

*ESIA 2023 - thématique Santé*

# **Interaction models for virtual agents and interactive robots in medical context**

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# Introduction

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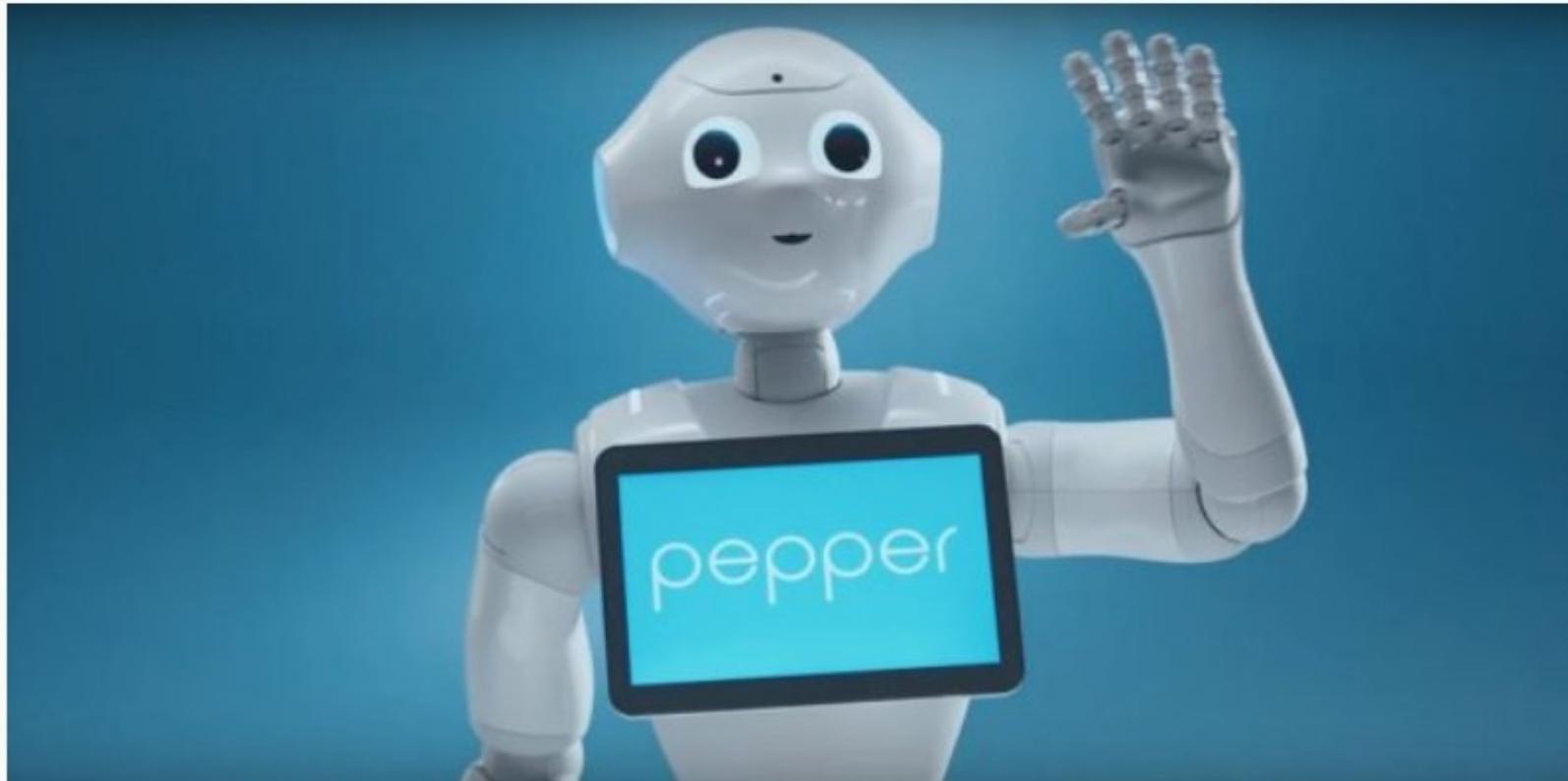


# French working group ACAI

## GT ACAI

GT Affects, Compagnons Artificiels et Interactions

Le groupe de travail "Affects, Compagnons Artificiels et Interactions" (ACAI) de l'AFIA a été créé en 2012. Son objectif est de regrouper les activités en France autour de l'informatique affective et de l'interaction avec des compagnons artificiels. Il se situe dans la continuité du groupe de travail ACA créé initialement au sein du GdR I3 du CNRS. Depuis le 1er janvier 2015, le GT ACAI est aussi un "Local Interest Group" (LIG-France) de l'association AAAC (ex-Humaine).



# GT ACAI

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- 2004: GT ACA (ECA)
- 2012: GT ACAI
  - GDR I3, SMA from AFIA
  - Affects, Artificial Companions and Interaction
- 2015: Local Interest Group (LIG-France) of AAAC (ex-Humaine association)
- Thematic meetings
  - Corpus
  - Virtual agents
  - Affective computing
  - Robotics
  - ....
- From 100 to 250 people in France

# GT ACAI

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- Workshop WACA 2005, 2006, 2008, 2010: Chatbots / dialogical agents, Assistant agents, Virtual agents, Emotions
- WACAI: Affects, Artificial Companions and Interaction
  - Workshop: 2012 in Grenoble, 2014 in Rouen, 2016 in Brest, 2018 in Porquerolles, 2021 in Île d'Oléron
- Web Site: <https://acai.cnrs.fr/>
- Mailing list: [acai@poleia.lip6.fr](mailto:acai@poleia.lip6.fr)  
(220 membres en juillet 2018)

# GDR Robotique

The screenshot shows the homepage of the GDR Robotique website. At the top right, there are links for "Se connecter | S'inscrire". On the left, the CNRS logo is displayed above the "GDR robotique" logo, which features a stylized robot head icon. Below the navigation bar, there is a banner for "LES JOURNÉES DU GDR ROBOTIQUE" held on 8/9 NOVEMBRE 2022, with a call-to-action button "CLIQUEZ ICI POUR VOUS INSCRIRE". To the right of the banner is a large image of a humanoid robot. At the bottom left, a message states that the Groupement de Recherche (GdR) en Robotique was created in 2007 by the CNRS. A British flag icon is also present. The navigation bar includes links for Accueil, Présentation, Membres, Annonces, Documents, International, Enseignement, and Prix de thèse.

cnrs

gdr robotique

Accueil

Présentation Membres Annonces Documents International Enseignement Prix de thèse

LES JOURNÉES  
DU GDR ROBOTIQUE  
8/9 NOVEMBRE 2022

CLIQUEZ ICI POUR VOUS INSCRIRE

Le Groupement de Recherche (GdR) en Robotique a été créé en 2007 par le CNRS.

CALENDRIER

Mai 2023

L	M	M	J	V	S	D
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	<b>16</b>	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

# Definitions

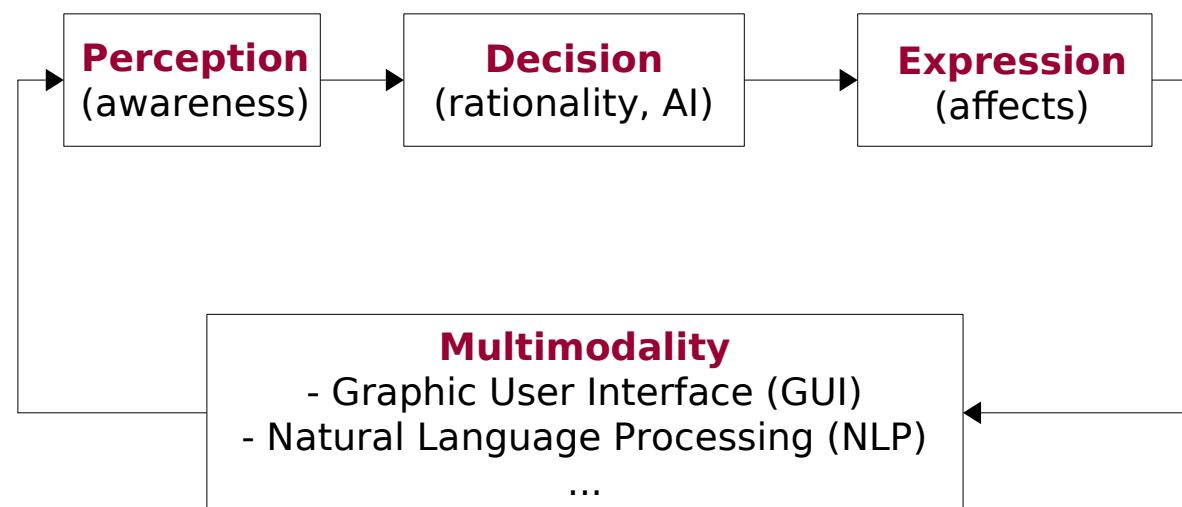
**ECA:** "Embodied Conversational Agent"

**IVA:** "Intelligent Virtual Agent"

**Agent**  
Rational  
Proactivity

**Conversational**  
Multimodal  
Social interaction

**Embodied**  
Personification  
Situated



Icons



Virtual  
Characters



Aibot  
Sony™

Robots

# Roles of ECAs

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ECAs are “**Interactive Virtual or Robotic Characters**” that are **situated** in mediated or physical environments.

They can play four main roles:

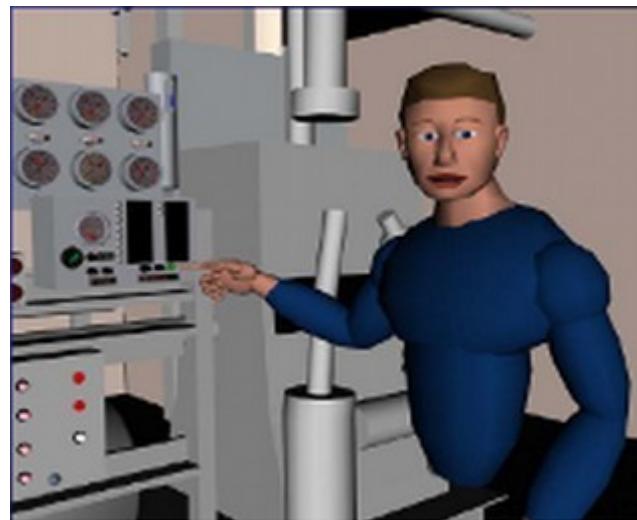
- Assistants** to welcome **users** and to assist them in understanding and using the structure and the functioning of applications
- Tutors** for **students** in human-learning mediated environments, or for **patients** in psychological/pathological monitoring systems
- Partners** for **actors** in virtual/physical/mixed environments: partner or adversary in a game, participant in creative design groups, member of a mixed-initiative community, ...
- Companions** as a friend in a long term relationship

# Categories of (virtual) ECAs

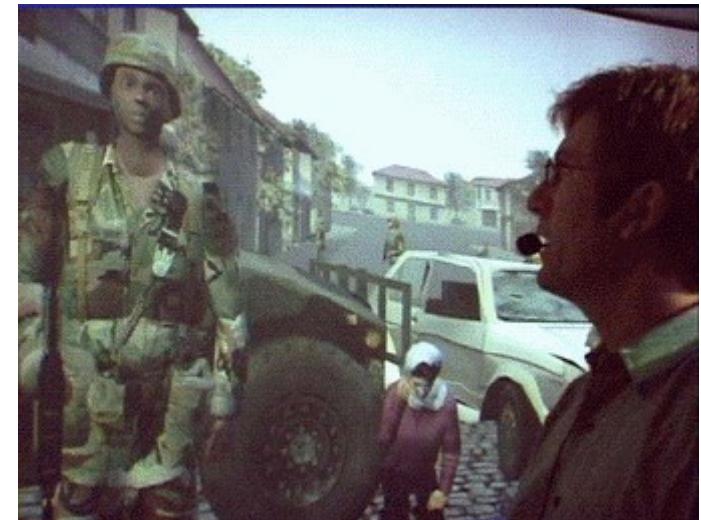
GRETA (Pélachaud LTCI)



