Validation of a virtual audience in VR environments

ETIENNE E. [a]

LECLERCQ A.-L.[bcd]

REMACLE A. [b]

SCHYNS M.[a]

[a]QuantOM , HEC Liège, University of Liège
[b] Département de Logopédie, Université de Liège
[c] Unité de Recherche Enfances
[d] Clinique Psychologique et Logopédique de l'Université de Liège

Introduction

How to improve public speaking performances ?

Definitions

Valence: corresponds to how positively or negatively the attendee (avatar in our context) feels toward the speaker (with VR headset) or the presentation

Arousal: audience member's level of alertness

Virtual environment for training
3-step process

Audience

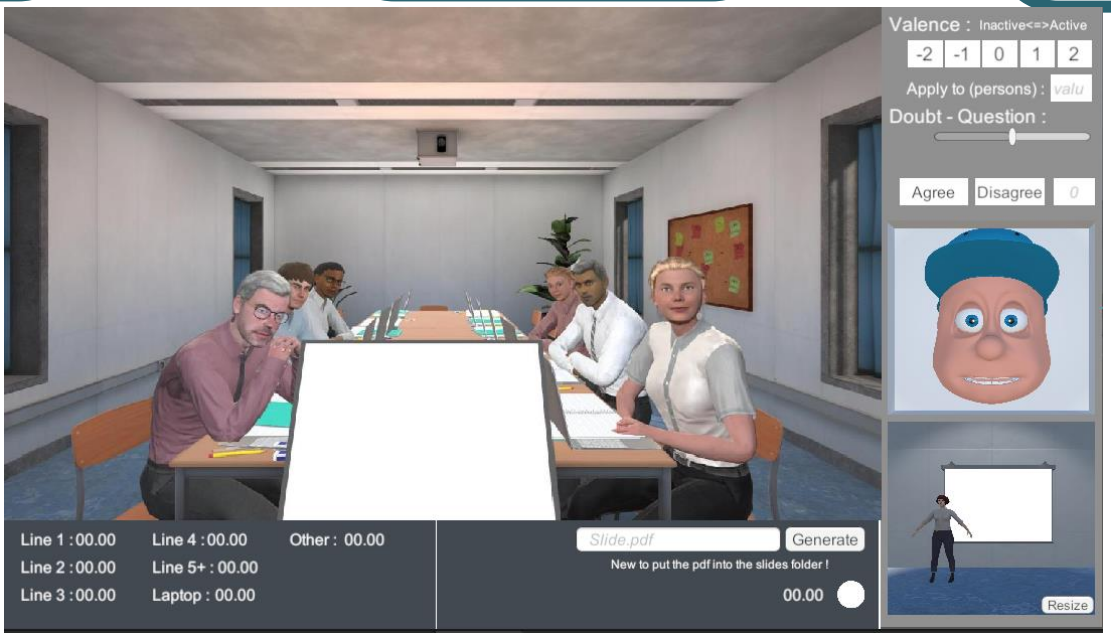
Creation of an interactive audience

Emotions detection

Voice and Speech analysis with Statistics, NLP, ML and DL approaches

Training

Public speaking training in virtual reality



Outline

I. Aims
II. Experiment
    i. Environment
    ii. Avatars used
    iii. Headsets used
    iv. Attitudes
III. Results
    i. Valence and arousal in terms of the attitudes
    ii. Drawn models VS Photorealisitc models
    iii. Low-end headset VS High-end headset
IV. Conclusions

Aims

Creation of a library of animated avatars

Virtual environment for public speaking training with an interactive and challenging audience

→ **Creation of a library of animated avatars**

- **To understand how some attitudes of a virtual audience are perceived in <u>Virtual Reality</u> (valence – arousal)**
- To study the impact of graphism used
- To study the impact of headset used

