

INSTITUTE  
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TECHNOLOGIES



Scuola Superiore  
Sant'Anna



**PERCRO** Perceptual  
Robotics Laboratory

# Investigating the Process of Emotion Recognition in Immersive and Non-Immersive Virtual Technological Setups

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# Presentation Overview

INTRODUCTION



Emotions in Face/  
Emotional Face in VR

RELATED WORK



Static vs dynamic Face of Emotion/  
Context in Facial Emotion Recognition

THE EXPERIMENT



Research Questions/  
Design/  
Measures and Data Analysis/  
Results

CONCLUSION AND  
FUTURE WORKS

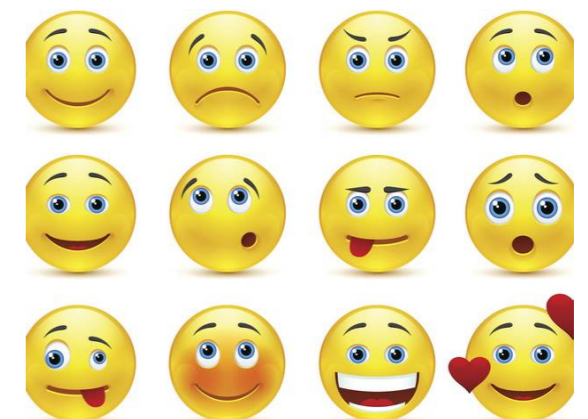


Discussion and Conclusion/ Future  
Works



## The importance of the face to communicate emotions

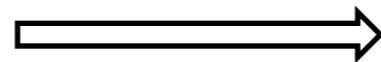
- Face is the primary way in which we express the emotions
- Face is the medium between what I feel and what I show
- We use the face in everyday interaction
- Face has a primary role in every form of communication (job, politics, relationship...)
- We simulate face expression in mediated communication



## Face of Emotions in Virtual Reality

### VR/IVE

- Ecological validity (manageability of environments, precise replication of context)
- Strong Sense of Presence



### Face of Emotion

- VR+ Virtual Agents= Sense of Presence
- Impact on Psychotherapy,



IVE for the study of aggressive behaviour



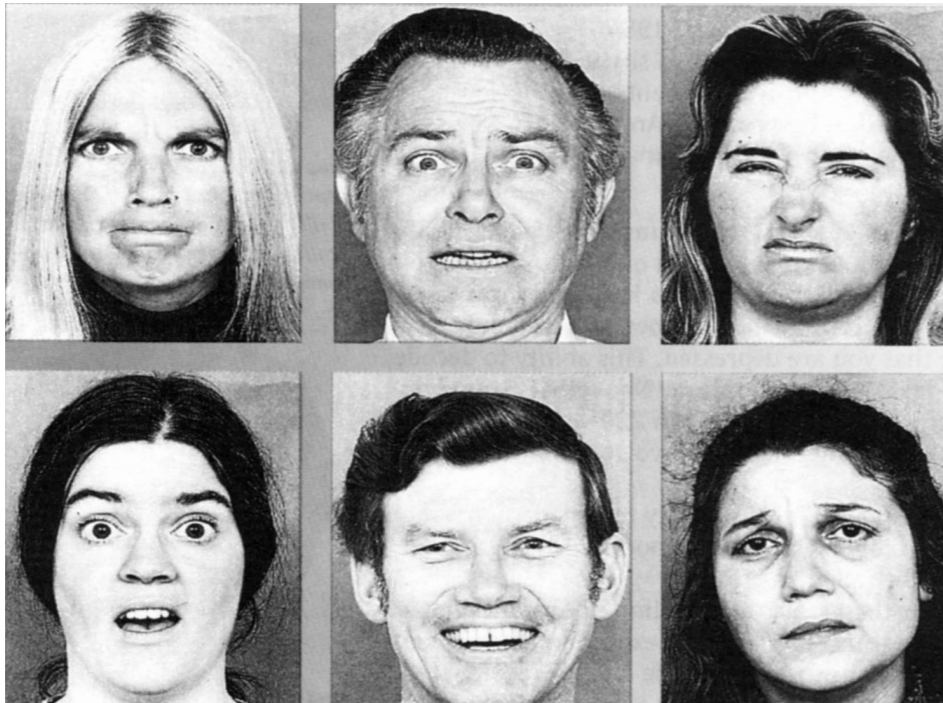
CAVE System: a room with virtual agents audience. Fear of Public Speaking Application