STEVE (Rickel et al USC)



VTE (Gratch et al USC)



## Talking heads

Fixed - Realistic  
Expressions - LipSync  
Emotions

## Gestural Agents

Fixes/floating - moving arms  
Dialogue - Deictic - Sign language  
Tutoring - Assistance

## Situated Agents

Complete mobile characters  
Virtual/Augmented reality  
Training - Action

# Deploying environments

## Assistance

### APPLICATIONS



## Education



### Mixed Communities



### WEB PAGES

## Welcoming



### Augmented Reality



### AMBIENT

## Smart Objects



# Scientific issues

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## Agent modelling: interaction performance/efficiency of models

- Interaction models with users: Multi-modality, H/M Dialogue
- Models of cognitive agents: BDI logics and planning, affective logics, ...
- Task models and user models: Symbolic Representation and Reasoning
- Perception
- Robotics

## Human modelling: ecological relevance of models

- Capture
  - Representation
  - Reproduction
  - Evaluation
  - Application
- 
- of physiology  
of expressions  
of behaviours
- of humans

# Scientific communities

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## **Computer Science and Natural Language Processing**

- Autonomous Agents and Multi-Agent Systems
- Human-Machine Interaction/Interfaces
- Human-Machine Dialogue
- Symbolic AI
- Machine Learning
- Robotics

## **Humanities and Society Sciences**

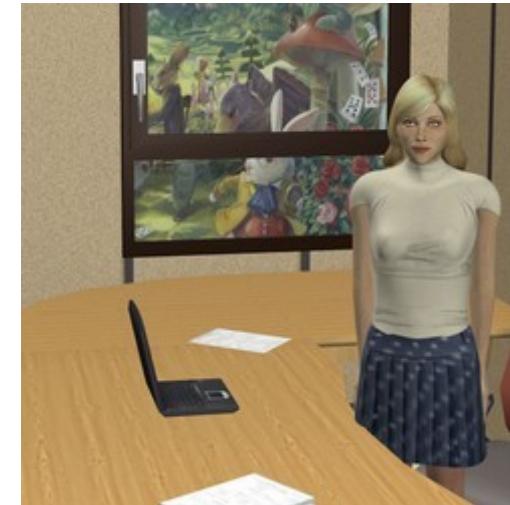
- Psychology of Language Interaction
- Ergonomic psychology

# Projects and teams concerning virtual agents

- European project SEMAINE (<http://www.semaine-project.eu/>)

- ISIR (France):

Greta



- LIMSI (France): MARC



- Bielefeld University (Germany)
- USC (USA): Virtual Human Toolkit

# Design of animated agents

- Independent of the embodiment level
- Non verbal behaviours (postures, gestures, ...):
  - Theoretical approach (related works)
  - Empirical approach (corpus analysis)
- Generated animations
  - From an intention (triggering action)
  - Automatically and cyclically



Evaluation



```
<configuration>
  <timecode>10</timecode>
  <body>front</body>
  <head>front</head>
  <eyes>open happy</eyes>
  ...
  ...
  ...
  <leftArm>hello</leftArm>
  <rightArm>hip</rightArm>
    <speech>Hello!</speech>
</configuration>
```



Reproduction

Corpora

Representation

# Talking heads

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**Nikita by Kozaburo © 2002**

Done with Poser 5 / No

Postwork

Model: DAZ-3D Victoria-3

Skin Texture:Mec4D

# Models based on visems

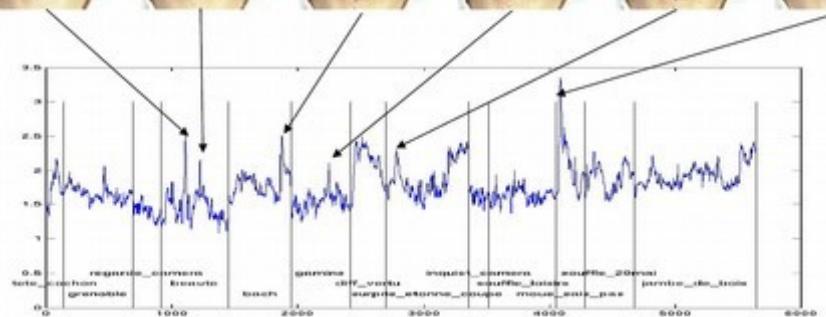
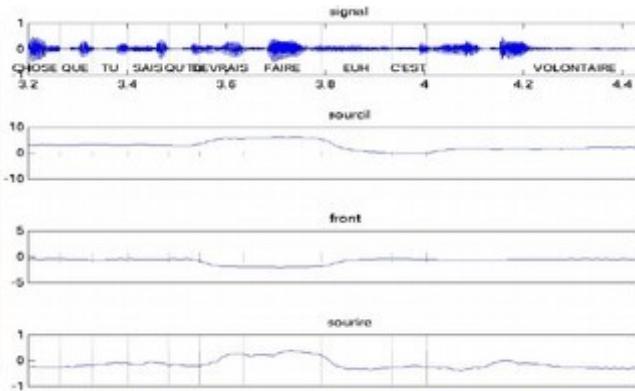
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- **Visem:** elementary unit of the position of the muscles of the human faces (3D model)
- Experimental settings:
  - Small red balls manually placed on the face
  - 3 to 5 cameras
  - Training corpus



G. Bailly and F. Elisey, GT ACA, 2006.03.15, <http://www.limsi.fr/aca/>

# Transitions between expressions



- Torsion model of the face and the neck
- The positions of the red balls are set manually
- Pattern recognition is used to monitor ball movements
- Extraction of key frames automatic and manual

G. Bailly and F. Elisey, GT ACA, 2006.03.15, <http://www.limsi.fr/aca/>

# Analysis and synthesis

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- Visems + 3D model are used to (re-)generate expressions
  - 6 to 11 parameters
- Validation by comparing to real expressions



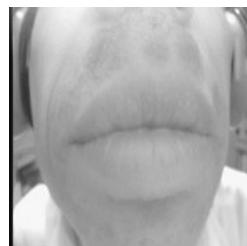
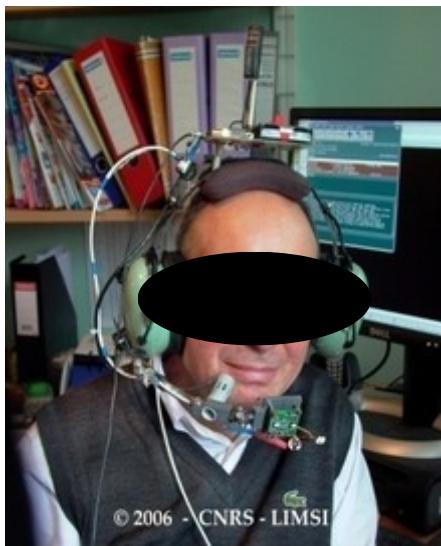
G. Bailly and F. Elisey, GT ACA, 2006.03.15, <http://www.limsi.fr/aca/>

# 'Talking heads' project (LIMSI)



- Based on visems
- Video corpus of 21 utterances:

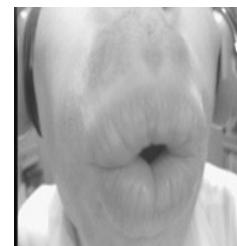
« C'est /phonem/ ici » (Ex: « C'est u ici »)



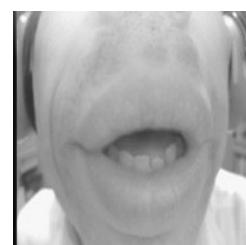
...



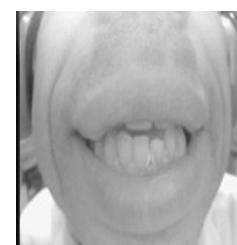
C'est



u



i



ci



...

# Realistic talking heads



Greta (Prudence, Obadiah, Poppy and Spike)  
LTCI - Telecom ParisTech



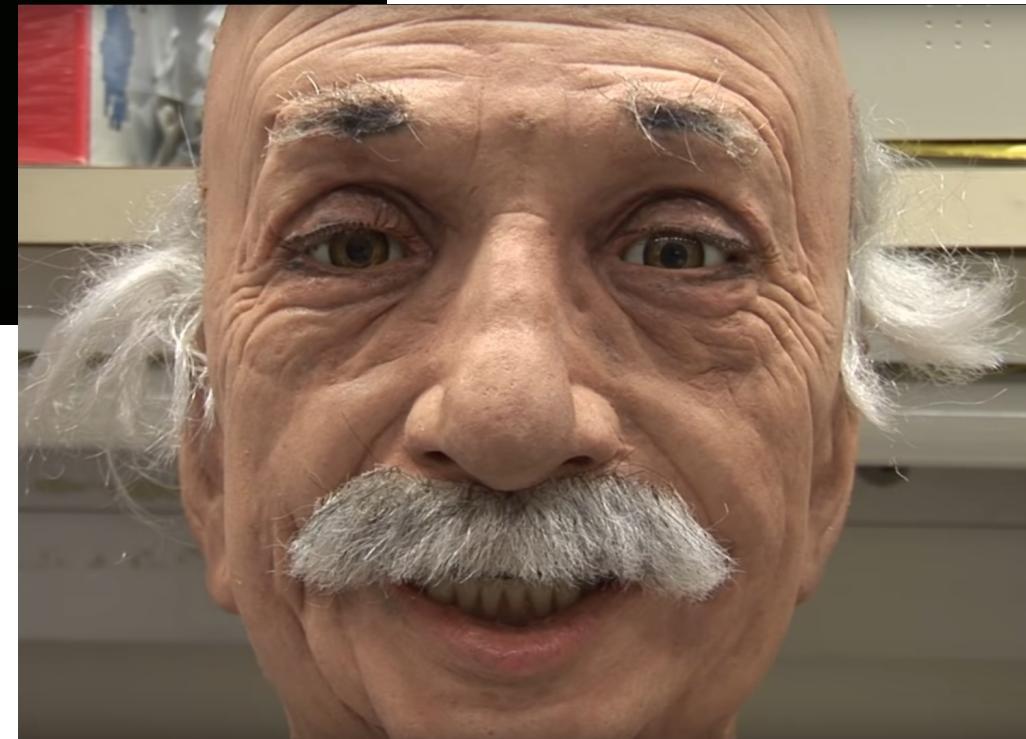
# Robotic heads



>Create immersive  
characters for  
any application

Furhat

[https://www.youtube.com/  
watch?v=vqZgIOAW9bo](https://www.youtube.com/watch?v=vqZgIOAW9bo)



