

# Analysis of environmental context factors impacting human perception and assessment of 360° video quality

Tomasz Konaszynski

AGH University of Science and Technology, Krakow, Poland

konaszyn@agh.edu.pl

## MOTIVATION

- The goal of this project is to gain the right knowledge to understand better how the context of a subjective experiment influences the assessment of Quality of Experience (QoE) when using 360 video
- The subjective QoE rating is a complicated creation. People are asked to evaluate the QoE of stimuli during subjective, traditional experiments carried out in the laboratory designed in accordance to the specific ITU standards
- Laboratory conditions differ significantly from the circumstances in which virtual reality is usually used. In this mode of action of participants of a subjective experiment, quality assessments come down to a pure determination of the gradation of technical parameters
- A better understanding of the factors affecting the context of the investigation will provide a factual basis for changing the current pattern in the future, and the research will have significant ecological validity
- The result of the project is a description of specific contextual factors affecting QoE (along with their theoretical foundations) for 360 video, and a proposal for their operationalization to be better measurable in future analyses

## RESEARCH QUESTIONS

- RQ1** How does the physical context (environment) influence the QoE assessment of 360° video?
- RQ2** How does the social context (inter-personal relations existing during the experience) influence the assessment of 360° video?
- RQ3** How does temperature in the environment influence the assessment of 360° video?
- RQ4** How do acoustic interruptions from the environment influence the QoE assessment of 360° video?
- RQ5** How does the hungeriness of a subject influence the assessment of 360° video?
- RQ6** How does a change in equipment influence the assessment of 360° video?
- RQ7** How does an application of epidemic precautions (COVID-19) influence the assessment of 360° video?

## RESEARCH METHODOLOGY

**General approach:** Idea of finding answers for the RQs defined in Section 1 is to compare the results of subjective experiments conducted under relevant conditions. Such comparisons would explain how selected CIFs influence the QoE assessment scores. It is planned to conduct 18 tests – one condition per test.

cond.	location	number of subjects	hungeriness	temp.	sound	epidemic precautions	HTC Vive Pro Eye	Varjo VR-3	RQ1	RQ2	RQ3	RQ4	RQ5	RQ6	RQ7
C1	lab	single	NO	room	silence	YES	x	-	x	x	x	x	x	-	x
C2	lab	single	NO	room	silence	YES	-	x	x	x	x	x	x	-	x
C3	lab	pair	n/s	room	silence	YES	x	-	x	x	x	x	x	-	x
C4	lab	pair	n/s	room	silence	YES	-	x	x	x	x	x	x	-	x
C5	lab	single	n/s	room	silence	YES	1st	2nd	-	-	-	-	-	-	x
C6	lab	single	n/s	room	silence	YES	2nd	1st	-	-	-	-	-	-	x
C7	lab	single	YES	room	silence	YES	x	-	-	-	-	-	-	-	x
C8	lab	single	YES	room	silence	YES	-	x	-	-	-	-	-	-	x
C9	public	single	n/s	n/s	silence	YES	x	-	x	-	-	-	-	-	-
C10	public	single	n/s	n/s	silence	YES	-	x	x	-	-	-	-	-	-
C11	lab	single	n/s	low	silence	YES	x	-	-	-	x	-	-	-	-
C12	lab	single	n/s	low	silence	YES	-	x	-	-	x	-	-	-	-
C13	lab	single	n/s	room	music	YES	x	-	-	-	x	-	-	-	-
C14	lab	single	n/s	room	music	YES	-	x	-	-	x	-	-	-	-
C15	lab	single	n/s	room	noise	YES	x	-	-	-	x	-	-	-	-
C16	lab	single	n/s	room	noise	YES	-	x	-	-	x	-	-	-	-
C17	lab	single	n/s	room	silence	NO	x	-	-	-	-	-	-	-	x
C18	lab	single	n/s	room	silence	NO	-	x	-	-	-	-	-	-	x

**Test Environments:** we are planning to arrange tests in two types of locations: private and public.

**Subjects:** A recruitment agency will randomly select subjects. The groups per experiment will be demographically balanced in terms of the age of several men and women, the level of education. We are planning to invite 540 different persons in total in this project (not aiming to have a common set).

**Pool of Source Sequences:** The database of source sequences will be formulated in task T1.3. This database will consist of about 20 source sequences (SRC) with realistic, natural, entertainment-oriented professional content.

**Processed Video Sequences (PVSes) in Experiments:** Generally, each SRC sequence will be compressed to four levels to produce PVS. The selection of compression levels will be made based on internal (team) assessment sessions.

**Test equipment:** High-quality consumer VR system with high resolution suport (HTC Vive Pro Eye and Varjo VR-3). Workstation with configuration supporting a playback card with HDMI/SDI interface, two fast 2TB SSD storage disks (>1.5 GB/s read).

**Analysis and Presentation of Results:** An analysis of the results of subjective quality experiments will be performed to verify whether each CIF impacts the QoE assessment scores. The problem considered in this project calls for a formal solution – a statistical method, owing to the large amount of ordinal QoE data collected. To perform comparisons with the results of self-report questionnaires, two specific statistical tests will be designed. The first is a test for stochastic dominance to assess which sample is more dominant (receives stochastically higher scores). The second one will be designed for practical reasons and will estimate the shift of the mean value to provide an estimator of the difference.

## RESEARCH PLAN

	2023				2024			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
<b>WP1 Experiments Preparation</b>								
T1.1 Software&Hardware Tools Preparation								
T1.2 Test Procedures Preparation								
T1.3 Content Selection								
T1.4 Stimuli Preparation								
<b>WP2 Execution of Subjective Experiments</b>								
T2.1 Subjects Pools Per Test								
T2.2 Detailed Schedule per Test								
T2.3 Conduction of Tests								
T2.4 Formulation of Conclusions per Test								
<b>WP3 Results Analysis</b>								
T3.1 Introductory Analysis								
T3.2 Answers for RQs								
T3.3 Formulation of General Conclusions								
<b>WP4 Dissemination</b>								
T4.1 Discussion of results								
T4.2 Tutorial on Best Practise								

## REFERENCES

- S. Möller and A. Raake, editors. *Quality of Experience*. T-Labs Series in Telecommunication Services. Springer International Publishing, Cham, 2014.
- K. De Moor, M. Fiedler, P. Reichl, and M. Varela. Quality of experience: From assessment to application (dagstuhl seminar 15022). In *Dagstuhl Reports*, volume 5. Schloss Dagstuhl-Leibniz- Zentrum fuer Informatik, 2015.
- S. Jumisko-Pyykkö and T. Vainio. Framing the Context of Use for Mobile HCI. *International Journal of Mobile Human Computer Interaction*, 2(4):1–28, jan 2010.
- P. Le Callet, S. Möller, and A. Perkis. Qualinet White Paper on Definitions of Quality of Experience (2012). Qualinet White Paper on Definitions of Quality of Experience Output from the fifth Qualinet meeting, Novi Sad, March 12, 2013, 2013.
- M. Hassenzahl, A. Wiklund-Engblom, A. Bengs, S. Hägglund, and S. Diefenbach. Experienceoriented and product-oriented evaluation: psychological need fulfillment, positive affect, and product perception. *International journal of human-computer interaction*, 31(8):530–544, 2015.
- M. Fiedler, S. Möller, and P. Reichl. Quality of experience: From user perception to instrumental metrics (Dagstuhl Seminar 12181). In *Dagstuhl Reports*, volume 2. Schloss Dagstuhl-Leibniz- Zentrum fuer Informatik, 2012.