Immersion, Presence and Flow

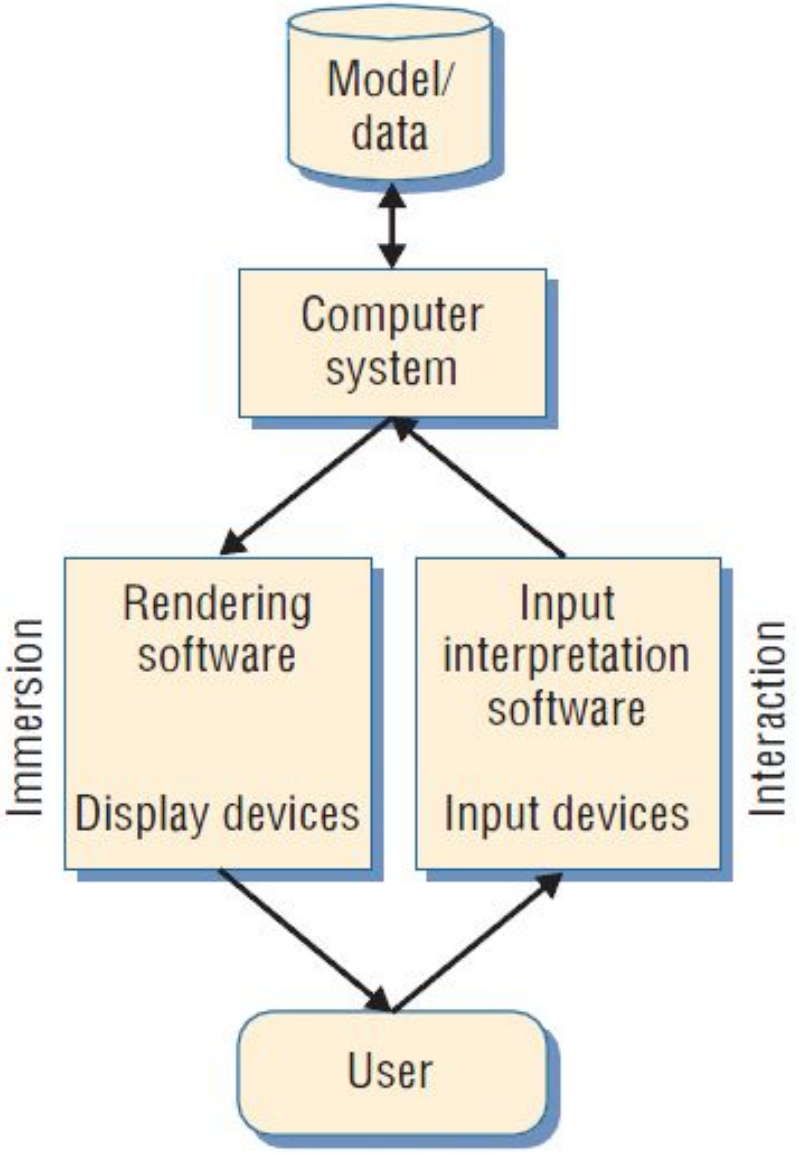
1. How much Immersion is necessary ?
2. What is Presence ?
3. The concept of Flow
4. Conclusion

Immersion: is the **objective** level of fidelity of the sensory stimuli produced by a technological system [S2003].

- Measurable and controllable as it depends only on technology
- Different systems can be compared

Why use Immersive VR ?

