Methodology to Assess Quality, Presence, Empathy, Attitude, and Attention in Social VR: International Experiences Use Case

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Motivation

• VR technology is achieving great interest in applications for social purposes

It allows the transmission of non-verbal signals such as facial expressions or body postures exchanged during a conversation that influences the effectiveness of face-to-face communications

So, we need methodologies to jointly assess technical parameters such as video quality and socioemotional features such as presence
Research Questions (RQs)

**RQ1:** Is it possible to evaluate video quality in videos of long duration designed for the evaluation of socioemotional features?

**RQ2:** Which technical aspects, such as the position of the camera, the type of conversation, the video quality, the acquisition perspective, etc., influence socioemotional features?

**RQ3:** Which interactive elements can be provided to the user to improve some socioemotional aspects such as presence or attention?
Work Approach

- Each participant was assigned a condition but all the participants visualized the same PVSs

- Observers visualized pre-recorded 360 videos with fluctuations of quality, simulating a VR streaming communication

| Condition | Assessment | Interactive element |
|-----------|------------|---------------------|
| A         | X          | Socioemotional      |
| B         | X          | Hands               |
| C         | X          |                     |
• Observers visualized pre-recorded 360 videos with fluctuations of quality, simulating a VR streaming communication.

• Each participant was assigned a condition but all the participants visualized the same PVSs.
Material test

Student Experiences Around the World (SEAW) dataset

| Name              | Genre              | Perspective-taking | Description                                                                 |
|-------------------|--------------------|--------------------|-----------------------------------------------------------------------------|
| Coffee shop       | Everyday conversation | Observer           | A coffee conversation between foreign and local students about cultural differences |
| International office | Educational       | Actor              | A presentation given by a professor to students about the foreign application process |
| Study in Spain    | Discussion         | Actor              | A conversation about the differences between transport and rental prices in different countries |
QP: 15, 22, 27, 32, 37, and 42

Student Experiences Around the World (SEAW) dataset

- Sequences were encoded with HEVC switching to a different QP each 25 seconds (randomized) to create one PVS per content

- Participants from condition A rated the quality of each one of the 25-seconds along the whole sequence

- Duration: ≈ 5 minutes
Test session

Video x3

Explanation | Pre-session questionnaire | Training session | QP 1 | QP 2 | QP 3 | QP N | Post-video questionnaire

If condition A:

QP 1 vote* | QP 2 | QP 3 | QP N vote*

25s

≈ 5s

25s

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Methodology

- **Personal information**
- **Empathy**: Interpersonal Reactivity Index (IRI)
- **Attitude**: designed questionnaire based on Facet theory
- **Quality**: SSDQE and ACR
- **Attention**: three questions that had pass/fail answers
- **Spatial and social presence**: aggregate measure of five items
- **Notes**: have your annotations helped you to solve the questions?
**Methodology**

Structure of the test sequences used with Single-Stimulus Discrete Quality Evaluation (SSDQE) methodology

- **SSDQE**
  - Processed segment
  - Evaluation segment
  - Processed segment

- **ACR**
  - the aggregate quality was asked in the post-questionnaire:

| Condition | Pre-questionnaire (once) | During each content | Post-questionnaire (for each content) |
|-----------|--------------------------|---------------------|---------------------------------------|
|           | Personal information | Empathy (IRI) | Attitude | Quality (SSDQE) | Quality (ACR) | Attention | Attitude | Spatial and Social Presence | Notes |
| A         | X                        | X                 | X           | X                | X                | X          | X       | X                        | X     |
| B         | X                        | X                 | X           | X                | X                | X          | X       | X                        | X     |
| C         | X                        | X                 | X           | X                | X                | X          | X       | X                        | X     |

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## Methodology

### Spatial Presence
- I felt I was present in the places shown in the video
- I felt surrounded by the actions in the video
- I felt I was sitting by the table at the place of the video
- I felt I could have reached out and touched the items on the table of the video
- I felt that all my senses were stimulated at the same time

### Social Presence
- I felt that people were talking to me
- I felt that I was listening to the others in the video
- I felt I was present with the other people in the video
- I felt like the people in the video could see me
- I felt I was actually interacting with other people

| Condition | Personal Information | Empathy (IRI) | Attitude | Quality (SSDQE) | Quality (ACR) | Attention | Attitude | Spatial and Social Presence |
|-----------|----------------------|---------------|----------|-----------------|---------------|-----------|----------|---------------------------|
| A         | X                    | X             | X        | X               | X             | X         | X        | X                         |
| B         | X                    | X             | X        | X               | X             | X         | X        | X                         |
| C         | X                    | X             | X        | X               | X             | X         | X        | X                         |

- 1: Strongly disagree
- 7: Strongly agree

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A total of 54 observers:
- 20 females
- 34 males
- age range between 17 and 26 years
- international experiences or nationalities from 15 countries in Europe, America, and Asia
Results

**H1**: video quality evaluation can be adapted to long-duration videos designed for socioemotional features assessment purposes

- **not significant difference** between QP values of 15 and 22
- **significant difference** between the rest of QP values
**Results**

**H1**: video quality evaluation can be adapted to long-duration videos designed for socioemotional features assessment purposes

- 😊 good distribution of the ratings and a consistent decrease of the perceived quality when increasing the QP, as expected in this type of tests