# Recognition of Static Faces of Emotion

## Facial Action Coding System (FACS). Paul Ekman Approach

- universal connection between emotional facial expressions and the emotional states
- there are 6 six universal Basic Emotions: Anger, Fear, Disgust, Surprise, Happiness, Sadness.
- facial Action Coding System (FACS, 1978): a system to taxonomize facial movements



Static Face to investigate the neural mechanism used to recognize emotional face.

Adolphs, Ralph. "Recognizing emotion from facial expressions: psychological and neurological mechanisms." *Behavioral and cognitive neuroscience reviews* 1.1 (2002): 21-62.

## LIMITATION:

- No dynamic Faces
- No Ecological Validity
- No vividness of real face
- No contextual Information



# Recognition of Dynamic Faces of Emotion

## ADVANTAGES

- Similarity human and virtual agents
- Vividness of real face
- Dynamism



**Knight and Johnston 1997**, Faces in movement are better recognized than fixed faces

**SATO et al. 2004**, The perception of face in movement enhanced the neural activity in humans, opposite to static pictures.

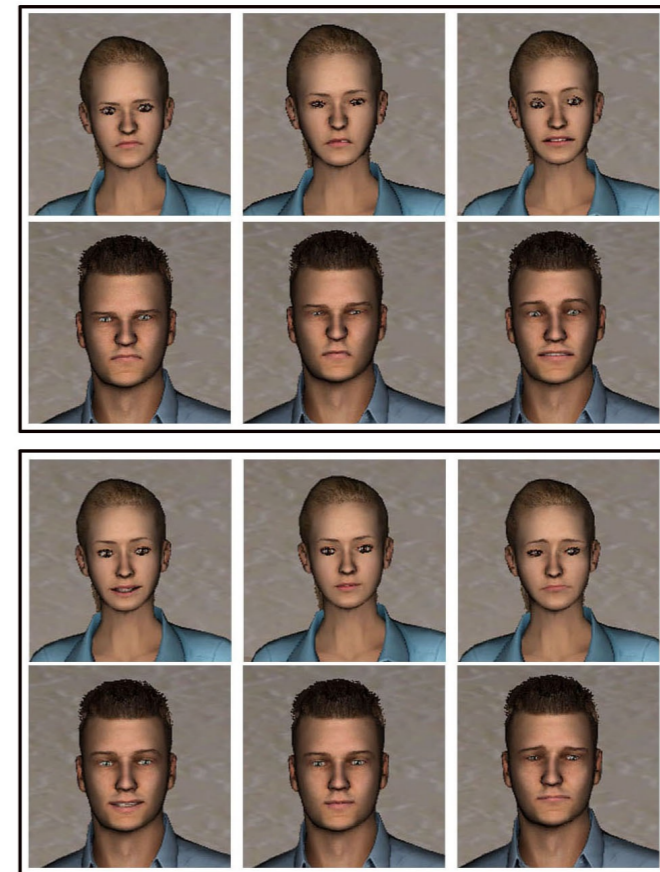
**Dyck et al. 2008**, There is a significant correlation between the recognition of emotional expressions on virtual and natural faces.

**Gutiérrez-Maldonado et al. 2014**, 3D virtual faces may be a useful tool to improve interpersonal communication in people suffering from emotional disorder

**Faita et al 2015**,

Dynamic Virtual Avatars (DVAs):

- High level of realism of virtual faces
- Dynamism of the facial stimuli.
- Results showed high level of intensity assigned to each emotion



# Recognition of Faces in Context

## The importance of Context

- human encounter takes place in context
- every context has a specific cue
- recent works with photographs remarked that the environment largely influences the perception of facial emotions

In daily life the emotions perception in face are influenced by the context in which they occur.

We need a new paradigm that includes an environment to study Emotion Recognition in Faces.