- More and better depth cues
- Proprioceptive (body-based) cues
- Greater spatial understanding
- More efficient and accurate visual analysis



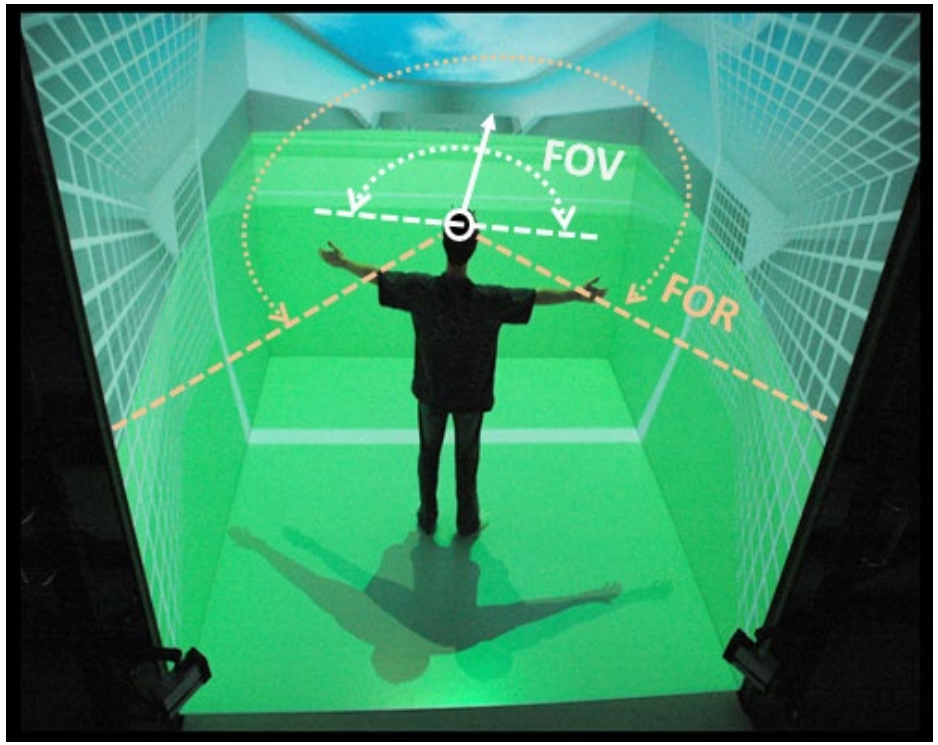
Immersion / Interaction

[from Bowman]

Objective measurable components of the visual immersion continuum :

- Field of View (FOV)
- Filed of Regard (FOR)
- display size
- display resolution
- stereoscopy
- head-tracking for 1PP rendering (1PP = first person viewpoint)
- realism of lighting
- frame rate

…



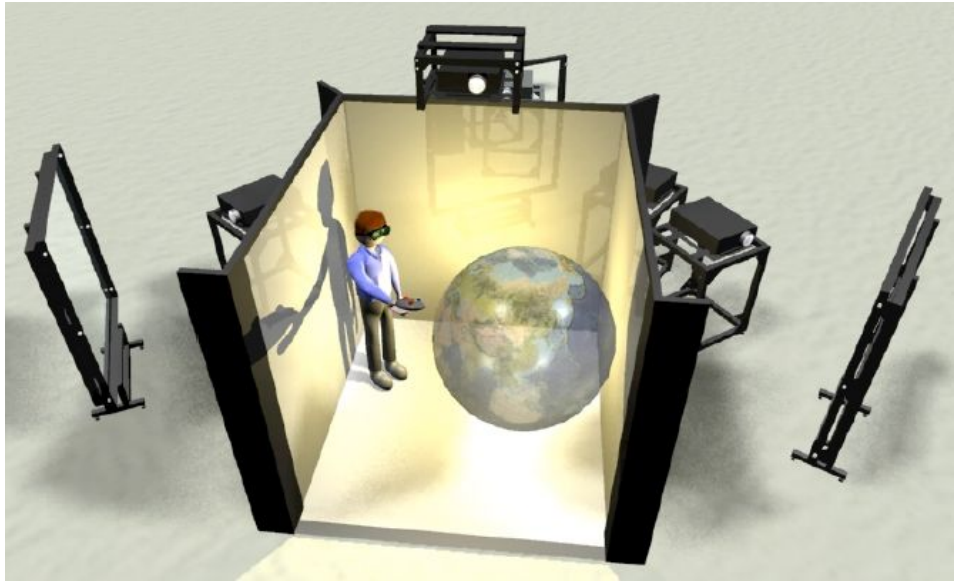
field of view (FOV), the size of the visual field (in degrees of visual angle) that can be viewed instantaneously

