Talking to Users in VR: Assessing Different Communication Methods

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Background(1)

- **User evaluation** is very important for VR user studies.
- **Subjective Data** collection is mostly done via **questionnaires & interviews**, which are conducted POST immersion.

The problem: We rely on memory recall, after a **Break In Presence (BIP)** occurred by removing the HMD.

Background(2)

Breaks in Presence:

- Moments where the users' awareness is **shifted** to the "real world" instead of the VE.
- Can occur due to **distractions**, **technical issues**, or **inconsistencies** between expectations and the VE.
- Can me used as an alternative way to assess **Presence**.
- Have the potential to impair **user experience** and **distort experimental results.**
- Can have different **intensity** and **recovery times**.

Background(3)

- What is the Solution? **In-VR questionnaires.**

- In-VR Questionnaires:
  - improve response consistency (**lower variance** in answers).
  - reduce **disorientation**, **study duration.**
  - are **less invasive** and yield **more reliable** self-reports.

Motivation

- What about **interviews**?
  - They face the same problems with **post immersion** questionnaires.
  - Researchers tend to speak to users **while immersed**, causing **BIPs**.
  - Techniques like the "**Think Aloud**" protocol also cause **BIPs** since they are unnatural.

- What is the Solution? **In-VR Interviews** (with a representation of the evaluator).

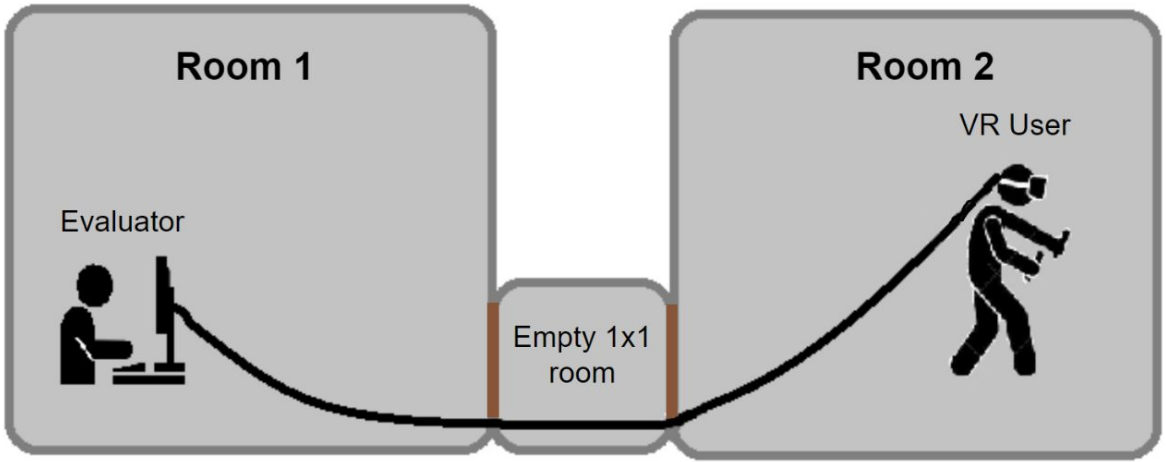
Communication Methods

- **Voice-Speaker**: Audio only.
- **Video-Screen**: Audio and 2D real-time Video.
- **3D-Avatar**: Audio and 3D representation of the evaluator.

We are evaluating them in terms of **realism**, **preference**, **BIPs**, and overall **user comfort**.

