



# Computational linguistics and human-agent interactions

Toward socially believable agents

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LTCl, Telecom-ParisTech

## Introduction

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# Telecom-ParisTech, Social Computing Topic

## Social Computing research topics

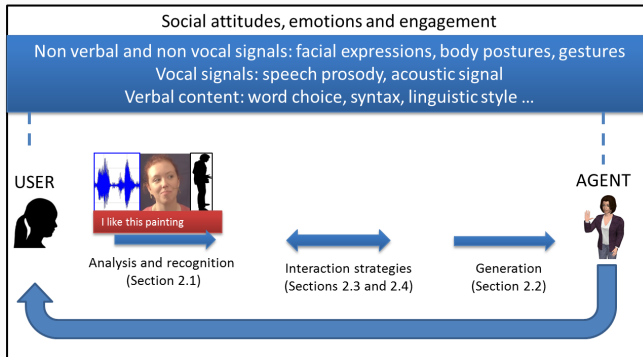
- Social web analysis
- Multimodal social signal processing
- Human-agent interaction

## European and national projects of the team

- Chaire Machine Learning for Big Data
- Labex SMART
- National and European projects : H2020 Aria-Valuspa, ANR JCJC MAOI
- Research Training Network Animatas

# Human-agent subtopic

in a close collaboration with ISIR : the greta team <sup>1</sup>



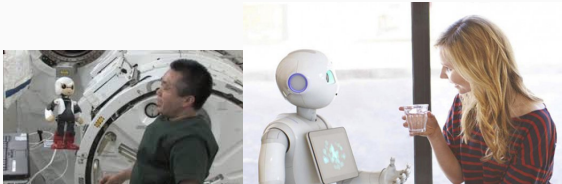
<sup>1</sup><http://www.tsi.telecom-paristech.fr/mm/en/themes-2/greta-team/>

# Human-agent/robot interaction : applications

## Personalized virtual assistant



## Social Robotics



# Outline of the talk

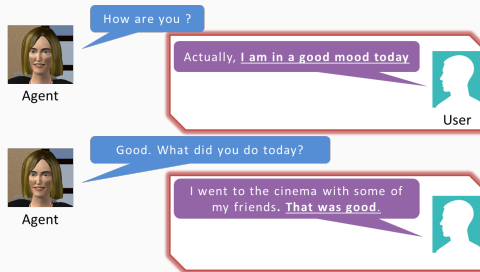
## Computational linguistics for human-agent interactions

1. Introduction
2. Opinion analysis in H-A interactions
3. Verbal alignment in human-agent interactions
4. Conclusion

## Opinion analysis in H-A interactions

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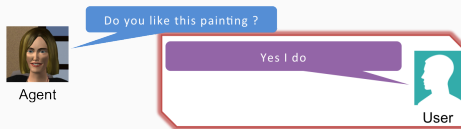
# Challenges



Clavel, C.; Callejas, Z., *Sentiment analysis: from opinion mining to human-agent interaction*, IEEE Transactions on Affective Computing,(2016)



# Challenges



## Features of human-agent interaction

- User's expression of opinion depends on agent's utterance
- the agent has its own social strategy
  - delimit relevant opinions according to agent's social goals

## Related work

### Related work

Non verbal cues analysis (facial expressions, prosody, ...) [Schuller et al., 2011]

First sentiment analysis modules integrated in human-agent interactions  
[Smith et al., 2011, Pulman et al., 2010]

→ use of an *off-the-shelf module* [Moilanen and Pulman, 2007] not designed for human-agent interaction

Clavel, C.; Callejas, Z., *Sentiment analysis: from opinion mining to human-agent interaction*, IEEE Transactions on Affective Computing, (2016)

## Knowledge-based approach

[Langlet and Clavel, 2015] knowledge-based approach to model opinions

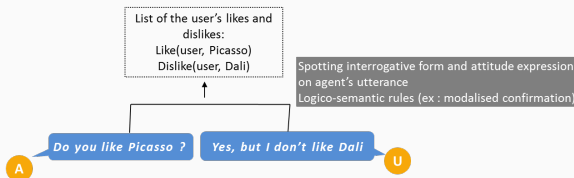
↪ opinions as defined by the appraisal theory [Martin and White, 2005] derived from functional systemic linguistics

C. Langlet and C. Clavel, *Improving social relationships in face-to-face human-agent interactions: when the agent wants to know users likes and dislikes* , in ACL 2015

## Knowledge-based approach

### Bottom-up approach based on three levels

- Patterns and rules to spot attitude expression in **the user's utterance**
- Patterns and rules to integrate **the adjacency pair** (agent utterance, user utterance)



C. Langlet and C. Clavel, *Improving social relationships in face-to-face human-agent interactions: when the agent wants to know users likes and dislikes* , in ACL 2015

# Knowledge-based methods for opinion analysis in human-agent interactions

## Bottom-up approach based on three levels

- Patterns and rules using **topic structure**
  - to help the modelling of the potential opinion target
  - to link the opinion target to the topic, ex: *I like it*