*DMOS was calculated with QP of 22 as hidden reference*
Results

Aggregate quality

| Questionnaire items          | Coffee shop | International office | Study in Spain | Significance     |
|-----------------------------|-------------|----------------------|----------------|-----------------|
| Aggregate quality (5-level scale) | M = 3.111   | M = 3.222            | M = 3.481      | $F_{2,153} = 2.485, p > .05$ |
|                             | (SD = .904) | (SD = .883)          | (SD = .885)    |                 |

| Questionnaire items          | Condition A | Condition B | Condition C | Significance     |
|-----------------------------|-------------|-------------|-------------|-----------------|
| Aggregate quality (5-level scale) | M = 3.537   | M = 3.111   | M = 3.167   | $F_{2,153} = 3.687, p < .05$ |
|                             | (SD = .719) | (SD = 1.022)| (SD = .883) |                 |

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H1 - conclusions:

- Subjects are able to assess the video quality of individual QPs and the content does not distract them from this task (assess the video quality)

- Growth of the ecological validity of the quality evaluation compared with traditional methods

- Participants that are focused on the quality evaluation along the sequence, change their perspective about the perceived global quality (aggregate quality)
### Results

**H2:** acquisition perspective, type of the conversation, and experimental condition have influence on: spatial and social presence

| Questionnaire items                  | Condition A | Condition B | Condition C | Significance |
|-------------------------------------|-------------|-------------|-------------|--------------|
| Aggregate quality (5-level scale)   | M = 3.537   | M = 3.111   | M = 3.167   | $F_{2,153} = 3.687$, $p < .05$ |
|                                     | (SD = .719) | (SD = 1.022)| (SD = .885) |              |
| Spatial Presence (7-level scale)    | M = 5.463   | M = 5.185   | M = 5.411   | $\chi^2 = .726$, $p > .05$, df = 2 |
|                                     | (SD = 1.019)| (SD = 1.318)| (SD = .942) |              |
| Social Presence (7-level scale)     | M = 5.059   | M = 5.133   | M = 5.144   | $\chi^2 = .09$, $p > .05$, df = 2 |
|                                     | (SD = 1.398)| (SD = 1.287)| (SD = 1.271)|              |
| Change in attitude (7-scale level)  | M = 1.931   | M = 2.514   | M = 2.250   | $F_{2,153} = 4.309$, $p < .05$ |
|                                     | (SD = 1.026)| (SD = 1.024)| (SD = 1.030)|              |
| Attention (3-level scale)           | M = 1.981   | M = 1.833   | M = 1.685   | $F_{2,153} = 1.839$, $p > .05$ |
|                                     | (SD = .765) | (SD = .885) | (SD = .748) |              |
**Results**

**H2:** acquisition perspective, type of the conversation, and experimental condition have influence on: spatial and social presence

| Questionnaire items                        | Coffee shop | International office | Study in Spain | Significance       |
|-------------------------------------------|-------------|----------------------|----------------|--------------------|
| Aggregate quality (5-level scale)         | M = 3.111   | M = 3.222            | M = 3.481      | $F_{2,153} = 2.485$, $p > .05$ |
|                                           | (SD = .904) | (SD = .883)          | (SD = .885)    |                    |
| Spatial Presence (7-level scale)          | M = 5.326   | M = 5.200            | M = 5.533      | $\chi^2 = 4.734$, $p > .05$, df = 2 |
|                                           | (SD = 1.173) | (SD = 1.137)        | (SD = .991)    |                    |
| Social Presence (7-level scale)           | M = 4.748   | M = 4.752            | M = 5.837      | $\chi^2 = 39.166$, $p < .01$, df = 2 |
|                                           | (SD = 1.364) | (SD = 1.280)      | (SD = .964)    |                    |
| Change in attitude (7-scale level)        | M = 2.292   | M = 2.046            | M = 2.356      | $F_{2,153} = 1.352$, $p > .05$ |
|                                           | (SD = .956) | (SD = 1.064)        | (SD = 1.111)   |                    |
| Attention (3-level scale)                 | M = 2       | M = 1.704            | M = 1.796      | $F_{2,153} = 1.925$, $p > .05$ |
|                                           | (SD = .777) | (SD = .743)          | (SD = .877)    |                    |
A method to simultaneously assess video quality and socioemotional features

- SSDQE is valid to evaluate individual quality variations
- SSDQE does not affect the evaluation of presence or attention

SSDQE affects the evaluation of the aggregate quality of the sequence
SSDQE has a small impact but statistically significant on the attitude change of observers
The experiment has been carried out in a specific type of content and context
Contributions

• **SSDQE methodology.** We propose and validate a methodology to jointly assess video quality and presence, empathy, attitude, and attention in VR communications
  — Extension of the experiment in progress: ACR and SSCQE

• **Video quality assessment in immersive communications**

• **Dataset.** We will make publicly available a Student Experiences Around the World dataset (**SEAW-dataset**) of 3 video sources (stereoscopic raw format) designed and acquired specifically for the purposes of the experiment.
  — Additionally, the questionnaires and the associated rates obtained from a diverse and balanced sample of 54 participants are provided
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https://arxiv.org/abs/2103.02550

Thank you!

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