*Barrett et al. 2011, Context in emotion perception*



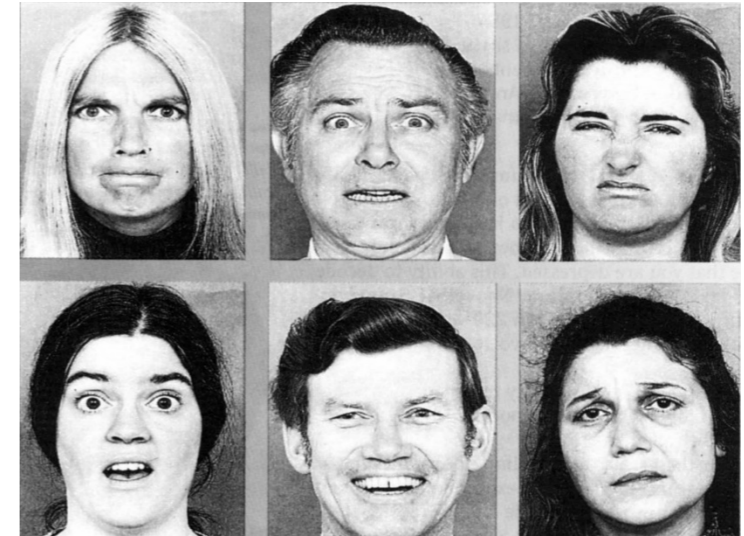
## **IVE Improvement:**

- *Simulates a realistic context*
- *Ecological validity*



## Research Questions

**RQ<sub>1</sub>.** The level of immersion in VE invalidate the universality of basic emotions?



**RQ<sub>2</sub>.** Is there a recognition accuracy of facial emotion in an immersive scenario simulating a real life situation?





## Design

### The Task

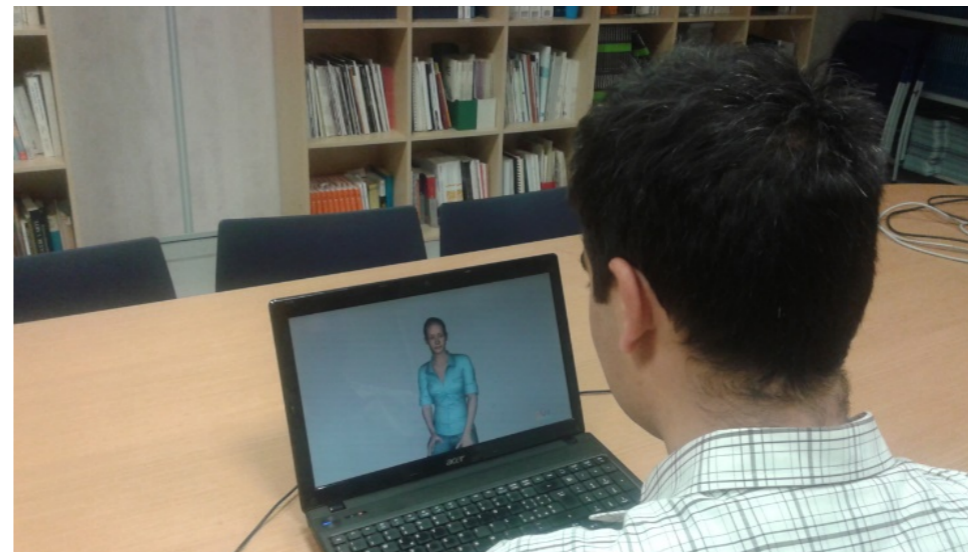
- choose what emotion had been shown: Anger, Disgust, Fear, Happiness, Neutral and Sadness
  - 24 trials,
- timeout of 7 seconds for the automatic triggering

### Two Setups

- VAs are presented in immersive virtual Environment: **IVE setup**
  - VAs are presented on a flat computer screen **N-IVE setup**

### Two Groups

- exploration phase\ interaction with the VE /recognition tasks with Facial Animation in IVE
  - : **IVE group**
- Facial Animation without VE: **N-IVE group**