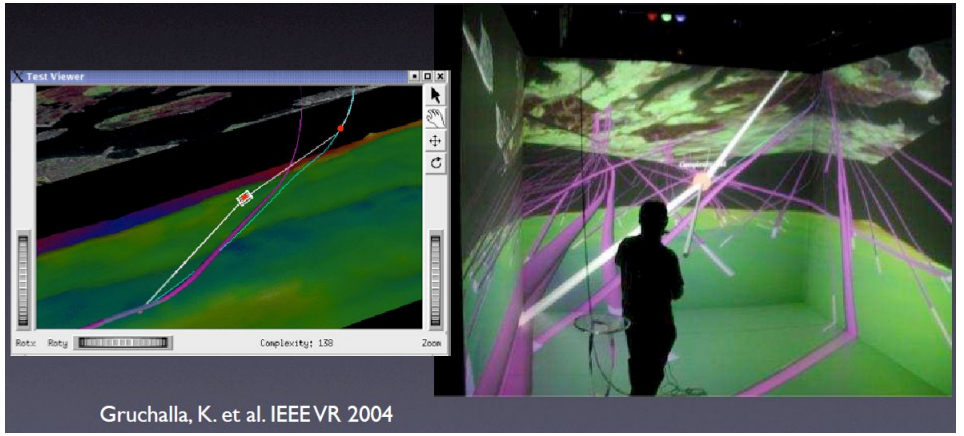
field of regard (FOR), the total size of the visual field (in degrees of visual angle) surrounding the user

1. How much immersion is necessary ? [B2007]

Immersion can be measured and controlled [Bowman 2007]:

- *Immersive VEs* have special technical characteristics.
- Intuitively, IVEs are different than 3D environments “on the desktop.”
- An understanding of the benefits of IVEs would transform research and commercial uses of VEs.
- BUT, it’s very hard to prove that IVEs are beneficial





How much immersion is necessary ?

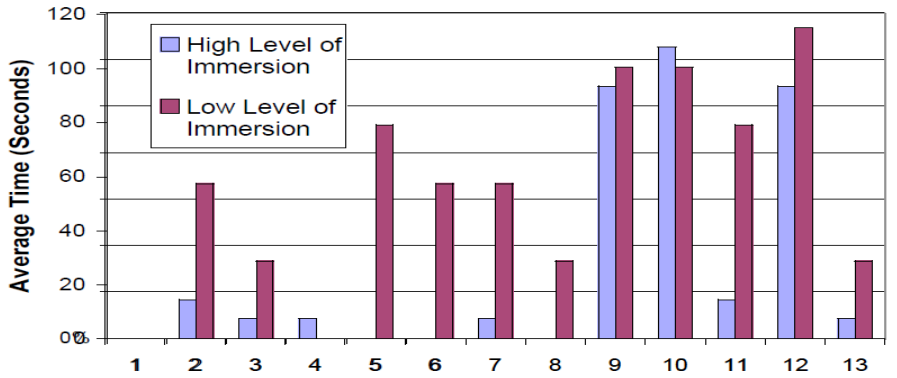
Some results from Bowman et al:

- **stereo**, **wide FOR** and **head tracking** work together to provide improved ***spatial understanding***