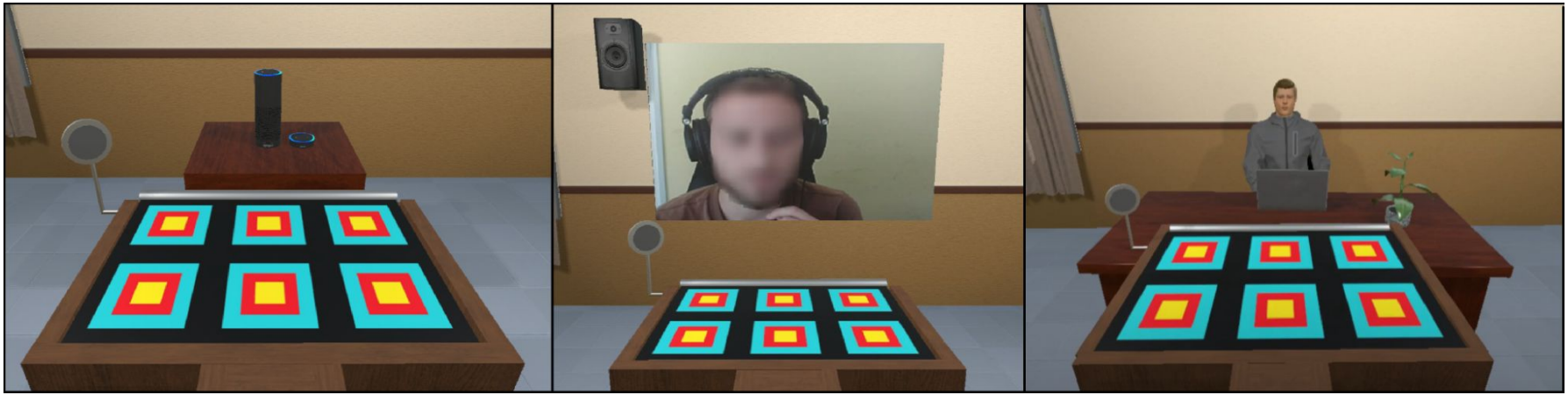
Participants & Setup

- N = **38** (22 women, 16 men), ages **18–53.**
- The evaluator and the user were located in **another room** to avoid BIPs.



Procedure

- **3 sessions** of 24 repetitions of the **pick-and place tasks**.
- **After** each session: brief **in-VR interview** with the current communication method, about the tasks.
- **At the end** of all sessions: **In-VR Questionnaire** about communication methods.
- **Post-Immersion**: **Interview** about communication methods.

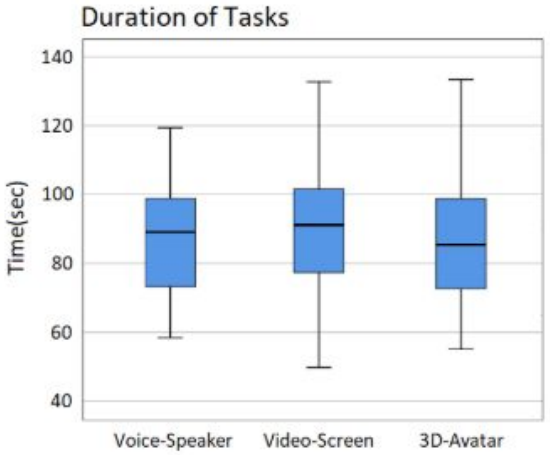


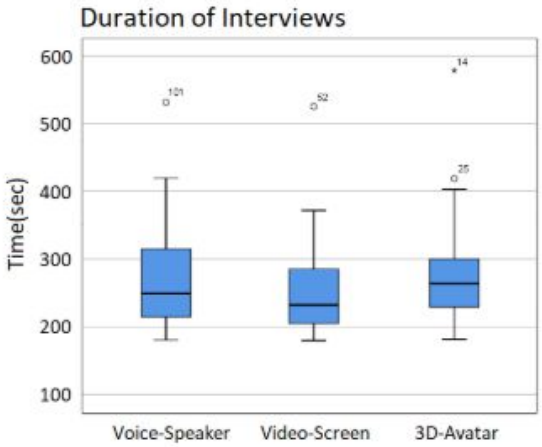
Logged Data

- Pick and-place **task duration** and **accuracy**.
- Interview **duration**.
- Pick-and-place **tasks eye fixation duration**.
- In-VR **interview eye fixations duration**.

Results - *Logged Data*(1)

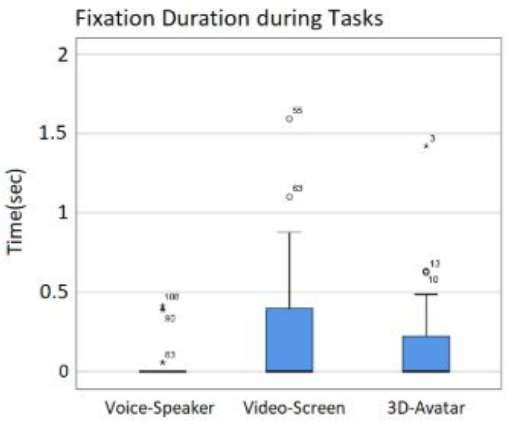
- **Task duration & accuracy**
  - No significant differences between methods.
- **Interview duration**
  - 3D-Avatar > Video-Screen. No significant difference for Voice-Speaker.