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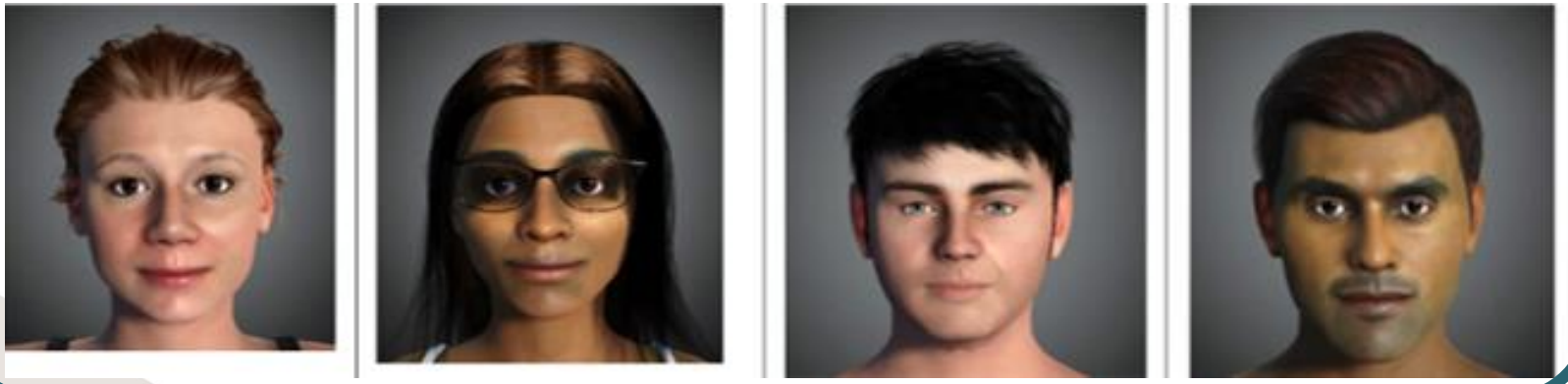
Experiment

Emotional valence and the level of arousal in VR

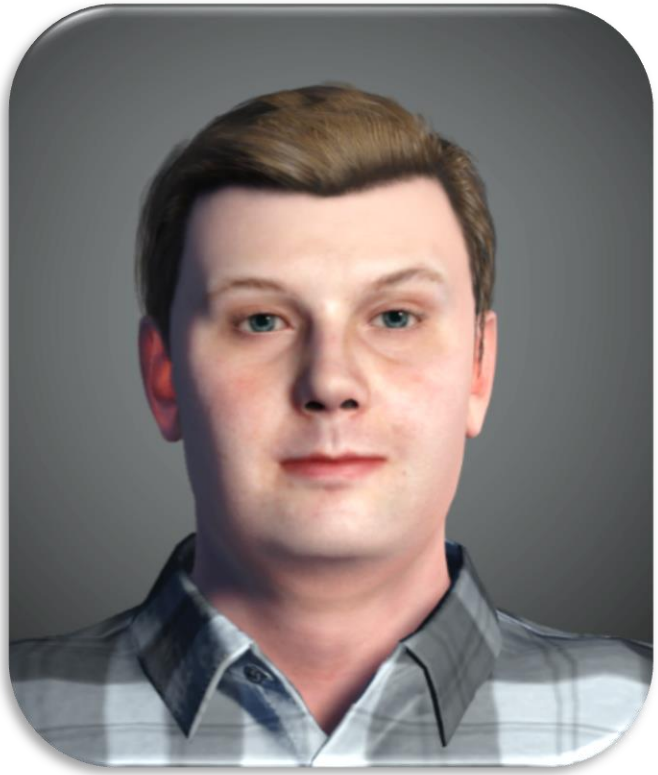
Avatars used

Sketched models

Photorealistic models



Photorealistic models : based on actual pictures



Headsets used

Low-end headset

- Basic quality
- Affordable
- Portability (smartphone and headset)
- No knowledge needed

High-end headset

- High quality
- Expensive (headset, computer)
- Heavy material

- Technical knowledge needed

Attitudes:
Identify typical groups of attitudes

Postures and hands:

- P1: Backward posture – Arms crossed
- P2: Backward posture –Arms stand (elbows on the table with hands crossed)
- P3: Backward posture – Arms behind the head
- P4: Upright posture – Hand on hand (hands on the table, one on top of the other)
- P5: Upright posture – Hands together (hands crossed on the table)
- P6: Upright posture – Hands separated in front
- P7: Forward posture – Hands together
- P8: Forward posture – Arms stand (elbows on the table with hands crossed)
- P9: Froward posture – Arms crossed

Facial expressions:

- F1: None
- F2: Smiling
- F3: Frowning
- F4: Eyebrows raised

Head movements:

H1: None
H2: Nod
H3: Shake
H4: Questioning (head tilted at 45 degrees)