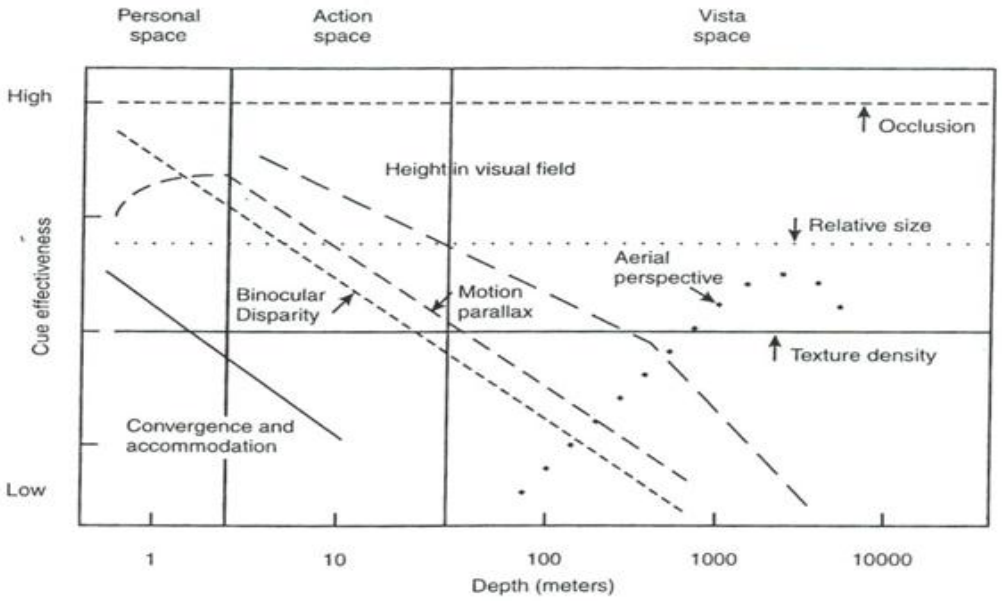
- complex tasks are **3x** faster with high level of immersion

- simple tasks equally good in both conditions

- **stereo** improve collaborative manipulation task performance, … but does not improve single-user distant manipulation [cf Stereo]



[D. Bowman VR course notes]



[Depth cues effectiveness from J. Cutting and P. Vishton]

Examples of beneficial fully immersive experience

Snowworld, H. Hoffman, U.W HIT lab, 2005

- Pain distraction: A higher level of immersion can “feel” different than a lower level.
- Phobia therapy: A high level of immersion can “feel” similar to the real world.
- A higher level of immersion may be more “natural” or produce “presence.”
- These experiential factors benefit certain applications (therapy, entertainment, training, design review)

