Virtual Reality and Collaborative Learning

How Virtual Presence can affect Collaboration between Learners

Centre for Education and Learning

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VR ZONE

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1: Background

Virtual Reality & Collaborative Learning

Virtual Reality (VR)

"A human computer interface that allows users to interact with a virtual environment through natural, real world motions" (Mehrfard et al., 2019)

"A way of transporting a person to a reality (i.e., a virtual environment) in which he or she is not physically present but feels like he or she is there" (Rebelo et al., 2012)

Collaborative Learning (CL)

"Two or more people working together toward a shared learning goal" (Jeong and Hmelo-Silver, 2016)

Computer-Supported Collaborative Learning:
"An emerging branch of the learning sciences concerned with studying how people can learn together with the help of computers" (Stahl et al., 2006)

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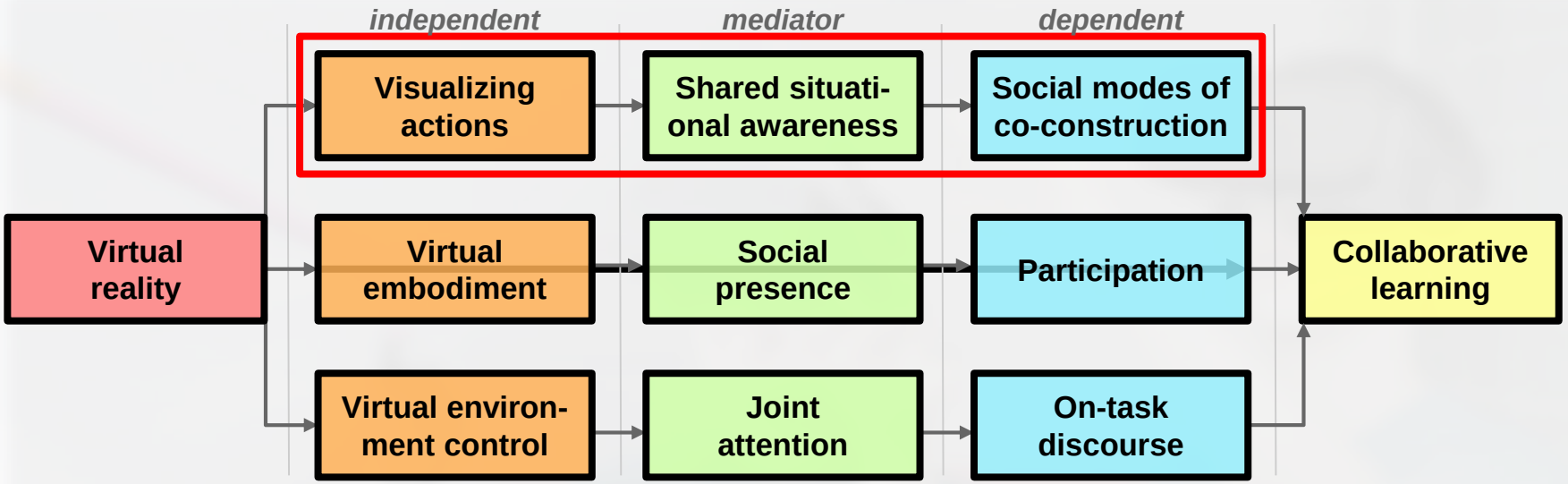
2: Focus of Project

Research question

How can Virtual Reality **support** and **enhance** Collaborative Learning?

2: Focus of Project

Framework



H1: **Visualizing users' actions** leads to higher **shared situational awareness** between them, in turn providing a higher level of **social modes of co-construction**

H2: **Higher virtual embodiment of users** leads to users **perceiving each other as more "real and present"** inside the virtual, which in turn leads to higher quantity and heterogeneity in **participation**;

H3: When users have a higher **control of the virtual environment**, the **shared focus between users** increases, leading to a higher **on-task discourse** in the group;

3: Experiment

Setup

Visualizing actions:

→ Making actions and activities of users visible to each other in the virtual that would not be visible in the real

→ "Supporting awareness using visualization has been directed to the representation of the team structure and to the representation of the daily traces of a collaborator" (Buono and Cuzzocrea, 2015)

Shared situational awareness:

→ Being conscious, i.e. aware, of a present situation and, more importantly, the different elements belonging to that situation (in relation to time, space, etc.)