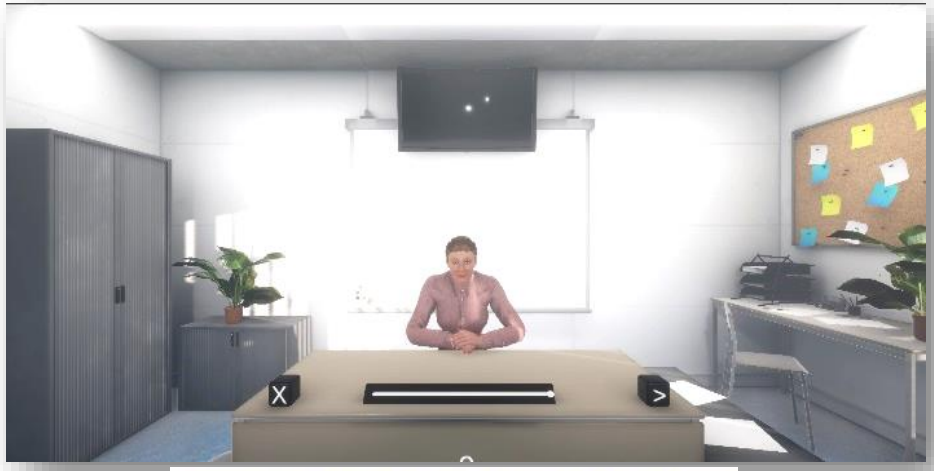
144 possible combinations

40 attitudes

Seq. 1	Seq. 2	Seq. 3	Seq. 4	Seq. 5	Seq. 6	Seq. 7	Seq. 8	Seq. 9	Seq. 10
P1F3H4	P3F4H2	P7F2H2	P7F2H4	P7F3H3	P7F4H3	P7F4H4	P9F1H2	P9F2H3	P9F3H3
Seq. 11	Seq. 12	Seq. 13	Seq. 14	Seq. 15	Seq. 16	Seq. 17	Seq. 18	Seq. 19	Seq. 20
P2F2H3	P2F4H2	P3F3H3	P3F4H3	P4F4H1	P4F4H3	P5F3H1	P7F3H1	P8F4H1	P9F1H3
Seq. 21	Seq. 22	Seq. 23	Seq. 24	Seq. 25	Seq. 26	Seq. 27	Seq. 28	Seq. 29	Seq. 30
P2F1H2	P2F4H4	P3F1H2	P3F3H2	P3F4H4	P4F1H2	P5F1H4	P6F3H4	P7F1H1	P7F1H2
Seq. 31	Seq. 32	Seq. 33	Seq. 34	Seq. 35	Seq. 36	Seq. 37	Seq. 38	Seq. 39	Seq. 40
P1F3H1	P2F4H3	P3F2H3	P3F4H1	P4F1H3	P4F2H2	P6F3H3	P7F1H4	P7F4H3	P8F3H4

Experiment

- 125 participants
- 40 sequences of attitudes were tested
- 7-point Likert scale
- Gatineau Presence Questionnaire



Vidéo 1	Faible	1	2	3	4	5	6	7	Elevé
Valence		○	○	○	○	◉	○	○	
Confiance		○	○	○	◉	○	○	○	
Eveil		○	○	○	○	◉	○	○	
Confiance		○	○	○	○	○	◉	○	

GPQ

- Feeling of presence
- Level of realism
- Level of artificiality
- Spatial awareness