Einstein head

<https://www.youtube.com/watch?v=pkpWCu1k0ZI>

# Gestural agents

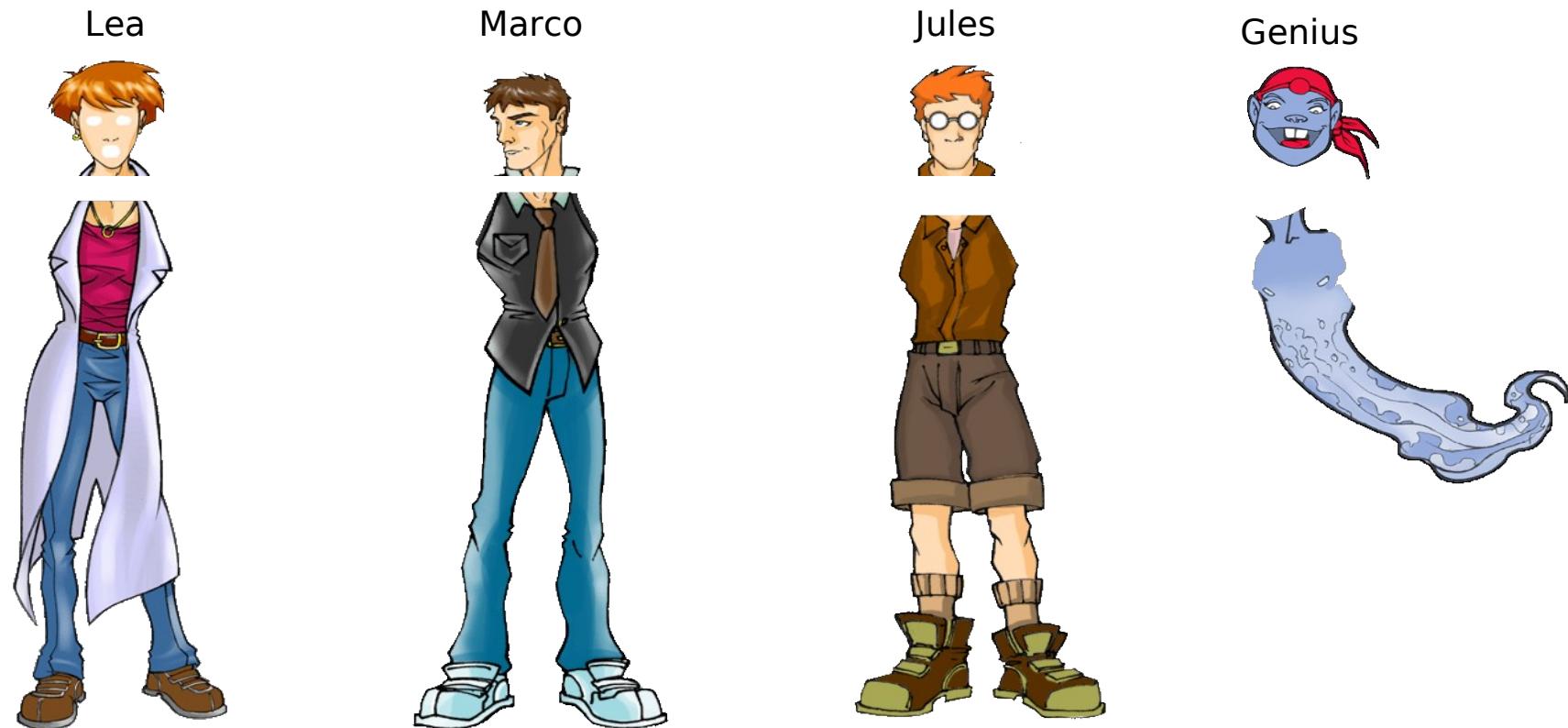
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<http://marc.limsi.fr/>

# 2D cartoon agents: Lea

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## LEA Agents (LIMSI)

- 2D cartoon characters (110 GIF files)
- Easily integrated into Java applications and Javascript
- Description language for high-level behaviours

# Lea: gestural expressiveness

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deictic gestures



iconic gestures



adapters



Emblematic gestures



...

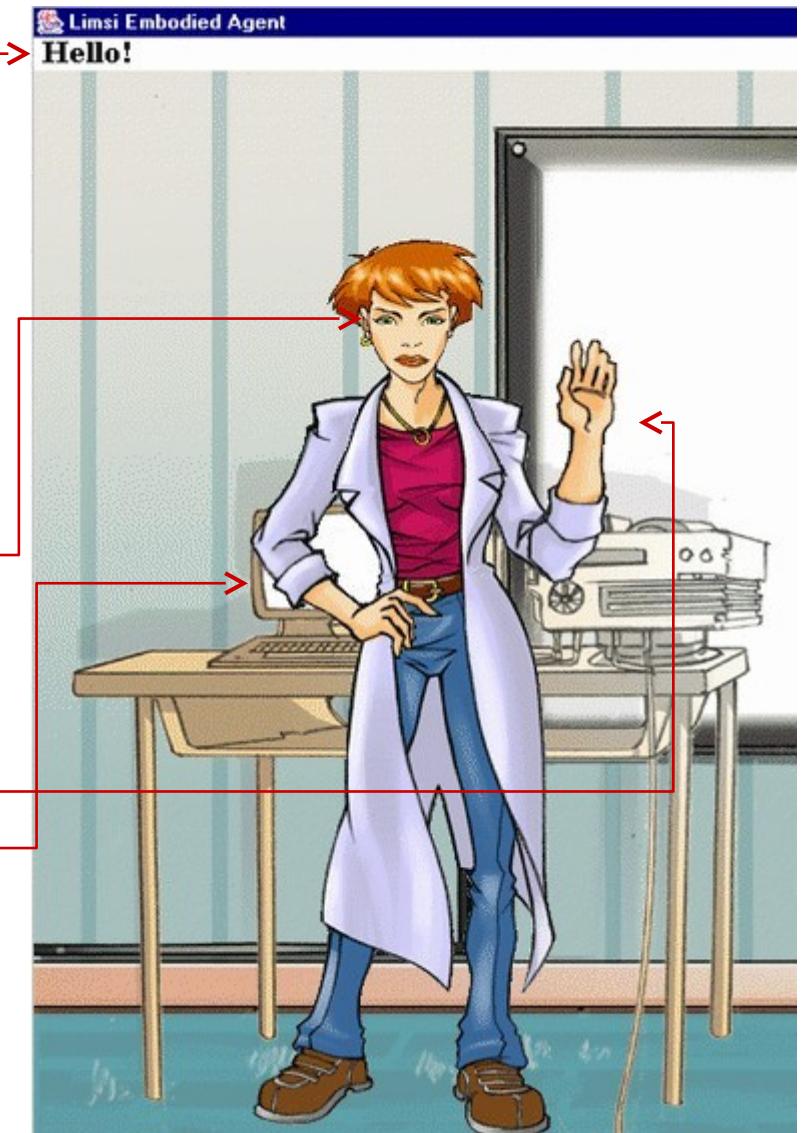
...

transparent GIF files

# Specifying attitudes and animations in XML

```
<?xml version='1.0' encoding='utf-8'?>  
  
<configurationsequence nbrconfig="1">  
  
  <configuration>  
    <timecode>10</timecode>      Number of  
    <body>front</body>          configurations  
    <head>front</head>          = attitudes  
    <eyes>open happy</eyes>  
    <gaze>middle</gaze>  
    <facialExpression>close</facialExpression>  
  
    <bothArms>null</bothArms>  
    <leftArm>hello</leftArm>  
    <rightArm>hip</rightArm>  
    <speech>Hello!</speech>  
  </configuration>  
</configurationsequence>
```

An attitude



# Dynamic Deictic

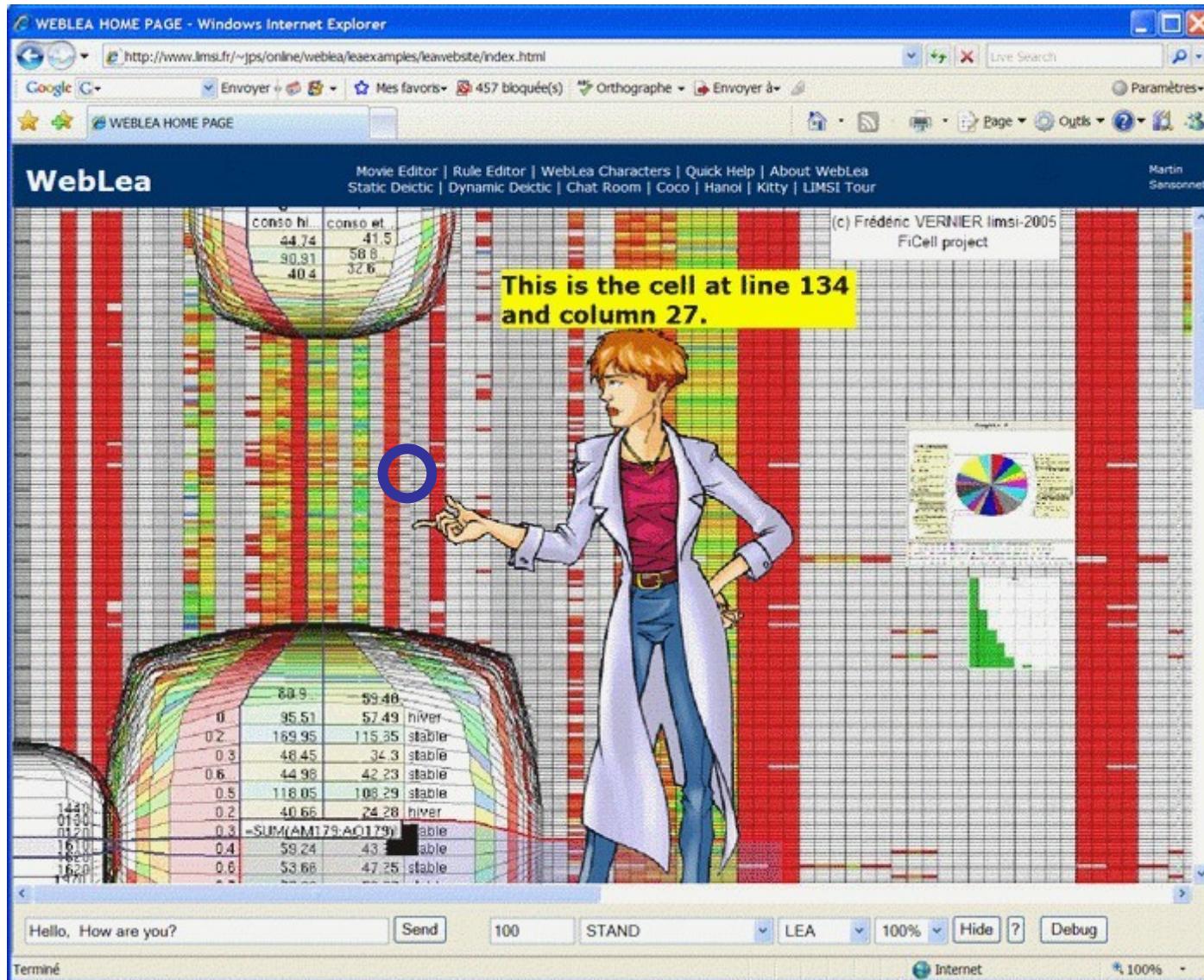
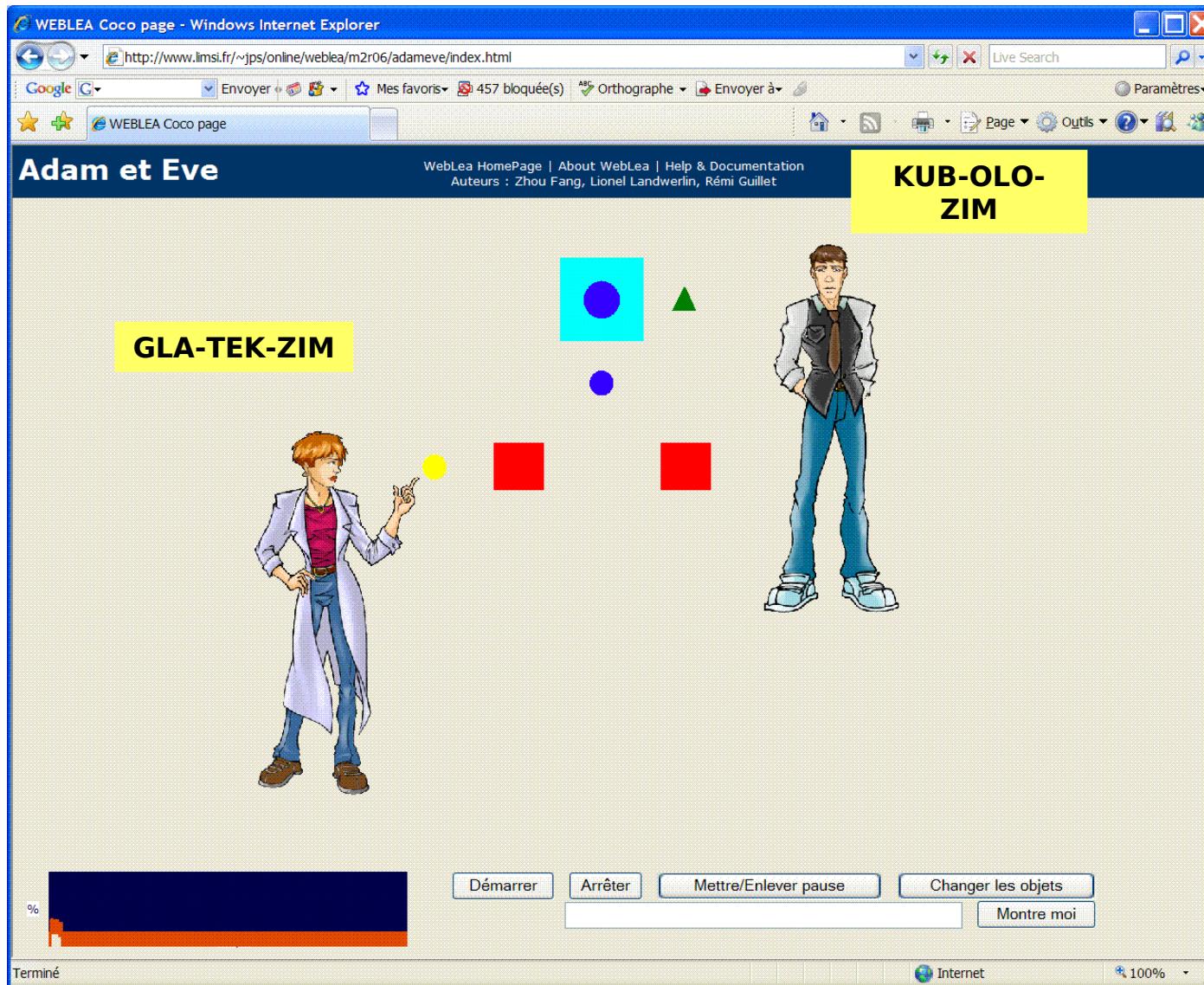