→ "Individuals performing as teams in these contexts need to develop an accurate common understanding of the situation" (Saner et al., 2009)

Social modes of co-construction:

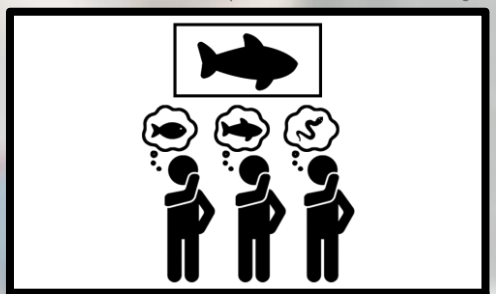
→ To what extent learners refer to contributions of their learning partners (Weinberger, 2006)

→ These social modes can vary between learners externalizing their thoughts to each other (low) to learners operating on each others' contributions (high)

Visualization of others' views

Highlighting points of interest

Awareness of your environment



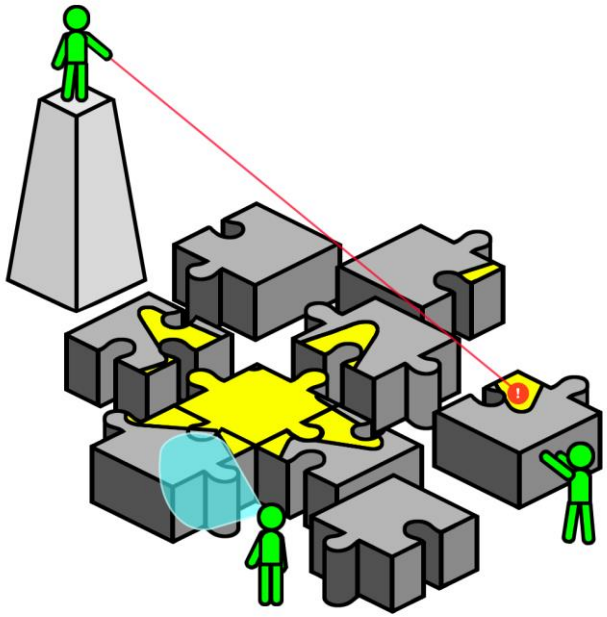
Group awareness of the environment (and how much they overlap)

Building on each others' contributions

Constructive arguments and different points of views leading to agreement

3: Experiment

Prototype v. 0.1



Requirements:

- Multi-user environment
- Two conditions: experimental and controlled
- Collaborative task(s)
  - Communication and collaboration must be central
  - Should be solvable for both conditions
- Repeated measures design
- +/- 30 min. experience

Development:

- Collaboration with VR Zone (TU Delft)
- Arend-Jan Krooneman & Arno Freeke

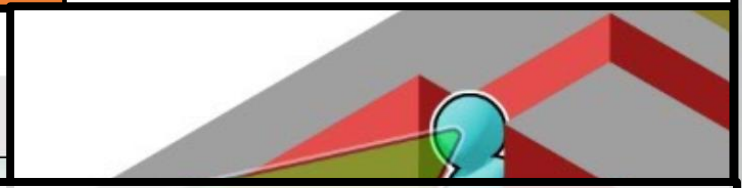
Prototype v. 0.1 (Collaborative jigsaw puzzle)

+ Evokes communication
+ Involves situational awareness
+ Simple to develop

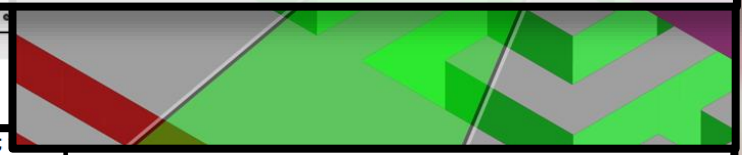
- Collaborative task too simple
- Does not suit repeated measures design