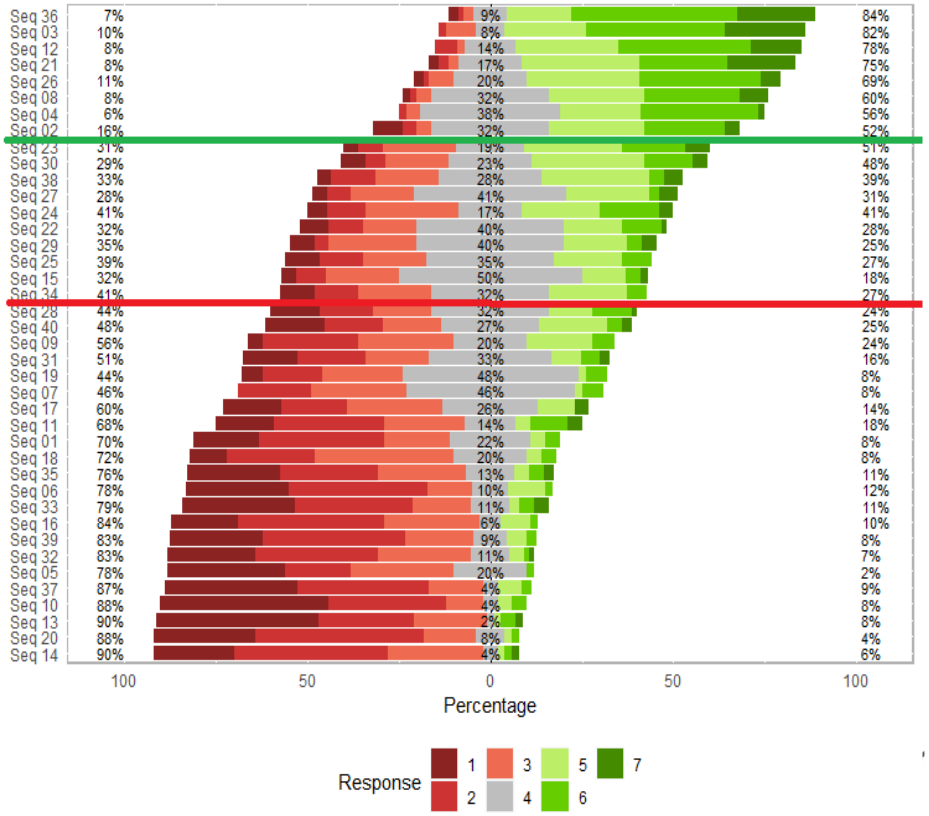
Results

Valence and arousal in terms of the attitudes

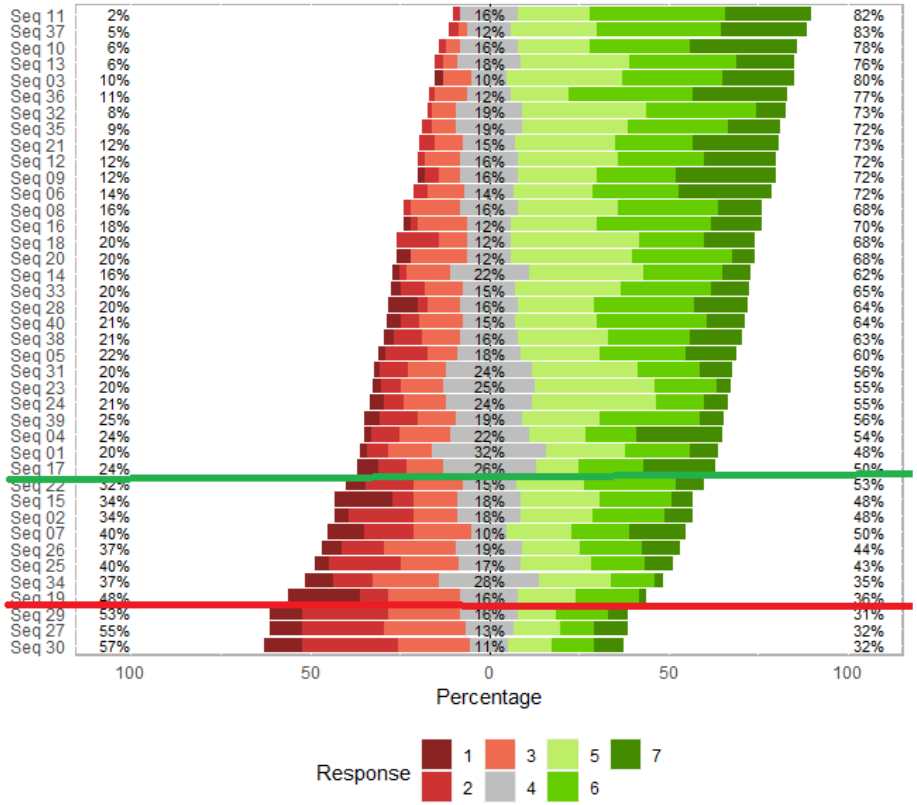
Results for the sequences

- Analysis of the level of arousal and valence at a gesture level
- Analysis of the level of arousal and valence for the combinations