Table : Frédéric Vernier LIMSI-CNRS

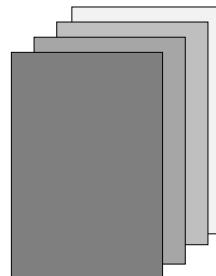
# Designation of DOM objects



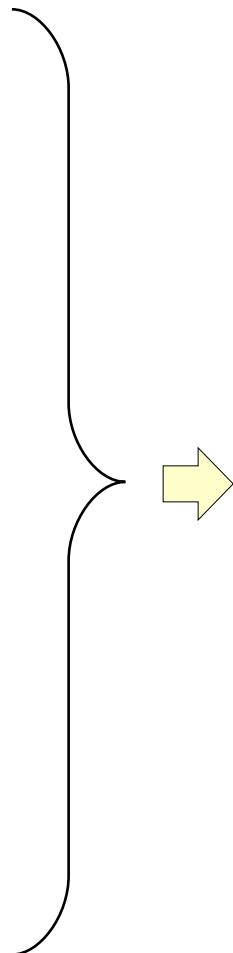
# Design of realistic gestural agents and avatars



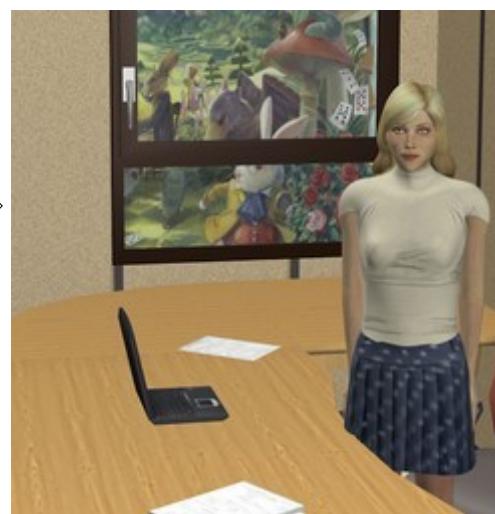
Annotated corpus of videos (ex: Anvil)



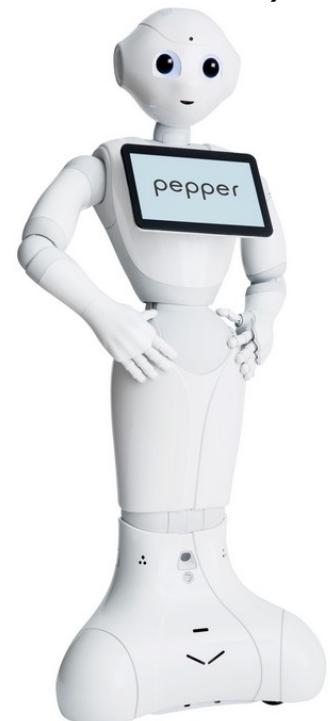
Psychological knowledge (Related works)



Pepper (Aldebaran / Softbank)



GRETA (ISIR)



# Multimodal Social Behaviours

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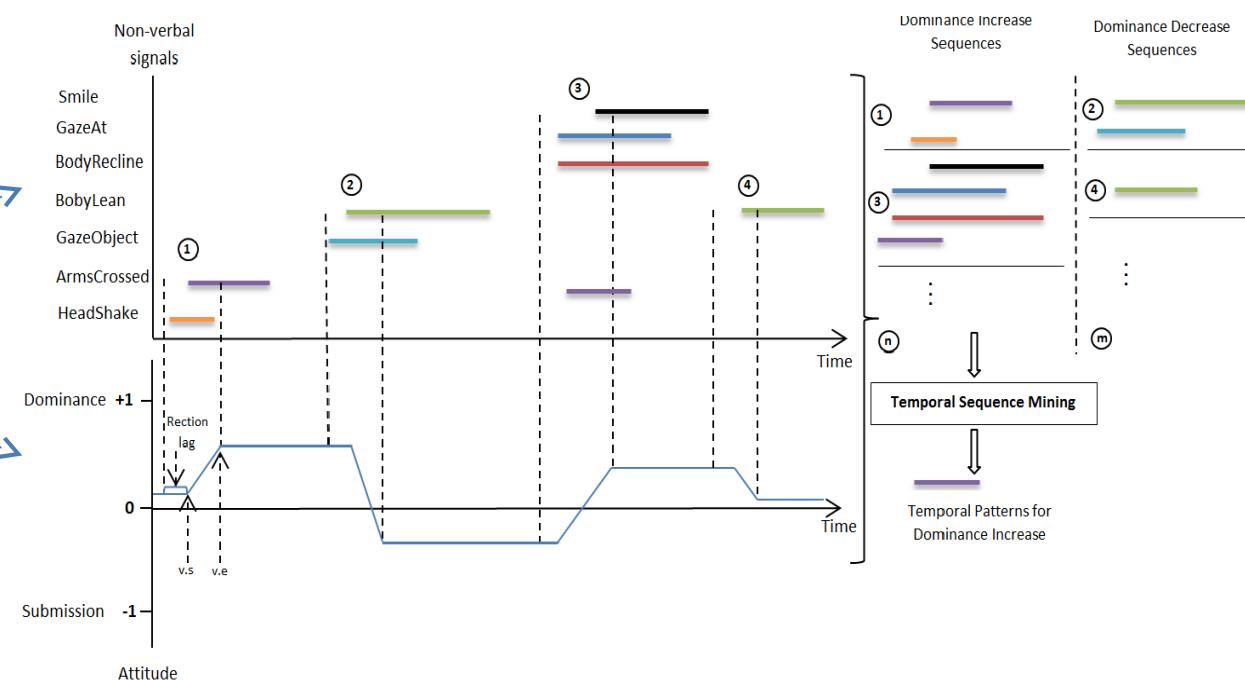
- How to capture variety and subtleness of human behaviours?
  - Build multimodal repertoire
  - Learn by imitation
- How to go beyond prototypical expressions of emotions?
- How to convey social attitudes?

# Social attitudes and behaviour model

1. What are the sequences of multimodal behaviours that trigger change in social attitude perception
2. Extraction of sequences of non-verbal signals expressing attitudes variations (increase or decrease)



Non-verbal behaviour  
Attitude variation



# Social Attitudes

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Decrease in dominance

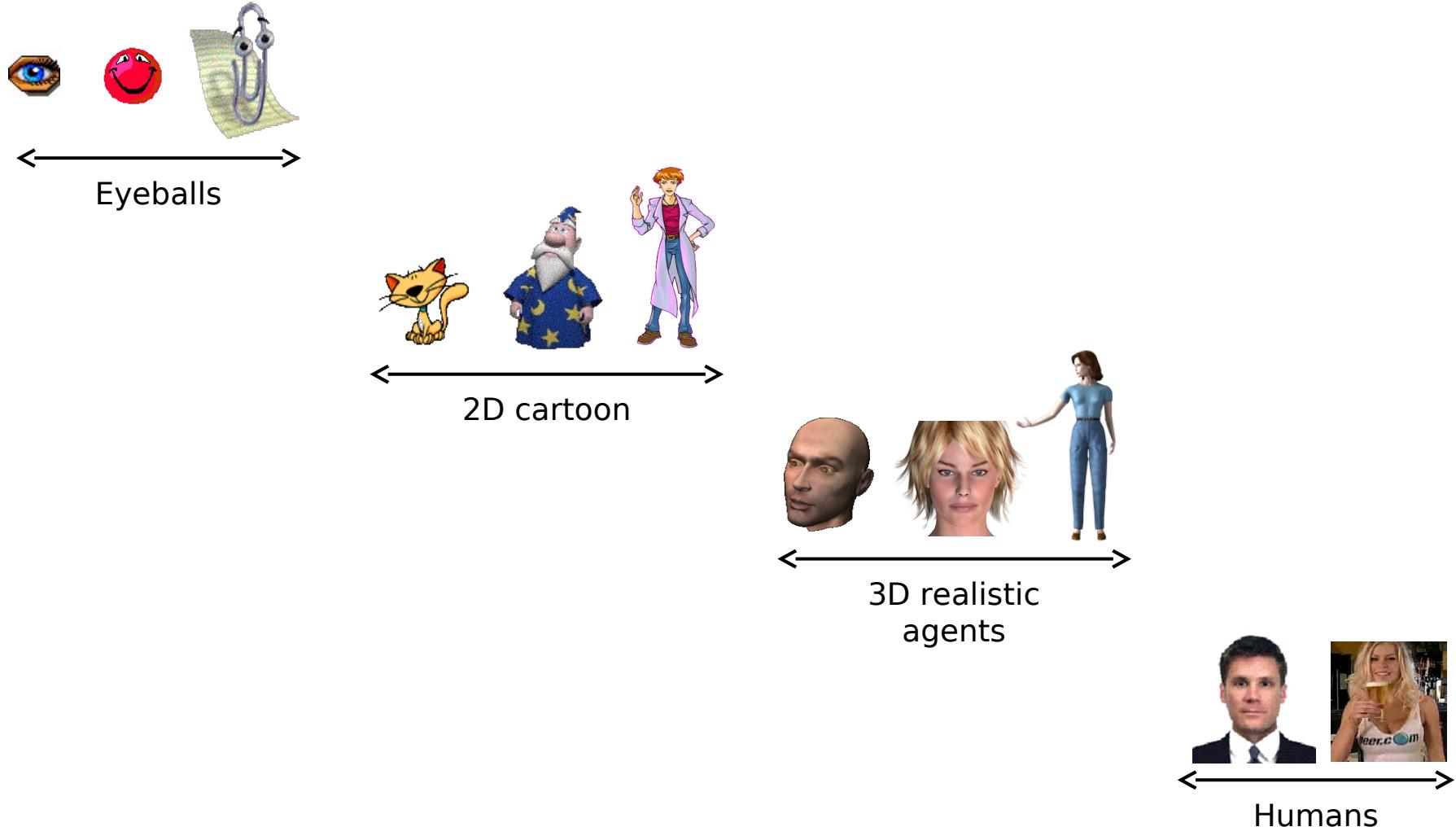


Decrease in friendliness



# Usefulness of embodiment

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# Evaluation of ECAs

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Objective

## Efficiency

Measures the actual performance of the couple user-agent when carrying out a given task.