3: Experiment

Prototype v. 0.2



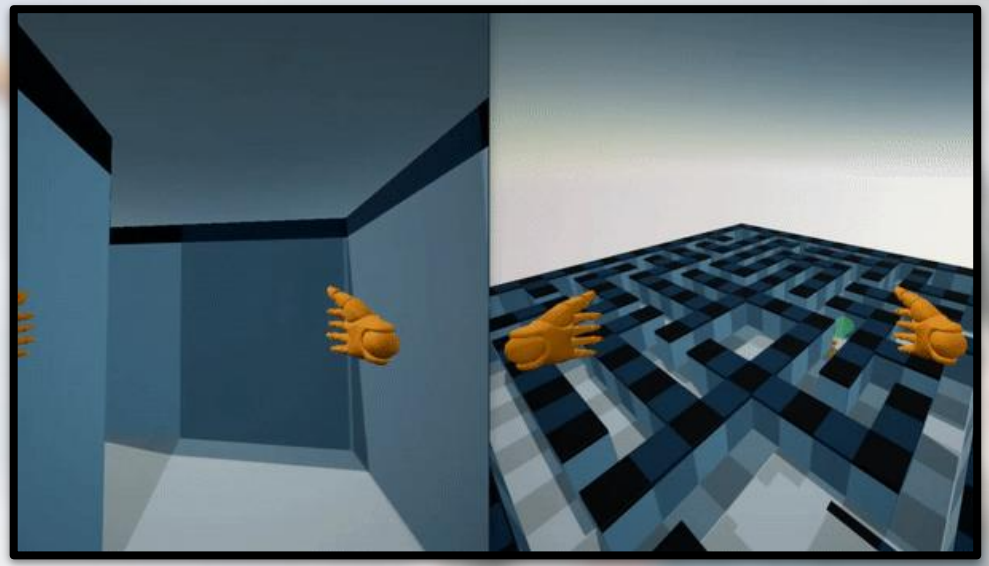
- **Collaborative task(s)**
  - **Communication and collaboration must be central**
  - **Should be solvable for both conditions**
- **Repeated measures design**

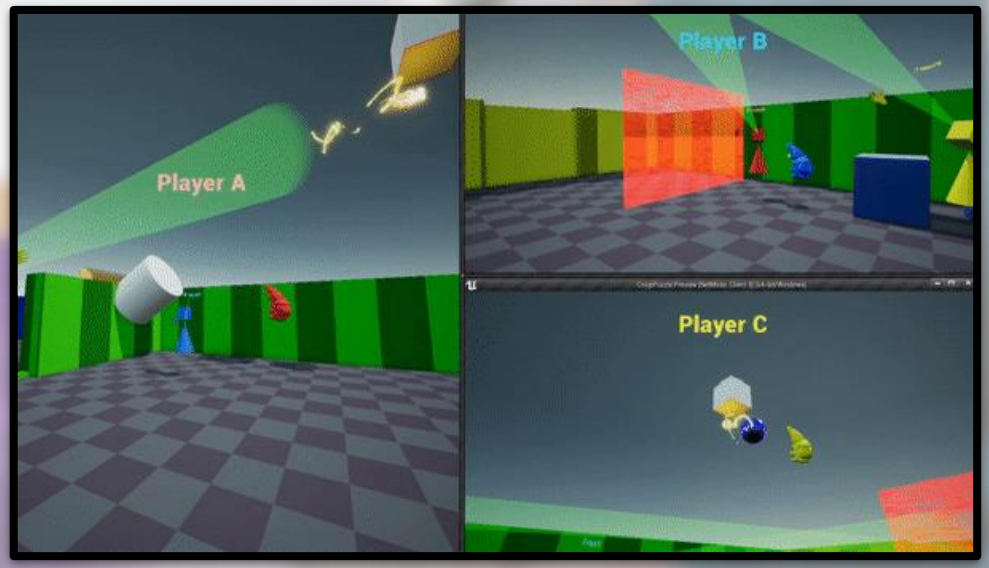


group decides which member does what while solving the task

3: Experiment

Prototype v. 0.2





Prototype v. 0.2 (Maze with collaborative puzzles)