2. What is *Presence* ?

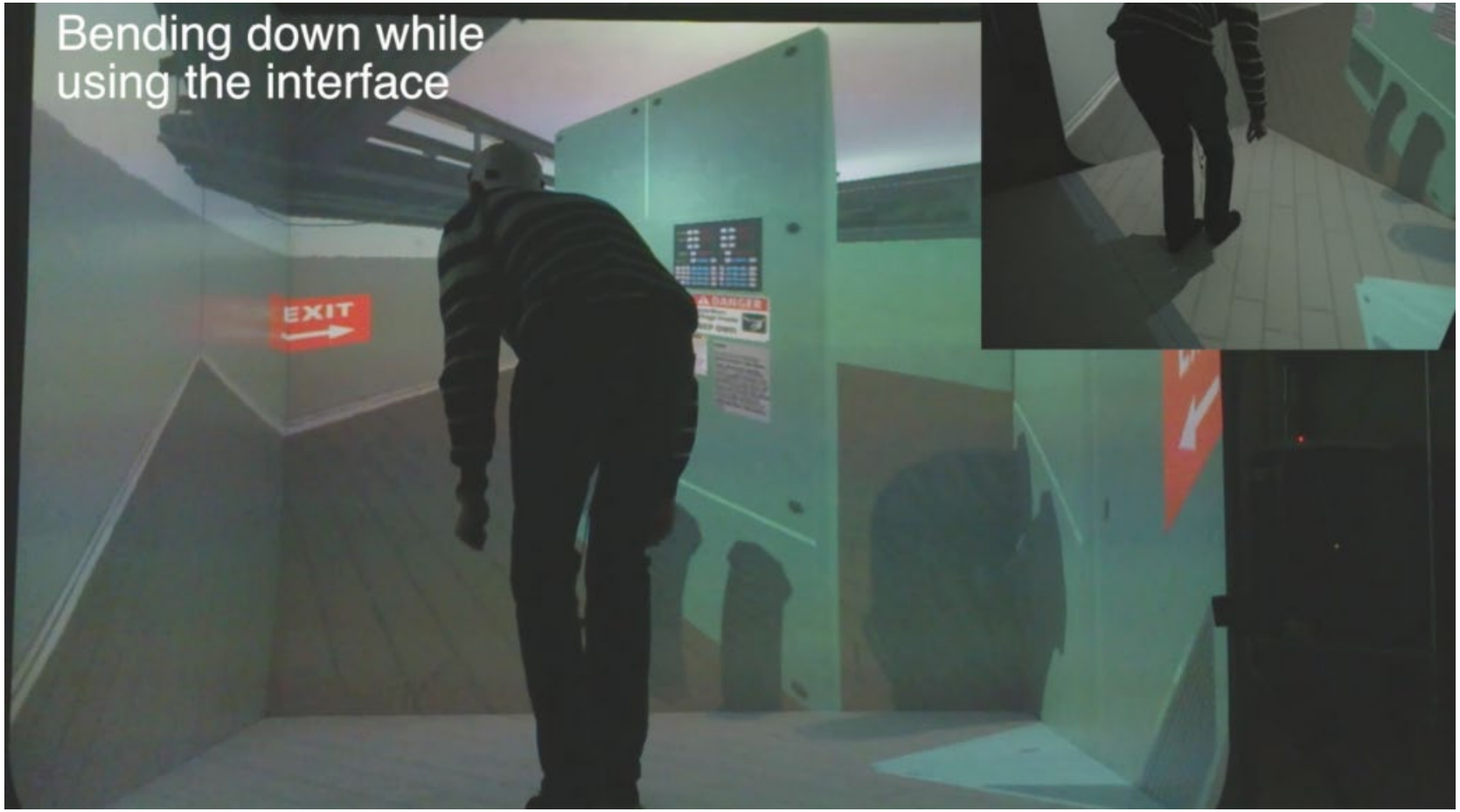
• **Presence**: is the **subjective** response of a human to an environment, as if the environment were real, indicating the feeling of *« being there »*. [S2003, SSV2016]

• not directly measurable, not controllable

• the same system may produce different levels of presence in different people

• ***immersion*** is the technical process
• ***presence*** is the subjective effect in individuals:
  • *being there, suspension of disbelief, illusion of non-mediation*
  • *the virtual world replaces the physical world*

Presence can partially be assessed by evaluating whether the participant behaves in the virtual environment in the same way as in reality (from 01:44)



Presence is not *Immersion*

- ***Component of immersion* lead to *presence response***

- Sense of Presence (Slater 1993 / 2010):
  - *Suspension of Disbelief*:

    - Users forget for a moment that they are « in a world other than where their real bodies are located »

    - forget the artificiality / or refrain from rejecting it

    - occur similarly in other situations :
      - when reading/viewing a fiction
        - novel, theater, movie

Evaluating *Presence* with questionnaires

Relative to subjects' point of view

☐Questionnaires (e.g. Witmer & Singer, Slater-Usoh-Steed)

➔ Questions related to past VR experience

➔ Direct or indirect

➔ Rating (discrete or continuous) or yes/no (forced choice)

Often used because easy

☐High risks of manipulation / exaggerated claims

➔ should not be used to compare different immersive configurations [UsohCAS 2000]

➔ How colourful was your day ? [Slater 2004]

☐NOT dynamic

➔ Assume presence is a persistent state

Guidelines / Trend

- Take advantage of standardized/validated questionnaires (avoid making up your own)
- Administrate the questionnaire within the VR experience (reduce set of questions) [SKHH19]