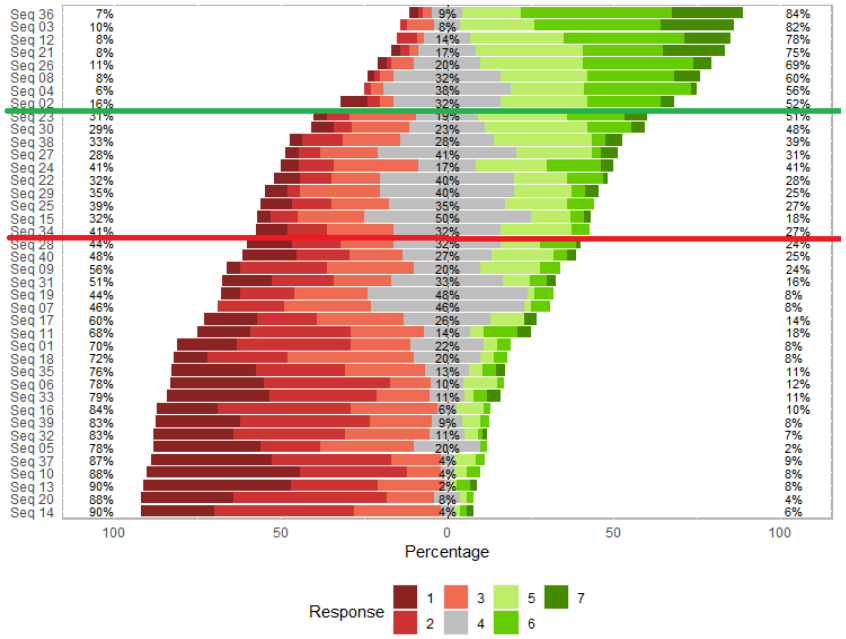
Valence per sequence

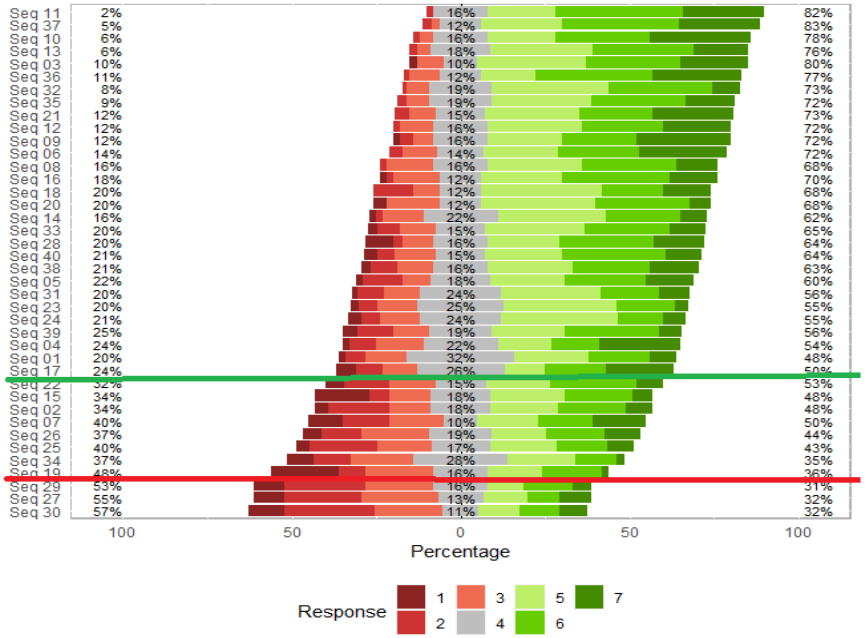


Arousal per sequence



Sequences





Valence:

- Most positive valence : Sequence 36 = P4F2H2= upright posture, hands on top of each other, neutral facial expression, and nodding the head
- Most negative valence : Sequence 14 = P3F4H3 = backward posture, hands behind the head, frowning eyes, and shaking the head

Arousal:

- Highest level of arousal : Sequence 11 = P2F2H3 = backward posture, elbows on the table, smiling face, shaking the head
- Lowest level of arousal : Sequence 30 = P7F1H2 = forward posture, hands together, neutral face, nodding the head

Library of animated avatars correspoding to some level of valence and arousal

Table 7: Sequences per level of valence and arousal

	Negative valence	Neutral valence	Positive valence
Low level of arousal	∅	Seq. 27: P5F1H4 Seq. 29: P7F1H1 Seq. 30: P7F1H2	∅
Neutral arousal	Seq. 07: P7H4H4 Seq. 19: P8F4H1	Seq. 15: P4F4H1 Seq. 22: P2F4H4 Seq. 25: P3F4H4 Seq. 34: P3F4H1	Seq. 02: P3F4H2 Seq. 26: P4F1H2
High level of arousal	Seq. 01: P1F3H4 Seq. 05: P7F3H3 Seq. 06: P7F4H3 Seq. 09: P9F2H3 Seq. 10: P9F3H3 Seq. 11: P2F2H3 Seq. 13: P3F3H3 Seq. 14: P3F4H3 Seq. 16: P4F4H3 Seq. 17: P5F3H1 Seq. 18: P7F3H1 Seq. 20: P9F1H3 Seq. 28: P6F3H4 Seq. 31: P1F3H1 Seq. 32: P2F4H3 Seq. 33: P2F2H3 Seq. 35: P4F1H3 Seq. 37: P6F3H3 Seq. 39: P7F4H3 Seq. 40: P8F3H4	Seq. 23: P3F1H2 Seq. 24: P3F3H2 Seq. 38: P7F1H4	Seq. 03: P7F2H2 Seq. 04: P7F2H4 Seq. 08: P9F1H2 Seq. 12: P2F4H2 Seq. 21: P2F1H2 Seq. 36: P4F2H2