- Maze allows for repeated sessions
- Vantage point evokes (1) communication and (2) roles
- Collaborative puzzles require discussion and joint coordination
- Different puzzles create different types of communication

\+ Maze suits repeated measures design
\+ Different types of collaboration
\+ Supports and enhances collaboration

\- Evoked communication lacks substance
\- Maze sections lack any collaboration aside from vantage point
\- Not all puzzles require situational awareness

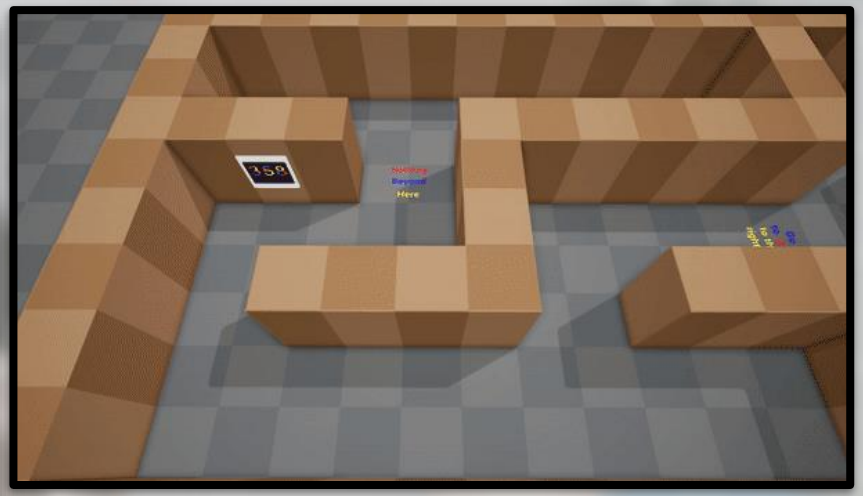
3: Experiment

Prototype v. 1.0

Prototype v. 1.0 (Collaborative maze)

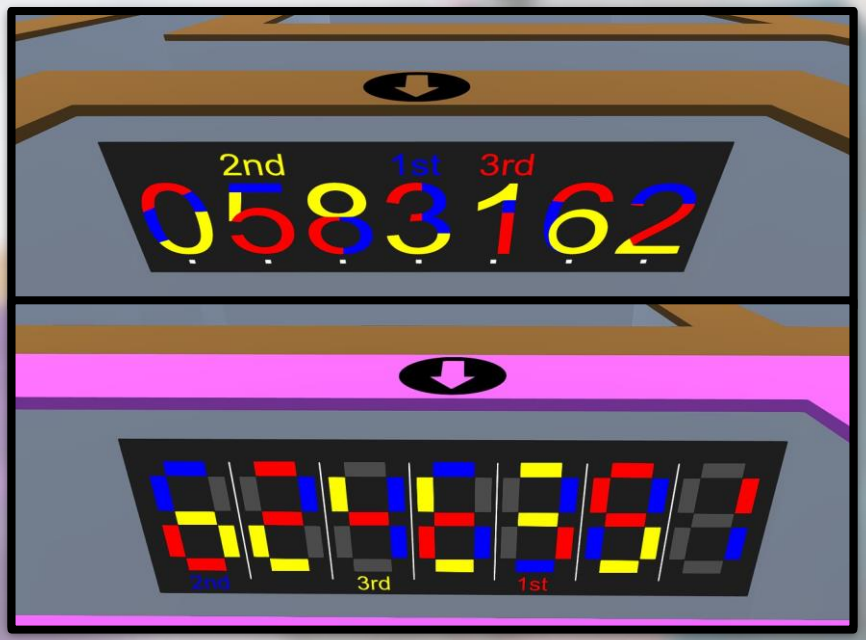
- Maze (still) allows for repeated sessions
- No more vantage points; orientation now relies on elements inside the maze
- One type of puzzle: decipher passcode to open gate to next section of maze
- Puzzles now part of the maze
- One key component throughout experience: each user only sees part of a whole, so all three **must** communicate and collaborate