## Usability

Measures the capacity of the user to have a good comprehension of the functioning of the system and the fluency of the control.

Subjective

## Friendliness

Measures the “feeling” of the user about the features of the system (attraction, commitment, esthetic, comfort, ...)

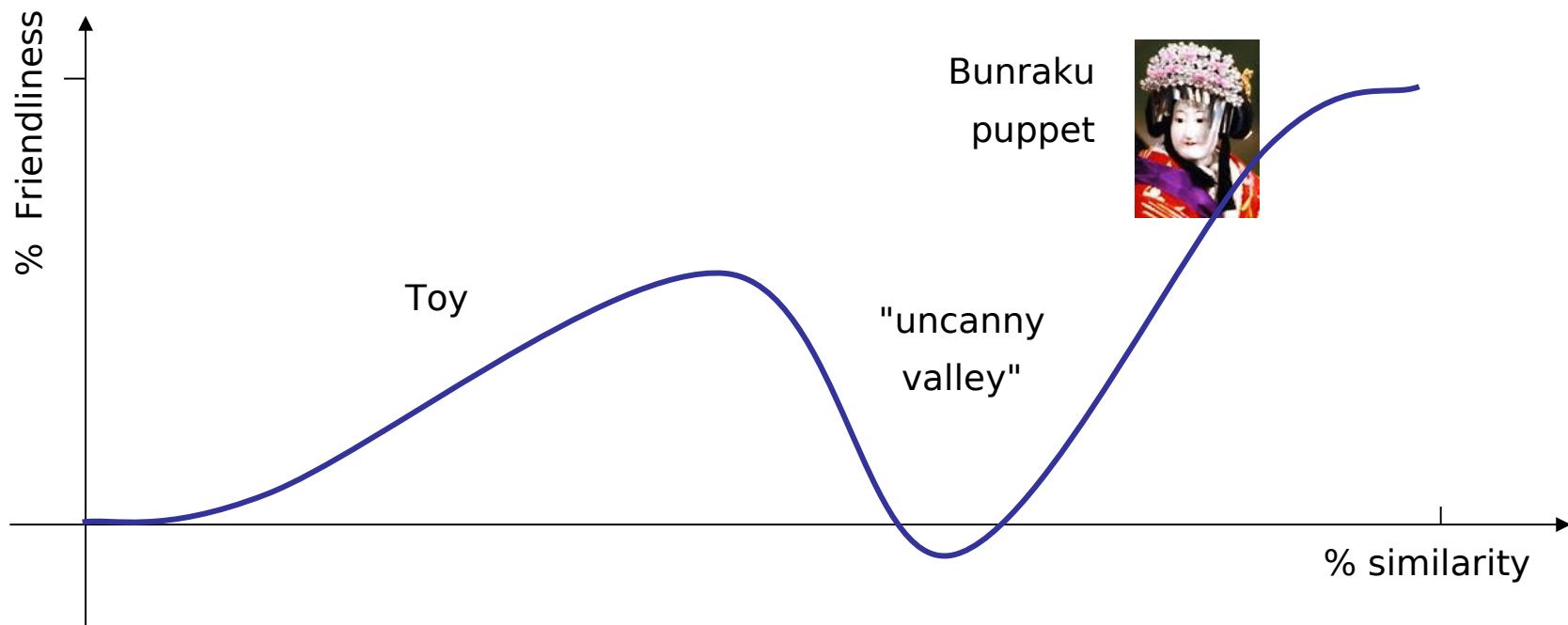
## Believability

Measures the “feeling” of the user about the fact that the agent can understand the user’s problems and has the capacity to help with real competence.

## Trust

Measures the “feeling” of the user about the fact that the agent behaves as a trustable and cooperative entity.

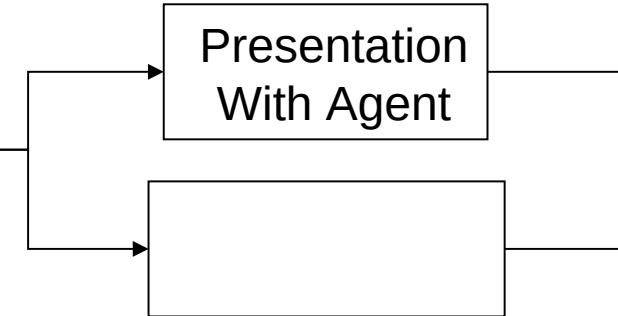
# Ratio realism / friendliness



Masahito Mori, Institut Robotique de Tokyo in Jasia Reicardt, "Robots are coming",  
Thames and Hudson Ltd, 1978

# The *Persona Effect* of Lester

30 Subjects :  
15 M & 15 F,  
age ≈ 28 years



## Results

Measured improving of the parameters:  
- performance of comprehension  
- performance of recall (memory)  
- subjective questions → satisfaction

ECA



WITH AGENT

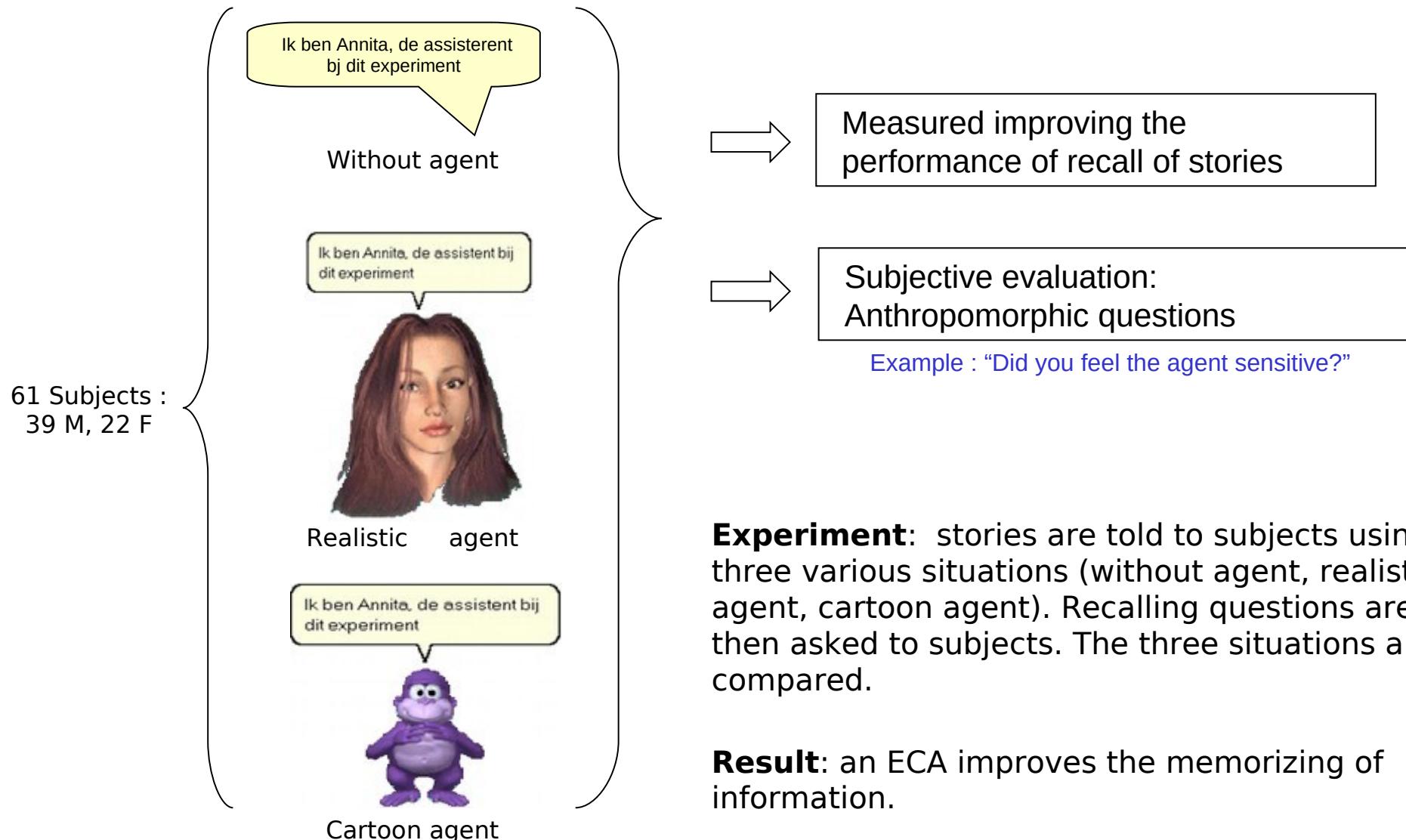
An arrow



WITHOUT AGENT

- Lester et al. (1997). The Persona Effect: Affective impact of Animated Pedagogical Agents. CHI'97.
- van Mulken et al. (1998). The Persona Effect: How substantial is it? HCI'98.

# Persona effect and memorizing



**Experiment:** stories are told to subjects using three various situations (without agent, realistic agent, cartoon agent). Recalling questions are then asked to subjects. The three situations are compared.

**Result:** an ECA improves the memorizing of information.

# Experiments on Functional description

## Three different agents:

- 2 men (Marco, Jules) with different garment
- 1 woman (Lea)

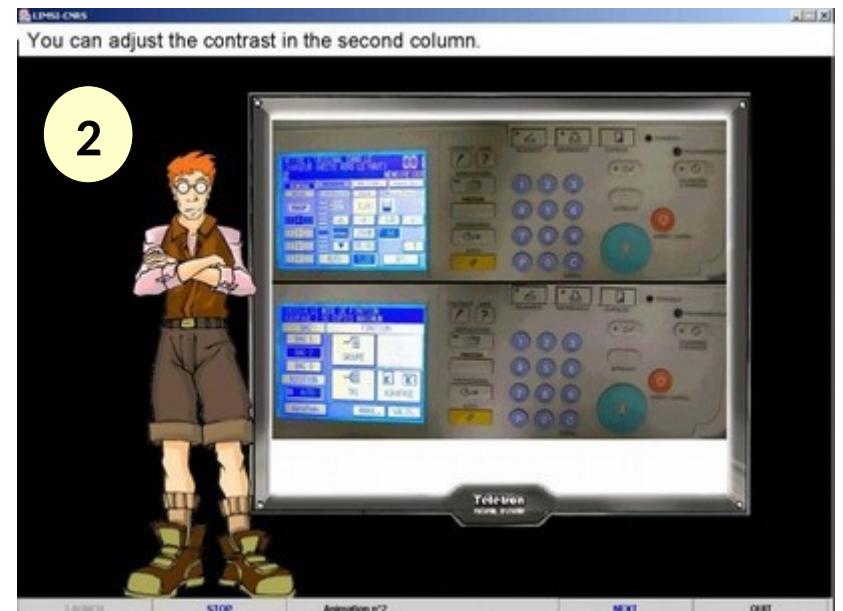
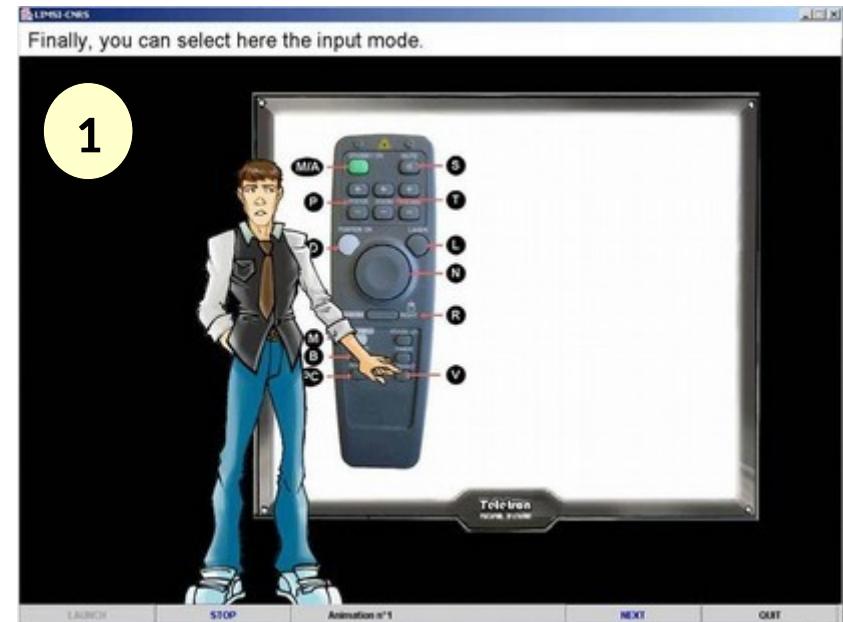
## Three strategies of cooperation:

- Redundancy (speech + gesture)
- Complementarity (50% speech / 50% gesture)
- Specialization (speech only)

## Three objects to describe:

1. Video recorder remote controller
2. Photocopier control panel
3. Application for designing graphic documents

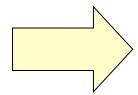
$3^3 = 27$   
experiments



# Functional description: evaluation results

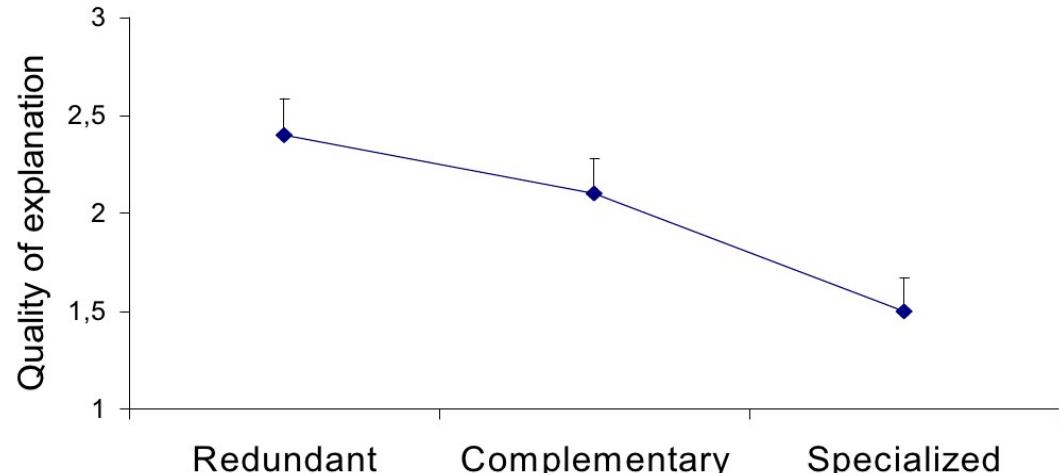
## Quality of explanation

- No noticeable effect of the appearance,
- Noticeable effect of the multimodal behaviour:  
the redundant explanations are preferred.



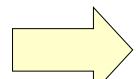
## Sympathy

- No noticeable effect of the multimodal behaviour,
- Noticeable effect of the appearance :



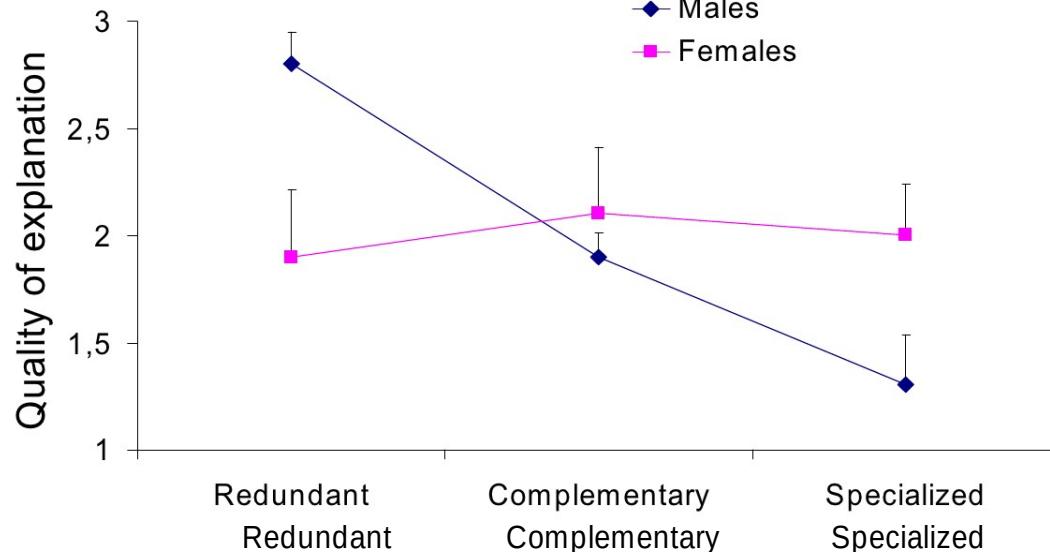
## Performance

- Same as the Sympathy,
- But no correlation between Sympathy and Performance.



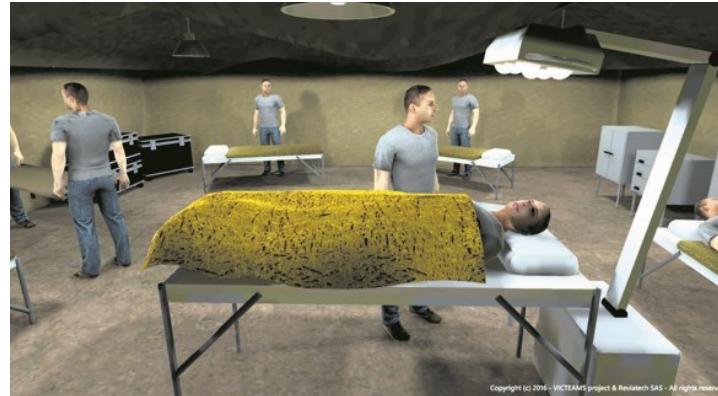
## Impact of the user's gender

- Men react differentially and prefer redoubling explanations,
- Women do not react differentially.



# Applications in healthcare

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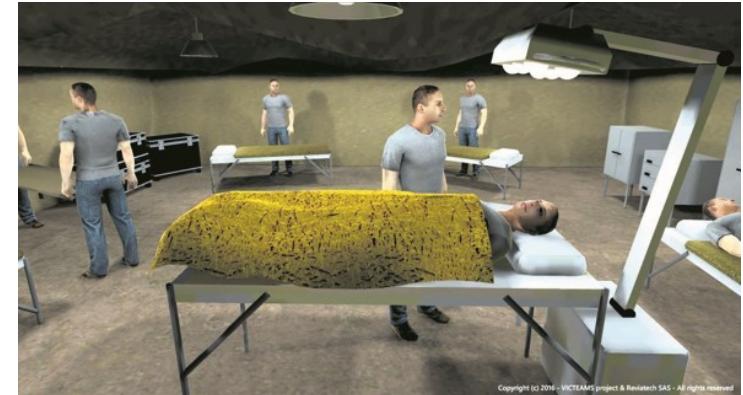


# Applications in healthcare

- Learning environments
  - Tutor
  - Character
  - Patients / medical staff



- Assistant
  - Help in medical applications (patients or practioners)
  - Data collection (diagnostic)



- Partner
  - Coach / training
  - Remediation

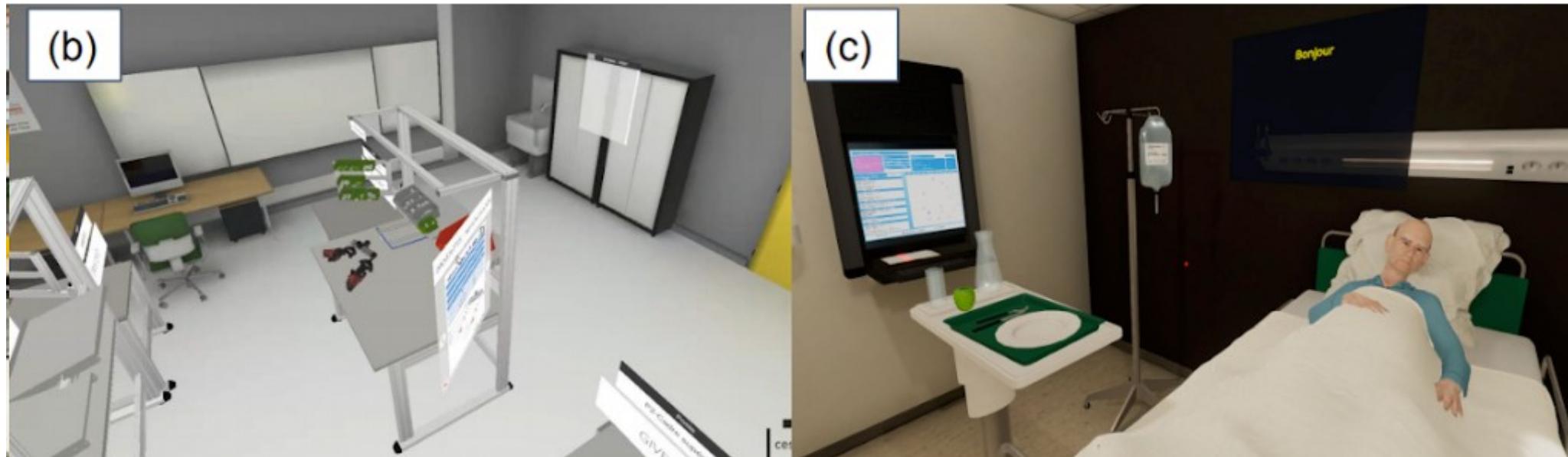


# Serious game: Train doctors to break bad news

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# Serious game: Train nurses to monitor patient



- Learning environment in healthcare: virtual room to train nurses
- Immersive environment, populated by interacting agents and tutors
- Goals:
  - engaging interaction for better learning
  - adaptation to the learner's profile