Objective evaluation of *Presence*

- i.e. Relative to external point of view.
  - ➔ Task performance
    - time, memory, skill
  - ➔ Overt behaviours
    - interactions
  - ➔ Physiological reactions
    - heart rate, sweat,
    - breathing,
    - Galvanic Skin Response, etc…

- Pros
  - Dynamic of Presence
  - Relative to context

- Cons : unknowns of human brain

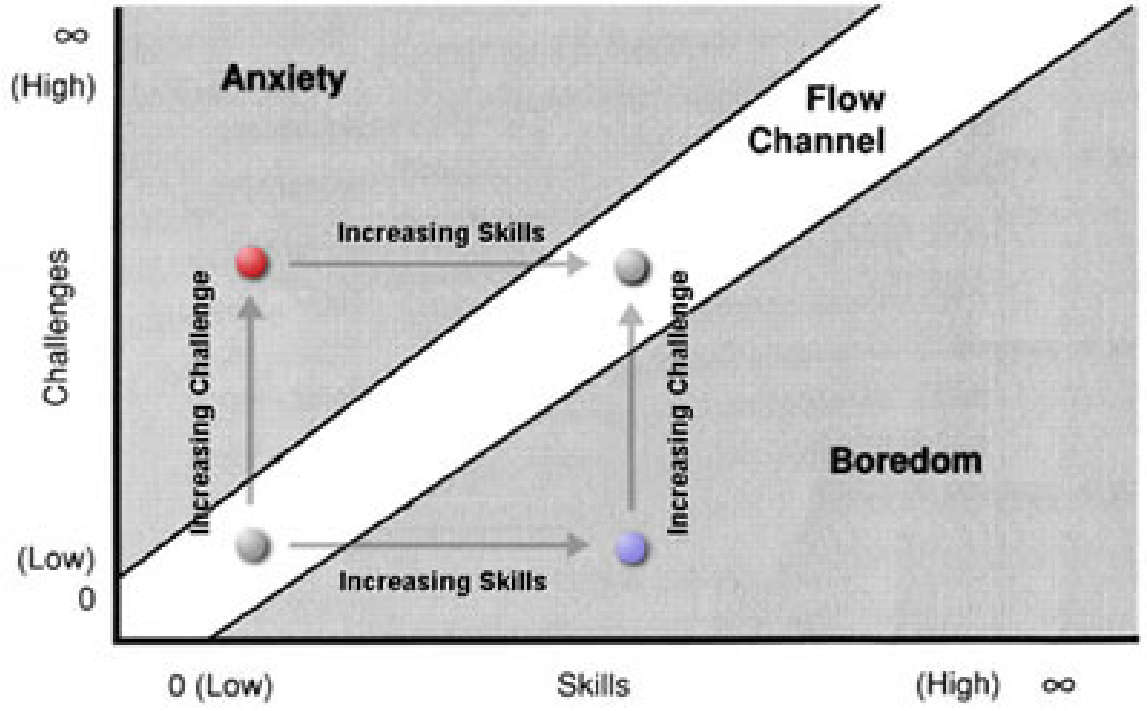
3. Concept of *Flow*

Introduced by Psychologist Csikszenmihalyi
• studied *autotelic* behaviors, i.e. *self-motivational* activities,
• people who showed to be deeply involved in a complex activity without direct conventional rewards.

Related to the **content** of the experience:

• *autotelicity* arises from a subtle balance between the exertion of available skills and addressing new challenges.

• He called ***flow*** the strong form of enjoyment resulting from the performance of an autotelic activity where one easily looses the sense of time and of oneself [S2004].



• Related concepts: *engagement / involment / enjoyment*

Presence is NOT *Flow* nor *Enjoyement* nor *Engagement* nor *Usability*

Presence has nothing to do with the ***content*** of an interactive experience but only with its form [S03].

A VR system can induce a high level of presence but the subject may find the proposed experience boring, unpleasant, stressing... What's important is to replicate a plausible real-world situation.