+ **Maze revolves around collaboration**
+ **Situational awareness is central**
+ **Heavily supports and enhances collaboration**
+ **Requires and evokes communication throughout**



3: Experiment

Passcodes and gates



Collaborative puzzles

Passcodes

- Maze is divided into separate sections
- Each section is locked off by a gate; a (three-numbered) passcode is required to open it
- Passcodes are hidden inside the maze
- Each user only sees one color (yellow, blue or red)
- Each passcode is made up of these three colors; **each user only sees part of the passcode**
- Only through communication and collaboration can the full passcode be deciphered

  → **Communication = progress**
- Passcodes change throughout the maze but core concept remains the same: communication is key

3: Experiment

Markings

Collaborative maze

Markings

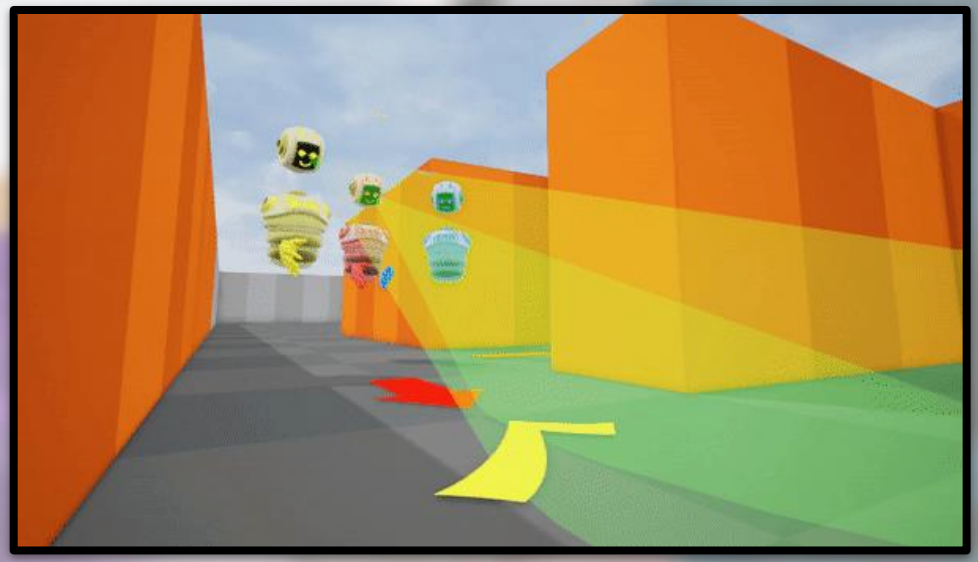
- Similarly to the passcodes, each user only sees one color
- Only through communication (sharing what is seen) is the entire message clear
- Limited information is not enough; the “full picture” is necessary for progression

Types of markings

- Markings change in appearance and use further on
- Use of text and sentences
- Use of symbols (e.g. arrows)
- A combination of symbols and text