## Participants, Stimuli and Apparatus

### Participants

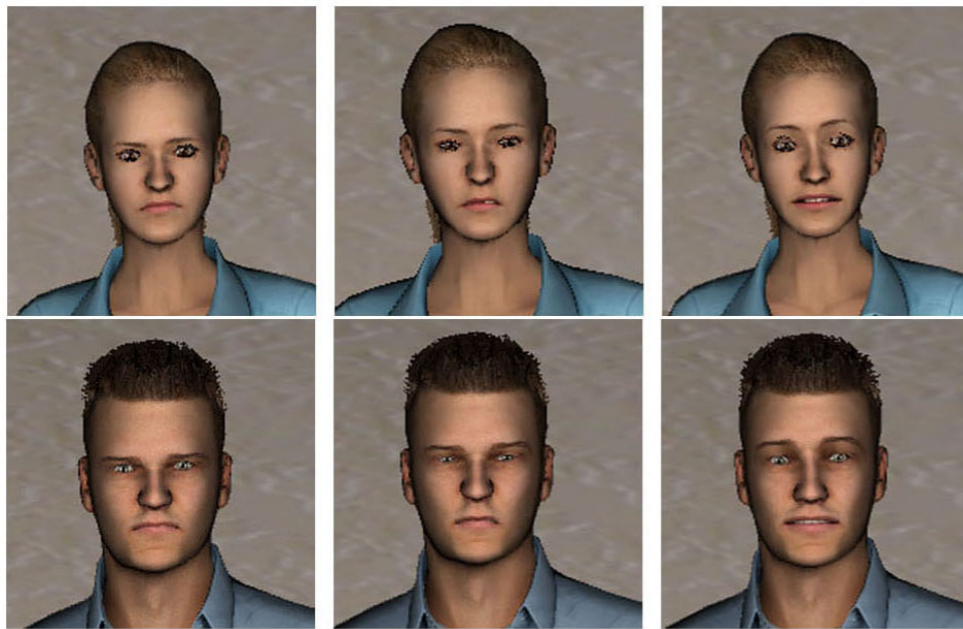
- 24 healthy subjects (6 females), 28 y.o.
  - No history of depression or anxiety disorders

### Stimuli

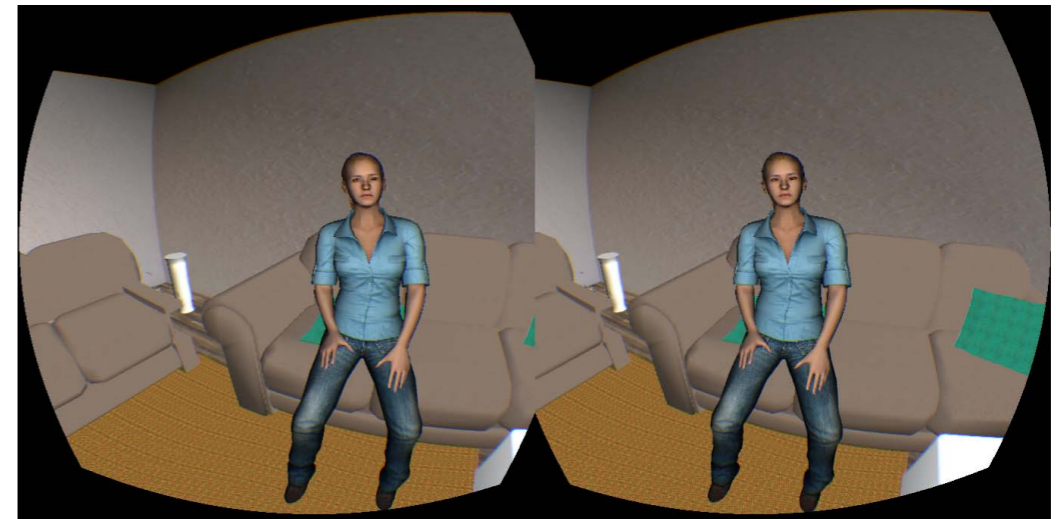
- VE: room with sofas, television and furniture
- environmental sound
- male and a female VAs display the basic facial expressions

### Apparatus

- faces animation: Faceshift 1.2
- characters model managed through the HALCA library
- XVR for the real-time rendering of the scene and participant interaction