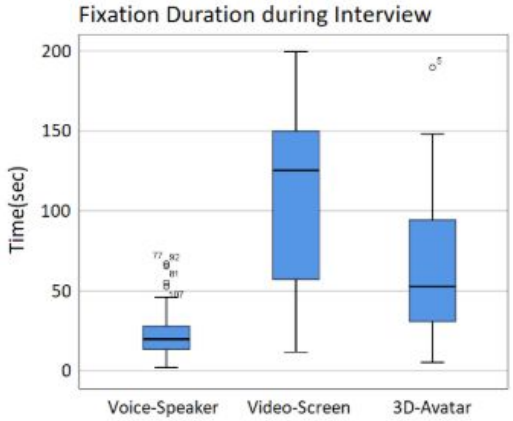




Results - *Logged Data*(2)

- Eye Fixations duration **during tasks**:
  - Video-Screen & 3D-Avatar > Voice-Speaker. ($p<0.001$)
  - Under 1 second for all methods. Not distracting overall.
- Eye Fixations duration **during interviews**:
  - Video-Screen > 3D-Avatar > Voice-Speaker. ($p<0.001$)
  - 45% of the Interview for Video-Screen, 24% for 3D-Avatar, 10% for Voice-Speaker

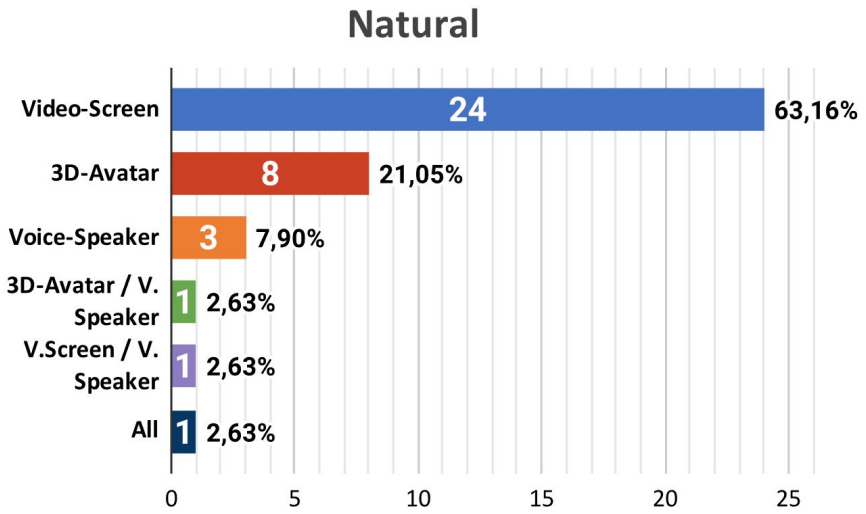




Results - *Hypotheses*

- H1. The **Video-Screen** will be perceived as the **most consistent with the** user's **real-world** experience - *Confirmed*

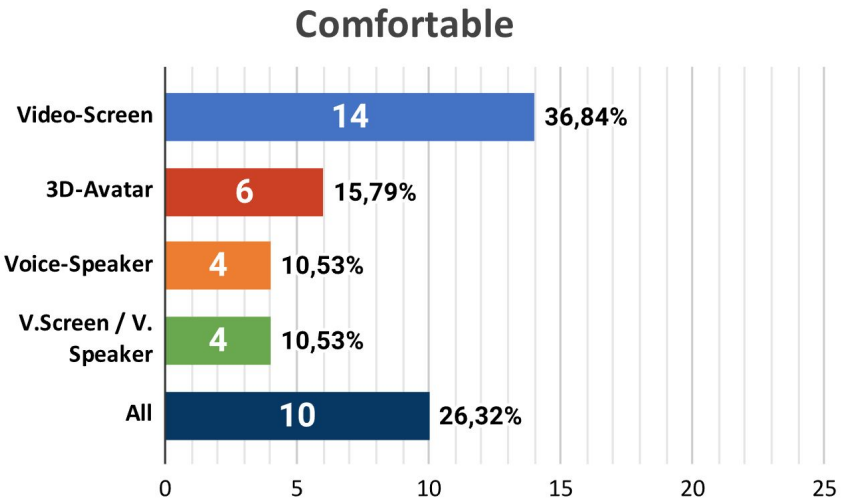
- Questionnaire:
  - more consistent with real-world experience (A1)
  - easier to adjust to (A3)