3: Experiment

Visualization of actions



Visualization of actions

1: Vision cones

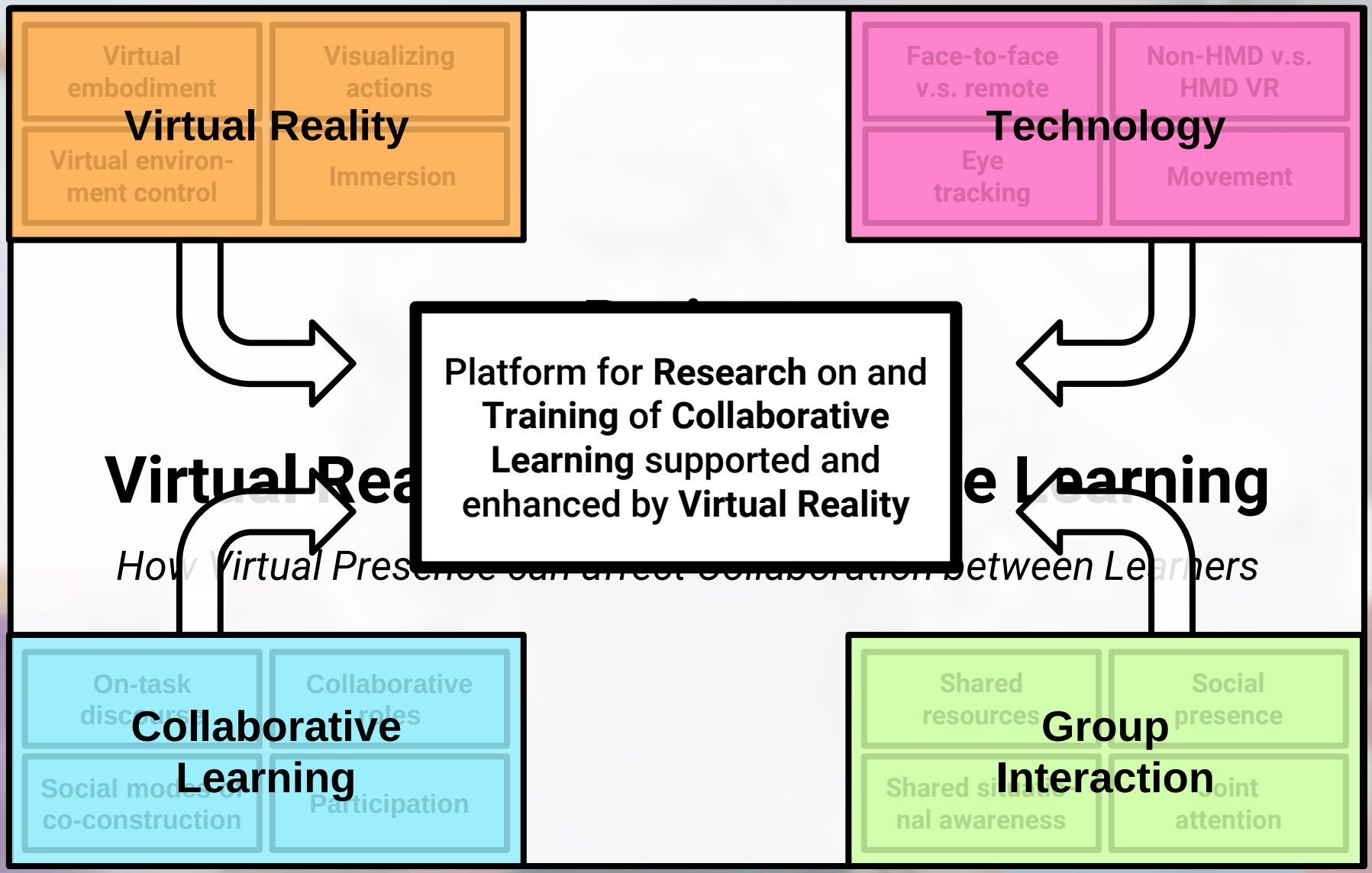
- Visualization of a user's view
- Others can see what is (and isn't) inside a user's vision
- Does knowing what your group members are (and aren't) looking at create a higher level of shared situational awareness and transactivity?