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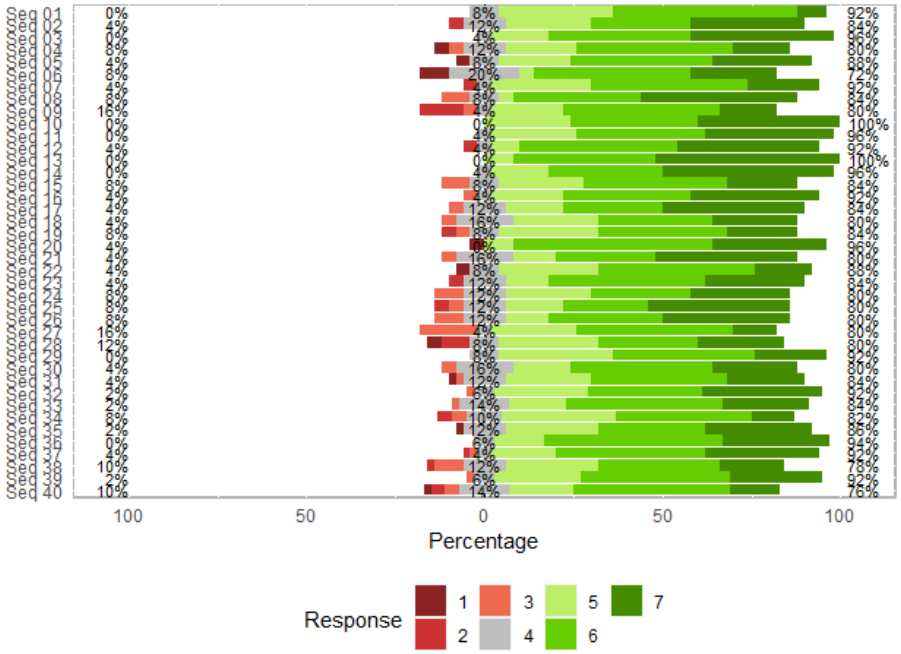
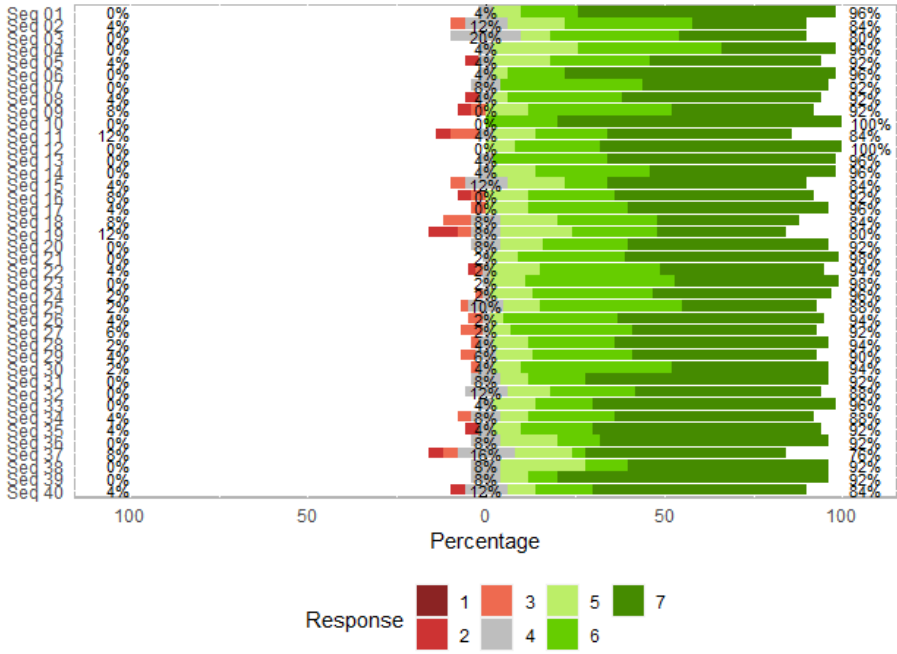
Drawn VS Photorealisitc models