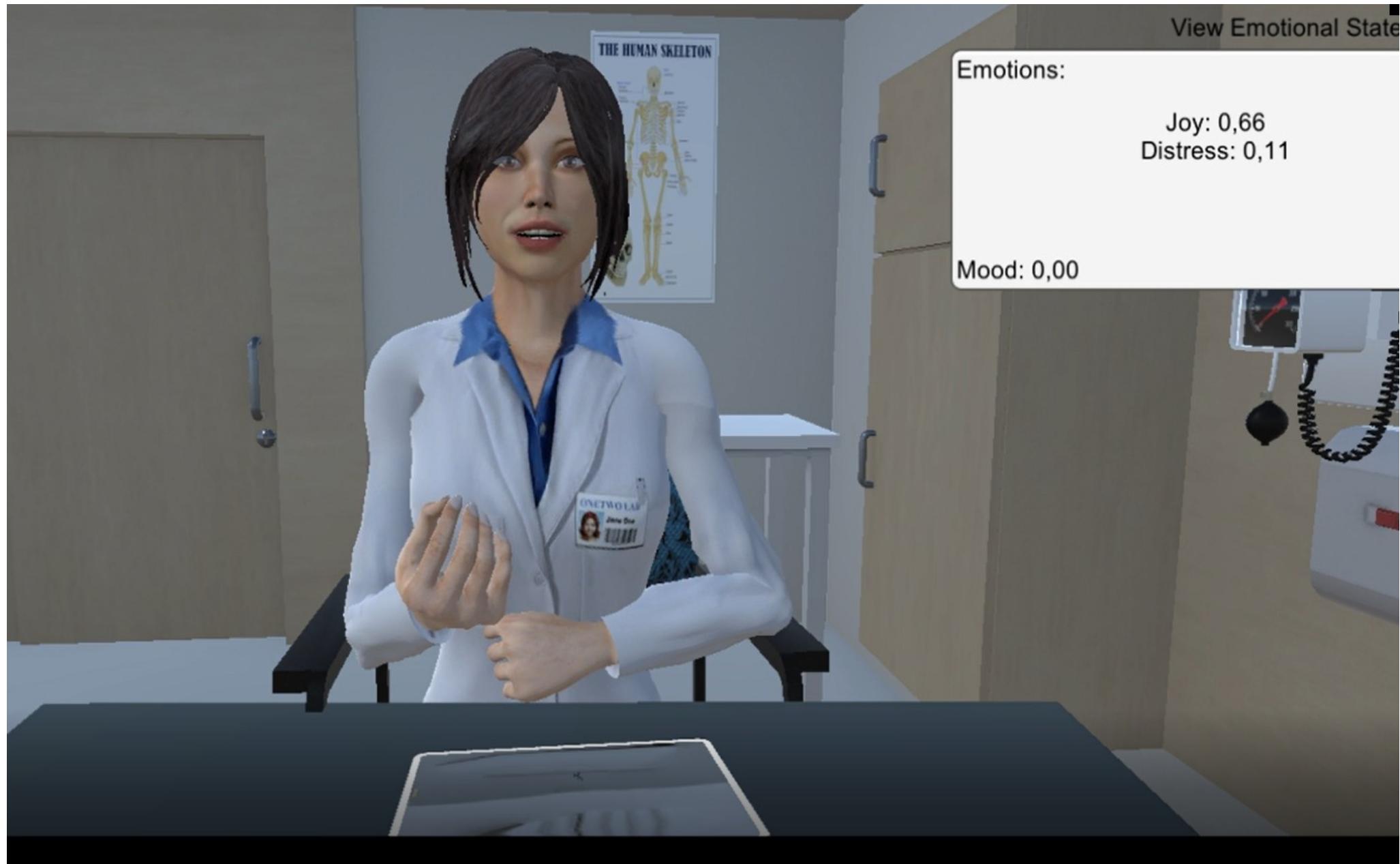
# Data collection or Coach

P. Philip, Sanpsy CHU Bordeaux, "clinique du sommeil"



Application Kanopée

# Data collection



# Diagnostic (or remediation?): Eliza

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- Chat bot = “chatterbox” + “robot”
- A program capable of NL dialogue
  - Usually keyword spotting
  - No dialogue session, context or memory
- No embodiment
- Goals: only chat



ELIZA (J. Weizenbaum, 1965)

# Diagnostic: Immersive teleoperation

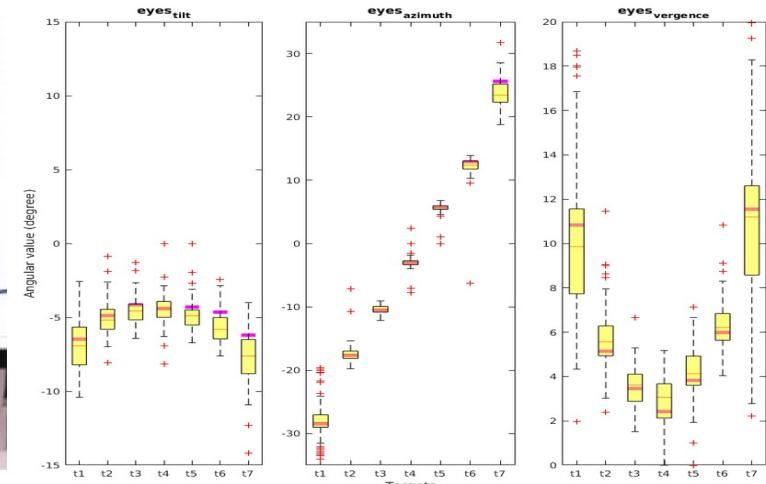
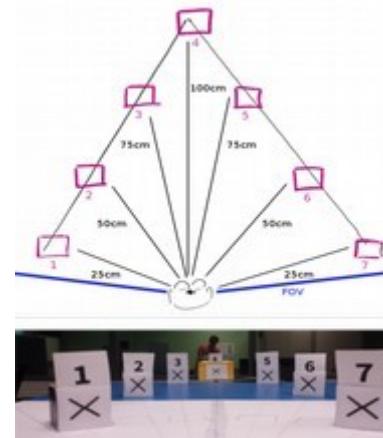


... for demonstrating social behaviors  
Gérard Bailly, Frédéric Elisei & Rémi Cambuzat

- Immersive teleoperation of Nina
  - Lips, head & eye movements (azimuth, elevation & vergence)
  - Audiovisual (binaural & stereo) feedback

Cambuzat, R., Elisei, F., Bailly, G., Simonin, O., & Spalanzani, A. (2018) Immersive teleoperation of the eye gaze of social robots, International Symposium on Robotics (ISR), Munich, Germany: pp. 232-239.

- Learning behaviors
  - Intra- & inter-modal coordination
- Embodied cognition
  - Pilot's behavior



# Projets NARECA (ANR) DAISI (Feder)

O. Serban, Z. Ales, M. Barange  
J. Saunier, A. PAuchet

# Contexte : interactions enfant - machine

*« En 2010, un écolier scolarisé en école primaire a passé plus de temps devant son poste de télévision que devant son professeur »*

(Chonchaiya et al. 2010)

- Nouvelles formes d'interaction  
(Bloomberg & Skantze 2012)



# Contexte : et pour les TSA ?

- Interactions personnage virtuel – enfant porteur d'un Trouble du Spectre de l'Autisme (TSA) (Tartaro & Cassel 2008)



## Objectif

Caractériser l'interaction avec un personnage virtuel des enfants typiques, des enfants avec TSA et des enfant avec un trouble socio-communicationnel

# Collecte de données

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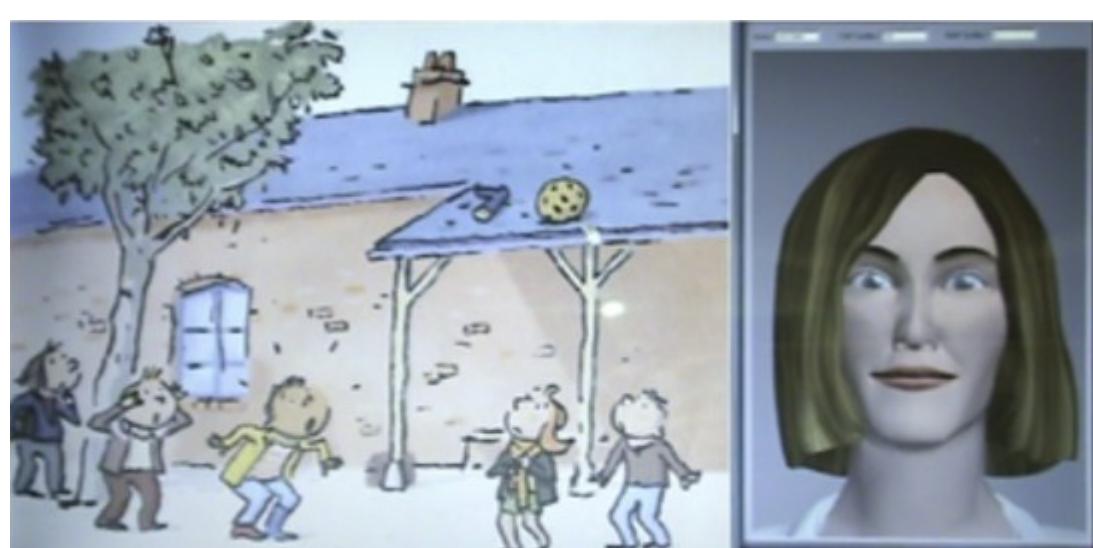
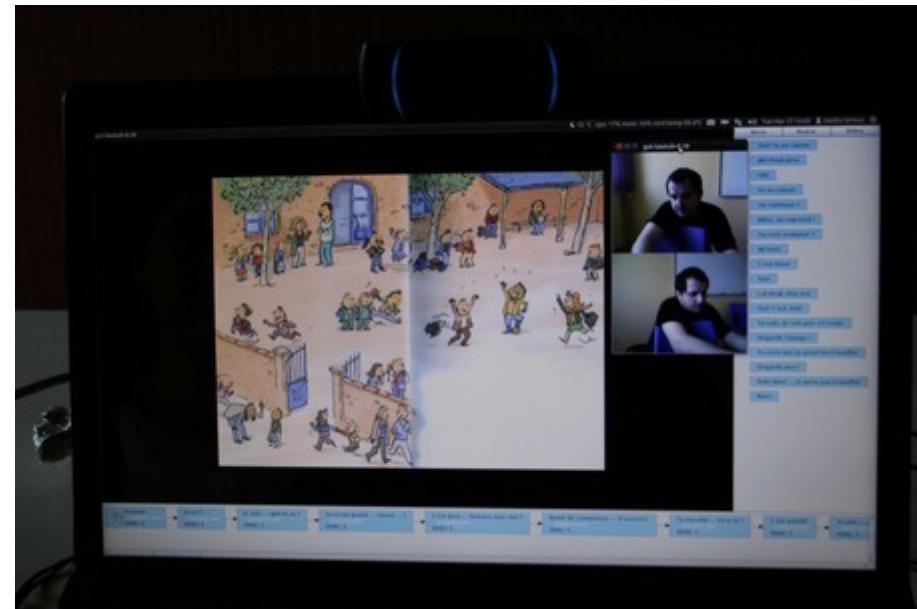
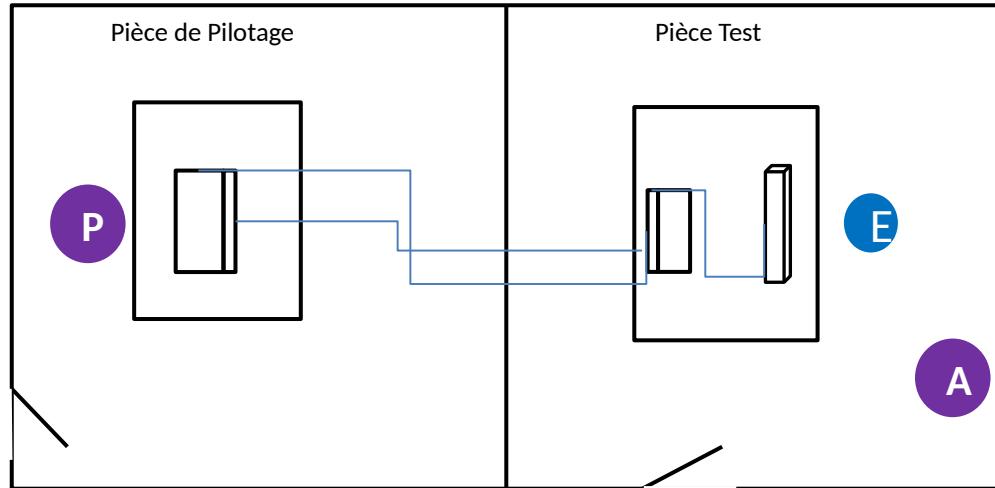
## Objectif

Caractériser l'interaction avec un personnage virtuel des enfants typiques, des enfants avec TSA et des enfant avec un trouble socio-communicationnel