2: Highlighting / pinging

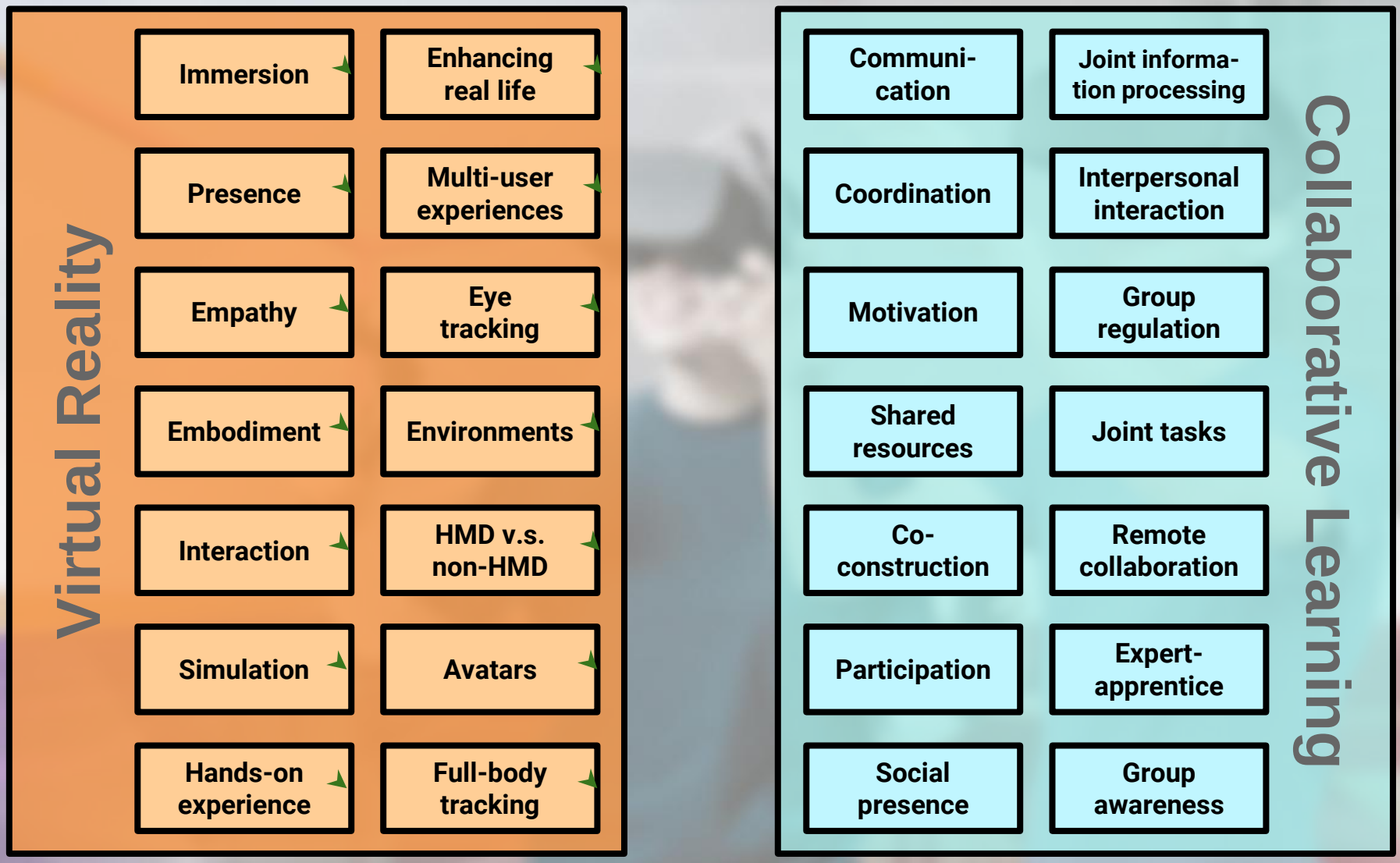
- Ability to highlight anything considered a point of interest
- Used (at will) to attract the attention of other users
- Does the ability to point out any elements of interest at will, both from far away and up close, create a higher level of shared situational awareness and transactivity?

4: Future

Platform for VRCL research and training



5: Discussion



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Thank you for attending!

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Links:

https://www.educationandlearning.nl/projects/virtual-reality-and-collaborative-learning

https://vrzone.tudelft.nl/

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