/9-00sc-introduction-to-psychology-fall-2011/emotion-motivation/discussion-emotion/>
- [15] Bullinger, A. H., Hemmeter, U. M., Stefani, O., Angehrn, I., Mueller-Spahn, F., Bekiaris, E., ... & Mager, R. (2005). Stimulation of Cortisol During Mental Task Performance in a Provocative Virtual Environment. *Applied Psychophysiology and Biofeedback*, 30(3), 205–216.
- [16] LaViola Jr., J. J. (2000). A Discussion of Cybersickness in Virtual Environments. *ACM SIGCHI Bulletin*, 32(1), 47–56.

# References

- [17] Davis, S., Nesbitt, K., & Nalivaiko, E. (2014). A Systematic Review of Cybersickness. In K. Blackmore, K. Nesbitt, & S. P. Smith (Eds.), *Proceedings of the 10th Australian Conference on Interactive Entertainment (IE2014)* (Article 8).
- [18] Yee, N., & Bailenson, J. (2007). The Proteus Effect: The Effect of Transformed Self-Representation on Behavior. *Human Communication Research*, 33(3), 271–290.
- [19] Figure retrieved from <https://www.windowscentral.com/can-i-use-my-oculus-rift-without-pc>
- [20] Mikšík, O. (2004). *Dotazník SUPSO: Příručka*. Psychodiagnostika s.r.o.
- [21] Figure retrieved from <https://www.cnsystems.com/news-archive/98-cnap-monitor-500/117-cnap-monitor-500-product-features>
- [22] Müllner, J., Ruisel, I., & Farkaš, G. (1980). *Príručka pre administráciu, interpretáciu a vyhodnocovanie dotazníka na meranie úzkosti a úzkostlivosti*. Psychodiagnostické a didaktické testy.
- [23] Figure retrieved from [http://computergraphics.ac.nz/hdi4d/resources/workshop1/03\\_Project\\_NZ\\_VUW\\_UC\\_small.pdf](http://computergraphics.ac.nz/hdi4d/resources/workshop1/03_Project_NZ_VUW_UC_small.pdf)
- [24] Figure retrieved from <https://blog.kitsplit.com/adventures-in-vr-guide-to-oculus-rift/>

# References

- [25] Sedlák, M. (2016). *Relaxation in Immersive Virtual Reality* [Master's thesis]. Faculty of Arts, Masaryk University, Brno, Czech Republic.
- [26] Hew, K. F., & Cheung, W. S. (2010). Use of three-dimensional (3-D) immersive virtual worlds in K-12 and higher education settings: A review of the research. *British Journal of Educational Technology*, 41(1), 33–55.
- [27] Jiří Chmelík, Milan Doležal
- [28] Čeněk Šašinka, Zdeněk Stachoň, Michal Sedlák, Lukáš Herman, Petr Kubíček, Alžběta Strnadová, Hynek Tejkl
- [29] Smith, J. A., Flowers, P., & Larkin, M. (2009). *Interpretative Phenomenological Analysis: Theory, Method and Research*. SAGE Publications Ltd.
- [30] Smith, J. A., Jarman, M., & Osborn, M. (1999). Doing Interpretative Phenomenological Analysis. In M. Murray & K. Chamberlain (Eds.), *Qualitative Health Psychology: Theories and Methods* (pp. 218–240). SAGE Publications Ltd.

# Contacts

- **Mgr. Michal Sedlák, Ph.D.** candidate
  - [m.sedlak@mail.muni.cz](mailto:m.sedlak@mail.muni.cz)
  - [www.linkedin.com/in/MichalSedlak](http://www.linkedin.com/in/MichalSedlak)
  - [www.researchgate.net/profile/Michal-Sedlak](http://www.researchgate.net/profile/Michal-Sedlak)