Facial Expressions of Male and Female Basic Emotion



Female Virtual Agents in Immersive Virtual Environment



## Measures and Data Analysis

<b>IVE</b> <b>N-IVE</b>	Correct identification of the emotion types displayed by the VAs	Basic Emotion Recognition Accuracy	Anova Group x Face Turkey post hoc test contrasting level of Face
<b>IVE</b>	Igroup Presence Questionnaire (IPQ) and two additional questions on difficulty in recognition task and expression engagement	Presence and engagement in VE	Mean score
<b>IVE</b> <b>N-IVE</b>	Positive and negative affect state at the time of the experiment PANAS	PANAS	2 sample t-test for independent Group
<b>IVE</b> <b>N-IVE</b>	Familiarity of participants with computers, videogames and VR systems	Self Rate Familiarity with PC, Games and VR	A Wilcoxon rank sum test for independent samples

### PRE-REQUISITE:

- homogeneity of the two groups in the use of computer, videogames, and VEs
- no statistical difference in the emotional state (PANAS) prior the experiment in both groups.

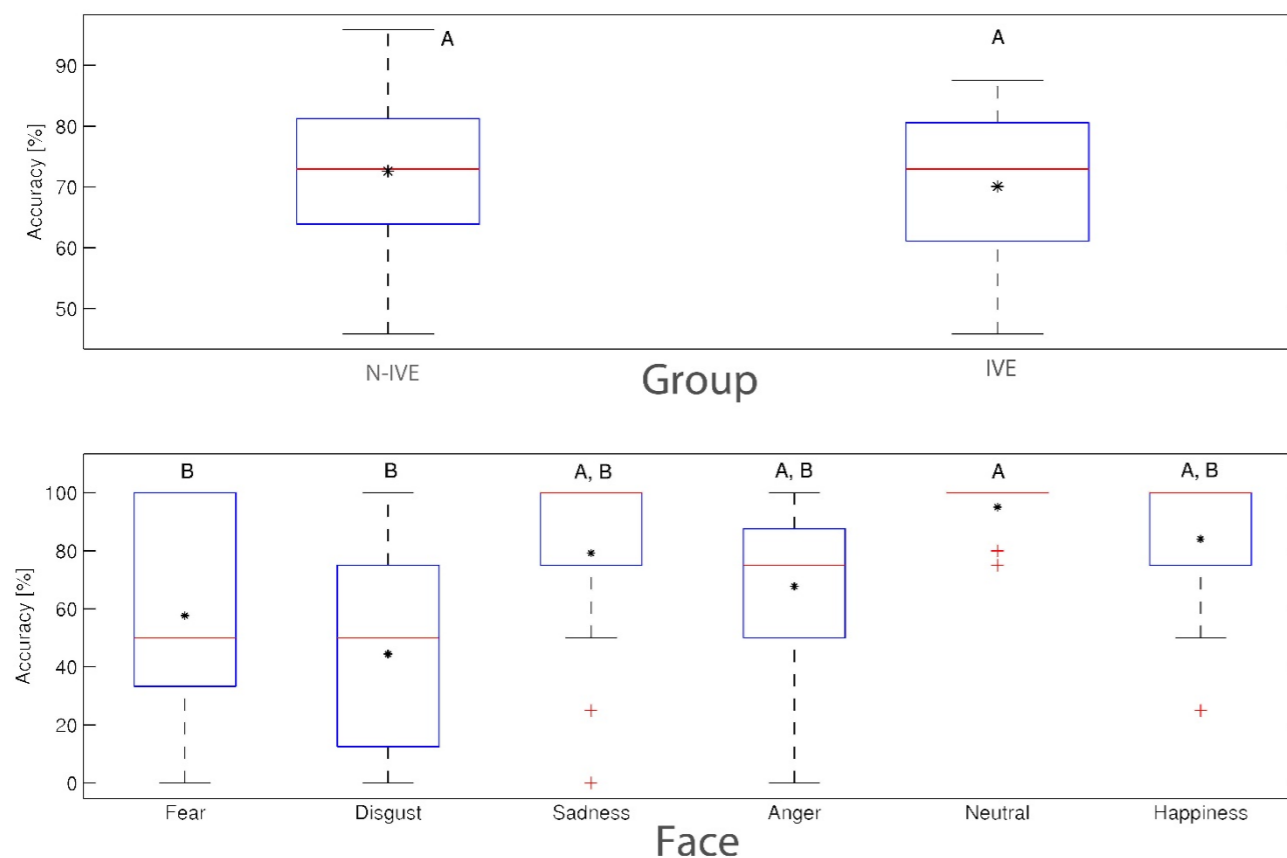


## Results

**RQ1.** the level of immersion in VE invalidate the universality of basic emotions?

**RQ2.** Is there a recognition accuracy of facial emotion in an immersive scenario simulating a real life situation?

Box plots of percent emotion recognition accuracy for N-IVE and IVE groups.