Sketched models VS Photorealistic models

- Similar results for both models in terms of the emotional valence and the level of arousal
- Confidence level improved with photo-realistic avatars for both the emotional valence and the level of arousal



Confidence level for sketched avatars

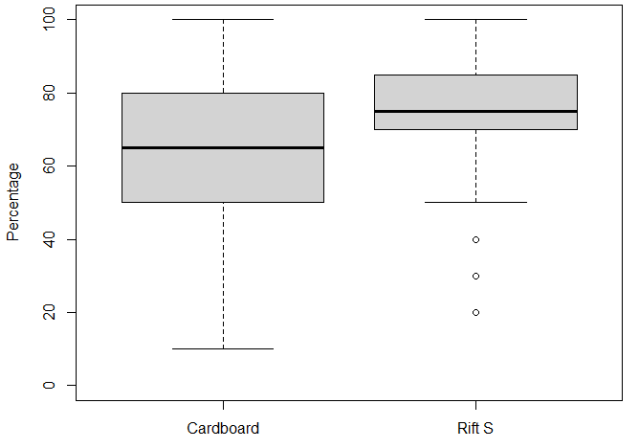


Confidence level for photo-realisic avatars

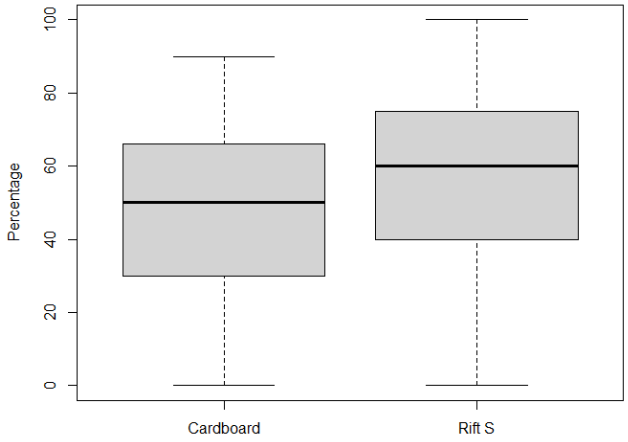
Low-end VS High-end headsets

Low-end VS High-end

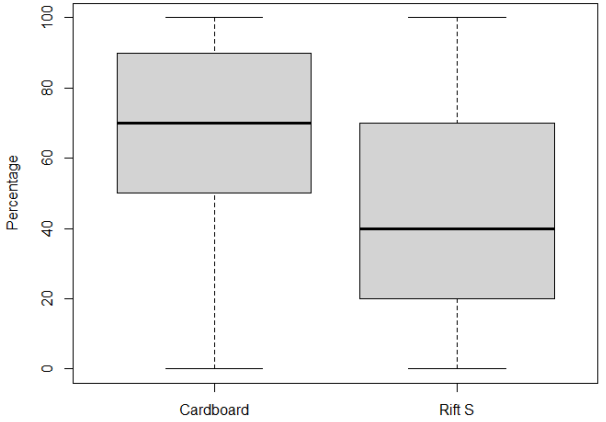
- Similar results for valence
- Higher level of arousal with high-end headset
- Similar results for confidence level
- Quality of immersion improved with high-end headset :



Presence



Realism



Spatial Awareness

Conclusions

Conclusions & Future work

- **Creation of a library of animated avatars associated with some levels of arousal and valence to be used in a VR training environment.**
- **Photorealistic avatars improved the confidence level**
- **High-end headset improved the quality of immersion but low-end headset can be used for this purpose (similar results)**

Next steps:

- Detection of emotions
- Autonomous audience
- Training environment

The end

Thank you

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Annexe

Table 6: P-values and interpretations of the test where the null hypothesis is $p_- = p_+$ for the valence and arousal per sequence