Results - *Hypotheses*

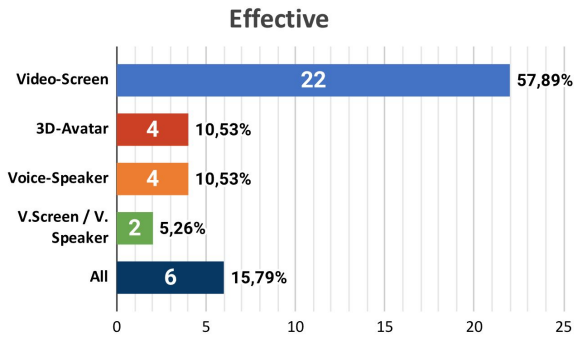
- H2. The users will feel **more comfortable** with the **Video-Screen** during the interview - *Confirmed*

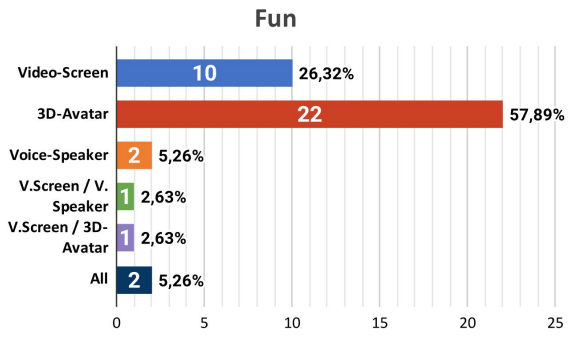
- Questionnaire:
  - **easiest** to adjust to (A3)
  - more **comfortable** for communication (A8 & A9)
  - more **desirable** for **prolonged** conversation (A4)

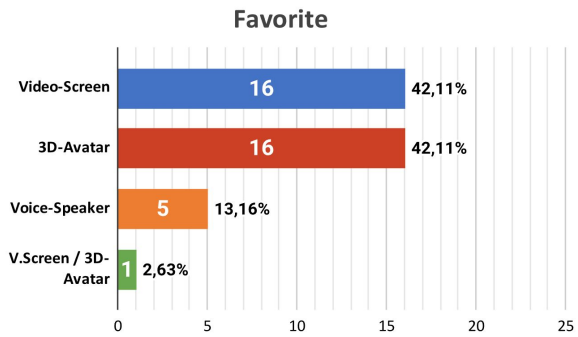


Results - *Hypotheses*

- H3. The **3D-Avatar** will be the **most preferred** method overall. - *Partly confirmed*







Results - *Hypotheses*

- H4. **None** of the methods will cause **high-intensity BIPs -** *Confirmed*

- During the Interviews:
  - No BIPs with Voice-Speaker.
  - One low-intensity BIP with 3D-Avatar.
  - 13 users noted Video-Screen reminded them of the physical world, but not distractingly so.

Results*(+/-)*

- ***Video-Screen*:**
  - **53%** users noted improved communication due to seeing a “real” person and **facial expressions** and **non-verbal** cues.
  - **32%** of users felt that It does not fit with the VE.
- ***3D-Avatar*:**
  - Many users appreciated that it “**fit the VE**” (**45%**) and found it “**fun**” (**32%**).
  - **58%** criticized its **unnatural** appearance and movements.
- ***Voice-Speaker:***
  - **37%** users described it as **non-intrusive** and **non-distracting.**
  - **26%** said it was **“impersonal”.**

Discussion

Our users confirmed the importance of in-VR evaluation methods.

- ~50% attempted spontaneously to **demonstrate** what they were trying to explain during the in-VR interviews.
- Quote during interview: "*I would love to have this interview in the VR, where **I could show you** exactly what I mean, what I liked and what I didn't [about the methods]*"

Conclusion

- **Task performance** did **not** differ significantly across methods.
- All 3 methods supported **smooth communication**, **without** triggering high intensity **BIPs**.
- **Video-Screen** emerged as the **most promising** with potential for design improvements.
- **3D-Avatar** and **Voice-Speaker** could also be used in some cases.

Conclusion

So what should we use?

- Selecting the best communication method in VR depends on task complexity and the evaluator's role.
- More research is needed to pinpoint the "perfect" in-VR communication method. This is just a start.
- Integrating communication tools directly into the VE **enhances immersion** and **minimizes BIPs.**

Thank you!