Available tools for assessing…

Enjoyment / engagement… : The Game Experience Questionnaire [GEQ13]

1 I felt content
2 I felt skilful
3 I was interested in the game's story
4 I thought it was fun
5 I was fully occupied with the game
6 I felt happy
…
33 I had to put a lot of effort in it

System Usability : A quick and dirty usability scale [SUS1986]

1. I think that I would like to use this system frequently
2. I found the system unnecessarily complex
3. I thought the system was easy to use

…

10. I needed to learn a lot of things before I could get going with this system

Presence is NOT *Flow (2)*

Example 2: The virtual classroom experience [N2013] can elicit feeling of stress if the students display some lack of attention, hence stimulating appropriate reaction from the trainee teacher.

Figure 10: *Virtual class of five students. Left screen shows virtual students on task; right shows them distracted, except for student in front row left who is presently controlled by Interactor.*

The current state of the art in AI does not allow to fully script such complex interactions between the trainee and the classroom. Instead in the AMITIE system one hidden person is needed for piloting the classroom behavior (concept of **Wizard of Oz [B1900]**).

4 Conclusion

Critical immersion factors for visual displays are head tracking, wide FOR and stereo.

Immersion is worth the cost for complex tasks requiring spatial understanding.

Presence is the subjective response of a human to an environment, i.e. *the sense of being there*

Flow characterize the degree of *engagement* of the user in the proposed interaction.

The ability to involve users in embodied immersive interactions producing *Presence,* or even sometimes *Flow,* has opened the way for a broader range of applications including the training of complex social interactions.

[References]

[B2007] Bowman, D., McMahan, P.: Virtual Reality: How Much Immersion Is Enough? Computer, 40(7), 36--43 (2007), & Course notes from D. Bowman / Immersion & Presence

[N2013]Nagendran, A, Pillat, R, Kavanaugh, A, Welch, G, Hughes, C,. 2013. AMITIES: avatar-mediated interactive training and individualized experience system. In Proceedings of the 19th ACM Symposium on Virtual Reality Software and Technology (VRST '13).

[R09] Rovira, A., Swapp, D., Spanlang, B., Slater, M.: The Use of Virtual Reality in the Study of People's Responses to Violent Incidents. Front Behav Neurosci 3: 12 (2009)

[S2003] Slater, M.: A note on presence terminology. Presence Connect 3: 3. (2003)

[S2004] Steel, L.: The autotelic principle. Embodied artificial intelligence. LNAI vol. 3139, 231--242 (2004)

[S2005] Sanchez-Vives, M.V., Slater, M.: From Presence to Consciousness through Virtual Reality. Nat Rev Neurosci 6(4), 332--339 (2005)

[S2016] Slater, M., Sanchez-Vives, M.V :Enhancing our Lives with Immersive Virtual Reality Frontiers in Robotics and AI, Vol 3, Article 74 (December 2016)

[About Questionnaires]

[GEQ13] IJsselsteijn, W. A., de Kort, Y. A. W., & Poels, K. (2013). **The Game Experience Questionnaire**. Eindhoven:Technische Universiteit Eindhoven

[SKHH19] Valentin Schwind, Pascal Knierim, Nico Haas, and Niels Henze. 2019. **Using Presence Questionnaires in Virtual Reality**. In CHI Conference on Human Factors in Computing Systems Proceedings (CHI 2019), May 4–9, 2019, Glasgow, Scotland UK. ACM, New York, NY, USA, 12 pages. https://doi.org/10.1145/3290605.3300590

[SUS1986] John Brooke, SUS -A quick and dirty usability scale, https://en.wikipedia.org/wiki/System_usability_scale

[UCAS2000] Martin Usoh, Ernest Catena, Sima Arman, and Mel Slater. 2000. Using Presence Questionnaires in Reality. Presence: Teleoperators and Virtual Environments 9, 5 (2000), 497–503. https://doi.org/10.1162/105474600566989

[WoZ Reference]

[B1900] Lyman Franck Baum, The Wonderful Wizard of Oz, 1900

The terrible Wizard of Oz

The real Wizard of Oz