**RQ1.**

- no significant main effect of Group and no significant interaction between Group and Face (overall mean recognition accuracy 71:33%).

**RQ2.**

- main effect of Face between means of recognition accuracies (Neutral and Disgust ( $p < 0:001$ ) and Fear and Neutral ( $p < 0:05$ ))

- IPQ questions revealed that the level of immersion in the IVE was very high and participants perceived the VE as a real life experience.



## Discussion and Conclusion

- High level of accuracy in the emotion recognition of VA's faces in both groups.
- IVE can be used in the study of ERF and
- the immersion in VE does not invalidate the recognition of basic emotions.

Disgust was the main difficulty face to recognize in both groups (mean=44:44%): in line with previous studies (Spencer-Smith et al. 2001; Moser et al. 2007; Dyck et al. 2008; GutierrezMaldonado et al.2014).



Disgust is a mixture of other expressions and is characterized by wrinkling at the base of the nose(require a large number of polygons) might depend

Highest recognition accuracy for the Neutral expression (mean=95:00%) and not for Happiness (mean=84:03%)



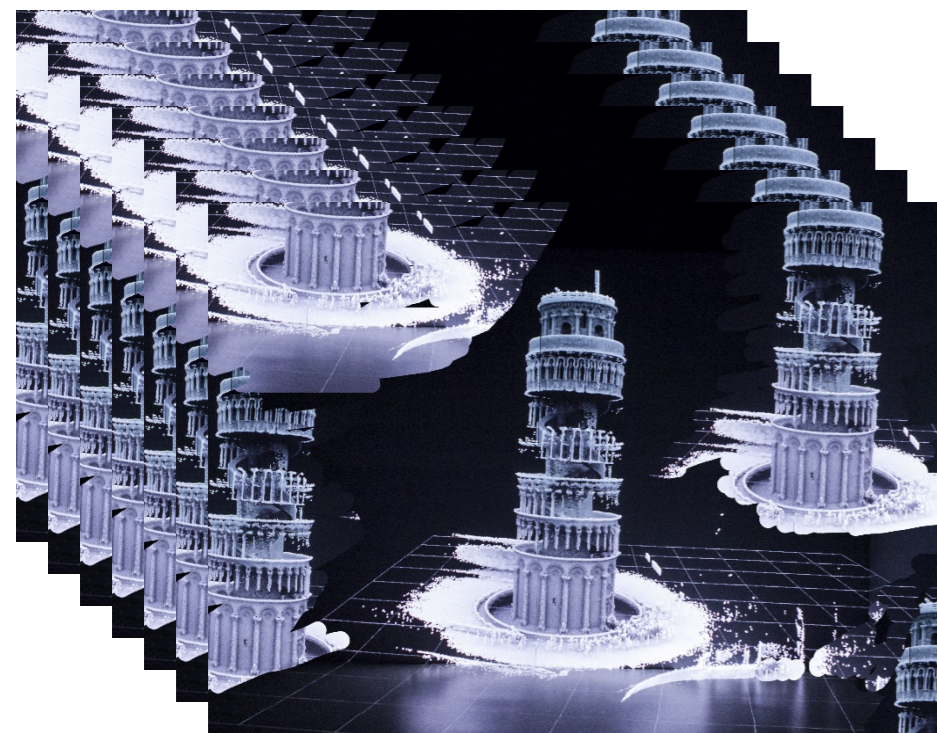
Neutral is the only face without a blending function, easier to be recognize



## Future Works

- Interaction between Human -Virtual Agents to improve the ecological validity of the study
- Create Context with emotional valence to combine with different face Expression of Emotion
- Improve the sample for a better statistical evaluation
- Test the Setup with emotionally-impaired participants





# Thank you for attention

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