	Valence					Arousal				
Sequence	Interpretation non-verbal behaviour	Proportions p_-	p_+	P-value	Interpretation	Interpretation non-verbal behaviour	Proportion p_-	p_+	P-value	Interpretation
1: P1F3H4	- - -	70%	8%	< 0.0001	-	+ + +	20%	48%	0.066	/
2: P3F4H2	- - +	16%	52%	0.0162	+	+ + +	34%	48%	0.3961	/
3: P7F2H2	/ / +	10%	82%	< 0.0001	+	+ + +	10%	80%	< 0.0001	+
4: P7F2H4	/ / -	6%	56%	0.0007	+	+ + +	24%	54%	< 0.0001	+
5: P7F3H3	/ - -	78%	2%	< 0.0001	-	+ + +	22%	60%	0.0109	+
6: P7F4H3	/ - -	78%	12%	< 0.0001	-	+ + +	14%	72%	0.0001	+
7: P7F4H4	/ - -	46%	8%	0.0109	-	+ + +	40%	50%	0.5716	/
8: P9F1H2	- / +	8%	60%	0.0004	+	+ + +	16%	68%	0.0004	+
9: P9F2H3	- / -	56%	24%	0.0339	-	+ + +	12%	72%	< 0.0001	+
10: P9F3H3	- - -	88%	8%	< 0.0001	-	+ + +	6%	78%	< 0.0001	+
11: P2F2H3	- / -	68%	18%	0.0007	-	+ + +	2%	82%	< 0.0001	+
12: P2F4H2	- - +	8%	78%	< 0.0001	+	+ + +	12%	72%	< 0.0001	+
13: P3F3H3	- - -	90%	8%	< 0.0001	-	+ + +	6%	76%	< 0.0001	+
14: P3F4H3	- - -	90%	6%	< 0.0001	-	+ + +	16%	62%	0.0019	+
15: P4F4H1	/ - -	32%	18%	0.3961	/	+ + +	34%	48%	0.3961	/
16: P4F4H3	/ - -	84%	10%	< 0.0001	-	+ + +	18%	70%	0.0004	+
17: P5F3H1	- - -	60%	14%	0.0019	-	/ + +	24%	50%	0.0897	/
18: P7F3H1	/ - -	72%	8%	< 0.0001	-	+ + +	20%	68%	0.0011	+
19: P8F4H1	- - -	44%	8%	0.0162	-	/ + +	48%	36%	0.4795	/
20: P9F1H3	- / -	88%	4%	< 0.0001	-	+ + +	20%	68%	0.0011	+
21: P2F1H2	- / +	8%	75%	< 0.0001	+	+ + +	12%	73%	< 0.0001	+
22: P2F4H4	- - -	32%	28%	0.8174	/	+ + +	32%	53%	0.1036	/
23: P3F1H2	- / +	30%	51%	0.106	/	+ + +	20%	55%	0.0039	+
24: P3F3H2	- - +	42%	41%	1	/	+ + +	21%	55%	0.0056	+
25: P3F4H4	- - -	38%	27%	0.3556	/	+ + +	40%	43%	0.9081	/
26: P4F1H2	// +	11%	69%	< 0.0001	+	+ + +	37%	44%	0.6442	/
27: P5F1H4	- / -	28%	31%	0.9081	/	/ + +	55%	32%	0.0647	-
28: P6F3H4	- - -	44%	24%	0.106	-	+ + +	20%	64%	0.0002	+
29: P7F1H1	/ / -	35%	25%	0.4884	/	+ + +	53%	31%	0.0647	-
30: P7F1H2	/ / +	29%	48%	0.1333	/	+ + +	57%	32%	0.0377	-
31: P1F3H1	- - -	51%	16%	0.0039	-	+ + +	20%	56%	0.0027	+
32: P2F4H3	- - -	82%	7%	< 0.0001	-	+ + +	8%	73%	< 0.0001	+
33: P3F2H3	- / -	78%	11%	< 0.0001	-	+ + +	20%	65%	0.0001	+
34: P3F4H1	- - -	41%	27%	0.2482	/	+ + +	37%	35%	0.9081	/
35: P4F1H3	/ / -	76%	11%	< 0.0001	-	+ + +	9%	72%	< 0.0001	+
36: P4F2H2	/ / +	7%	84%	< 0.0001	+	+ + +	11%	77%	< 0.0001	+
37: P6F3H3	- - -	87%	9%	< 0.0001	-	+ + +	5%	83%	< 0.0001	+
38: P7F1H4	/ / -	33%	39%	0.729	/	+ + +	21%	63%	0.0005	+
39:P7F4H3	/ - -	83%	8%	< 0.0001	-	+ + +	25%	56%	0.0111	+
40: P8F3H4	- - -	48%	25%	0.0647	/	/ + +	21%	64%	0.0003	+

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