## Population

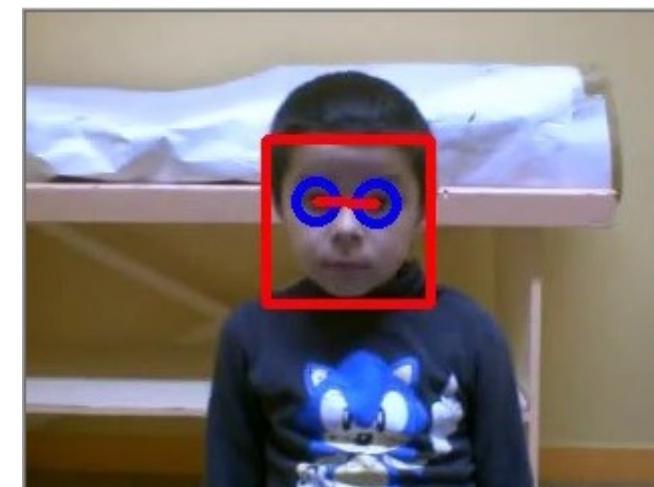
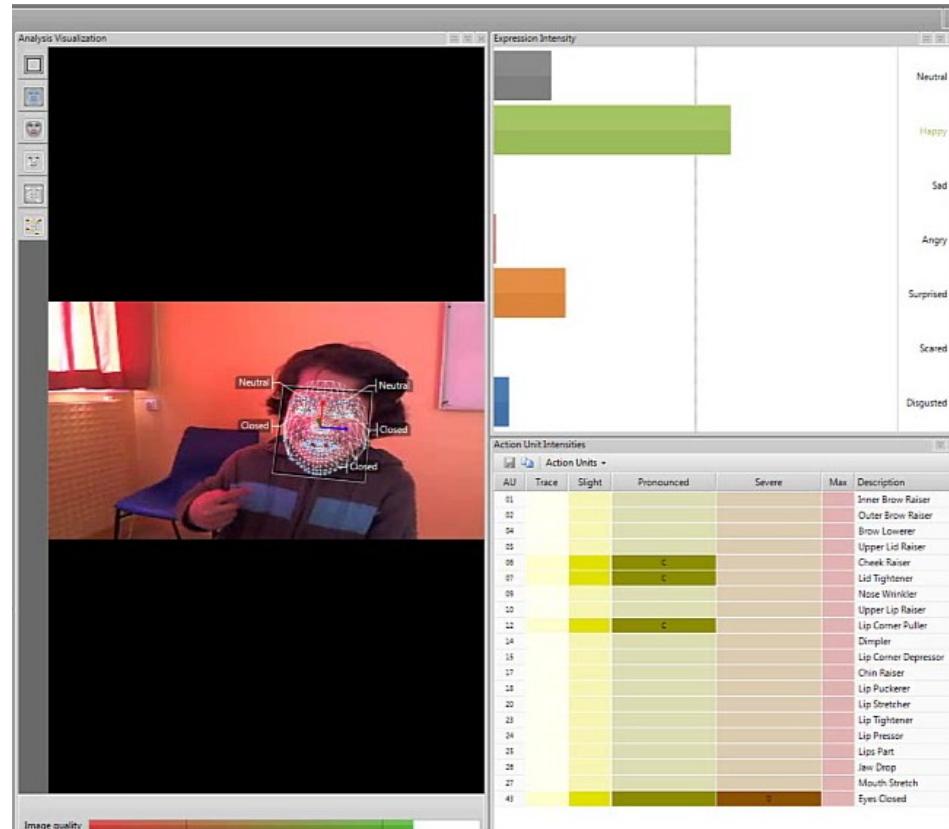
- Enfants typiques
- Enfants avec TSA
- Enfants avec troubles socio-communicationnels
- Écoles
- CRA, IME, SESSAD
- CRA, IME, SESSAD, ADAPT

# Dispositif : Magicien d'Oz



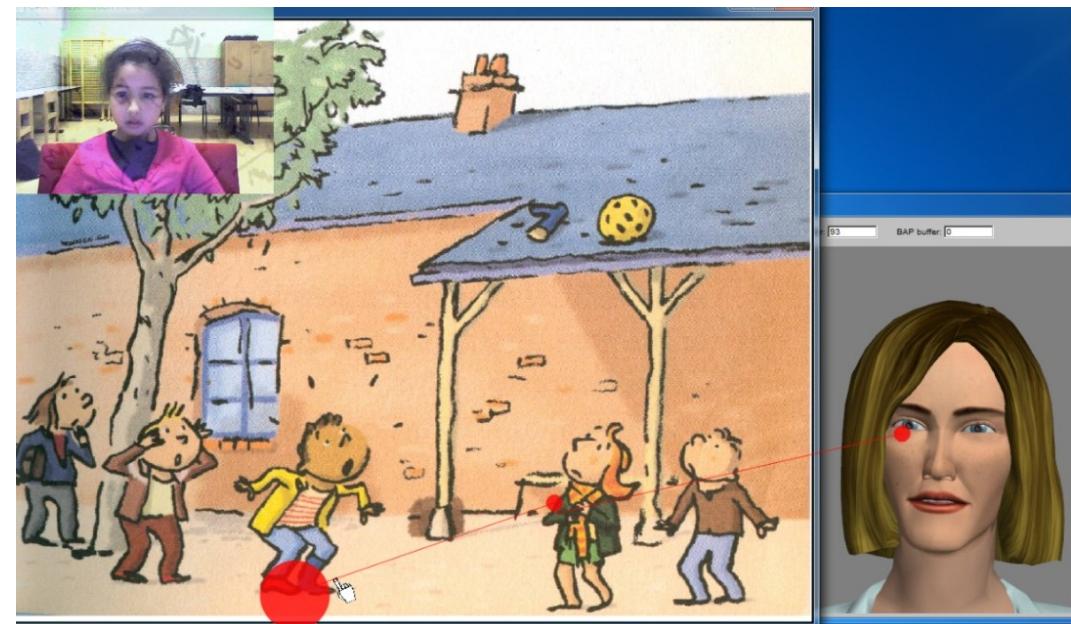
# Éléments d'analyse et outils

- Comportements non verbaux : sourires, expressions faciales, gestes et postures, ...



# Éléments d'analyse et outils

- **Comportements verbaux** : latences de réponses, disfluences
- **Exploration visuelle** : durées de fixation et zones d'intérêt



# Résultats (enfants typiques)

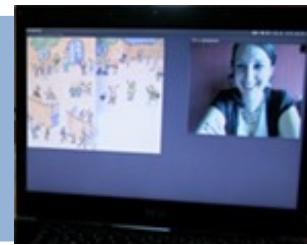
149 enfants âgés de 6 à 11 ans  
filmés en situation de narration interactive

- Comparaison : Avatar (MOz) - Humain Webcam - HH (FàF)

Avatar



Humain  
Webcam



Humain  
face à face



- Comparaison :

Avatar Prosodie+Mimiques (MP) - Ø Mimique (NoM) - Ø prosodie (NoP)

Avatar  
MP



Avatar  
NoM



Avatar  
NoP



# Résultats (enfants typiques)

- **Comparaison Avatar - Humain webcam - HH**

La **latence** de réponse des enfants diffère selon le type de narrateur ( $F_{(2;87)} = 8,902$  ;  $p < .001$ )

La latence de réponse est influencée :

- 1/ par la communication médiatisée par l'écran
- 2/ par le caractère virtuel ou humain du narrateur



- **Comparaison Avatar MP - NoM - NoP**

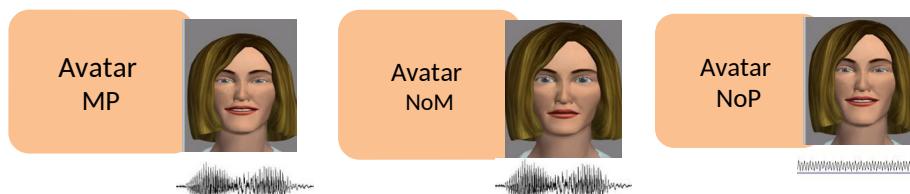
NoP affecte les comportements communicationnels des enfants

- 1/ l'absence de prosodie de l'avatar altère plus le dialogue que l'absence de mimiques faciales
- 2/ Pas de différence significative entre MP et NoM mais NoM diminue l'appréciation de l'interaction

+ de sourires en MP qu'en NoP ( $p = .001$ )

+ de réponses aux questions en MP qu'en NoP ( $p = .001$ )

Latence de réponse aux questions + long en NoP qu'en MP ( $p = .04$ )



# Agent virtuel narrateur

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<https://agentslang.github.io/>

# Perspectives

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## Objectifs scientifiques

Caractérisation de l'interaction ⇒ paramétrage du personnage virtuel  
⇒ interactions avec un robot

- **Outil de diagnostic**

- Diagnostic de troubles
  - Entraînement au diagnostic pour les professionnels

- **Outil de remédiation**

- Enfants typiques
  - Enfants avec TSA
  - Enfants avec trouble socio-communicationnel

# Acknowledgements

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- Jean-Paul Sansonnet (LIMSI)
- Catherine Pelachaud (ISIR)
- All members of GT ACAI

# Conclusion

## Bienvenue sur le site du GT ACAI

Le groupe de travail "Affects, Compagnons Artificiels et Interactions" (ACAI) a pour objectif est de regrouper les activités en informatique affective et interactions en France. Il se situe dans la continuité du [groupe de travail WACA](#).

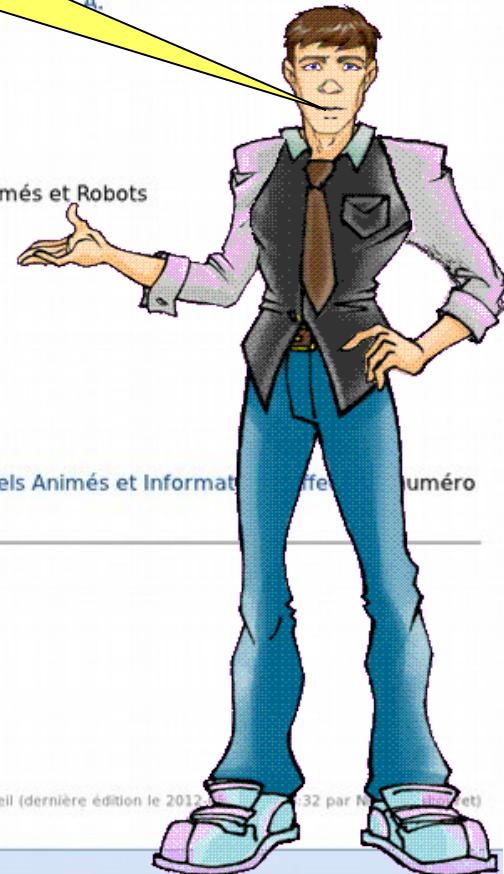
Ses principales actions sont :

- La diffusion d'information à travers la liste [acai@poleia.lip6.fr](mailto:acai@poleia.lip6.fr)  
Pour vous abonner, vous pouvez envoyer un email à [Nicolas.Sabouret@lip6.fr](mailto:Nicolas.Sabouret@lip6.fr)
- L'organisation de journées de travail :
  - La journée du [22 novembre 2011](#) à Paris - Informatique Affective, Agents Conversationnels Animés et Robots
  - La journée du [6 avril 2012](#) à Paris - Affects, Compagnons Artificiels et Interactions
- L'organisation de la conférence WACAI (qui prend la suite des conférences WACA) :
  - [WACA 2005](#) Premier Workshop ACA, 13-14 juin 2005, Grenoble
  - [WACA 2006](#) Deuxième Workshop ACA, 26 et 27 octobre 2006, Toulouse
  - [WACA 2008](#) Troisième Workshop ACA, 28 novembre 2008, Paris
  - [WACA 2010](#) Quatrième Workshop ACA, 25-26 novembre 2010, Lille
  - Le **WACAI 2012** aura lieu à Grenoble jeudi 15 et vendredi 16 novembre 2012.
- La publication de travaux scientifiques de la communauté :
  - Après le numéro de 2011, la revue TSI édite en 2012 un numéro spécial [Agents Conversationnels Animés et Informatique Affective](#) (numéro 31, volume 4), à paraître bientôt.

### Voir aussi

- Présentation des objectifs scientifiques du GT
- Les quatre axes thématiques du GT
- Organisation du GT
- Principales équipes impliquées (en France)

Join the  
GT ACAI!



Accueil (dernière édition le 2012-04-13 à 13:32 par [Nathalie](#) et)