Caroline Langlet, Chloe Clavel, *Grounding the detection of the users likes and dislikes on the topic structure of human-agent interactions*, Knowledge-Based Systems (2016)

## Machine learning/Deep learning vs. knowledge-based

### ML advantage

- few linguistic expertise is required to build the model from the annotated data,

## Machine learning/Deep learning vs. knowledge-based

### ML advantage

- few linguistic expertise is required to build the model from the annotated data,

### ML drawback

- require a labelled dataset (big dataset for deep learning approaches) while annotating data in opinions is a difficult task

## Machine learning for opinion dynamics modelling



### Example of study

Model dynamics of movie review by using HCRF (Hidden Conditional Random Field) a latent state model interpretable and efficient with a small dataset

Barriere, V., Clavel, C., Essid, E., Opinion Dynamics Modeling for Movie Review Transcripts Classification with Hidden Conditional Random Fields, Interspeech 2017



## **Verbal alignment in human-agent interactions**

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# Implementation of verbal alignment strategies in H-A

## Challenge : foster user engagement (Poggi, 2007)

- Work on alignment phenomenon (Pickering and Garrod): the convergence of two participants;
- Work on verbal content and on other-repetitions [Svennevig, 2004]

37 - Obadiah: "**Life** is hard **sometimes**."

38 - User: "(Nods). **Life** can suck **sometimes**. I agree."

Clavel, C., Cafaro, A., Campano, S., & Pelachaud, C. (2016). Fostering user engagement in face-to-face human-agent interactions: a survey. In Toward Robotic Socially Believable Behaving Systems. Springer International Publishing.

## Agent's verbal alignment on user appreciations relying on

- a module for the planification of appreciation task
- generation patterns of agent's verbal content

S. Campano, C. Clavel, C. Pelachaud, *I like this painting too : when an ECA shares appreciations to engage users*, in AAMAS 2015

# Measures of verbal alignment in interactions

## Motivations

- build a measure of the *social glue* during human-agent interaction ...
- ... as a paramater of socio-emotional interaction strategies

Dubuisson Duplessis, G.; Clavel, C.; Landragin, F., *Automatic Measures to Characterise Verbal Alignment in Human-Agent Interaction*, 18th Annual Meeting of the Special Interest Group on Discourse and Dialogue (SIGDIAL), 2017

Code available at <https://github.com/GuillaumeDD/dialign>

## Measures of verbal alignment in interactions

### Automatic building of the shared expression lexicon

Applying sequential pattern mining [Mooney and Roddick, 2013] on text pattern extraction (inspired from [Dubuisson Duplessis et al., 2017])

A <sub>1</sub>	well, that's an interesting idea. but no, <u>that's not gonna work for me.</u>
B <sub>2</sub>	what will <u>work for</u> you?
A <sub>3</sub>	<u>what</u> do <u>you</u> think about <u>me</u> getting two chairs and one plate and <u>you</u> getting one chair, one plate, and the clock?
B <sub>4</sub>	<u>that's not gonna work for me</u>



Shared Expr. Lexicon
<u>that's not gonna work for me</u>
<u>work for</u>
<u>me</u>
<u>what</u>
<u>you</u>

Dubuisson Duplessis, G.; Clavel, C.; Landragin, F., *Automatic Measures to Characterise Verbal Alignment in Human-Agent Interaction*, 18th Annual Meeting of the Special Interest Group on Discourse and Dialogue (SIGDIAL), 2017

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## Measures of verbal alignment in interactions

### Measures derived from the built shared Expression Lexicon

Example : the proportion of shared expressions initiated by locutor *S*

Dubuisson Duplessis, G.; Clavel, C.; Landragin, F., *Automatic Measures to Characterise Verbal Alignment in Human-Agent Interaction*, 18th Annual Meeting of the Special Interest Group on Discourse and Dialogue (SIGDIAL), 2017

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## Conclusion

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# Computational linguistics and Social computing in human-agent interactions

## What we've done...

- detecting user's likes and dislikes
- measuring and implementing verbal alignment

## Lessons learnt

- pluridisciplinarity is crucial (psychology, functional linguistics, social science, machine learning, knowledge reasoning)
- knowledge-based methods are required to lay the foundations of new scientific issues of social computing
- machine learning/deep learning methods are great as soon as you get big reliable dataset labelled into socio-emotional phenomena (which is a big challenge !)

## Other topics in the team

### Human-robot interaction database for user engagement studies

Atef Ben Youssef, Miriam Bilac, Slim Essid, Chlo Clavel, Angelica Lim, Marine Chamoux, UE-HRI: A New Dataset for the Study of User Engagement in Spontaneous Human-Robot Interactions In Proceedings of ACM International Conference on Multimodal Interaction, Glasgow, Scotland, November 2017 (ICMI17)

### Generation of socio-emotional behavior

Towards the Generation of Expressive Co-Speech Gestures - Brian Ravenet, Chlo Clavel and Catherine Pelachaud, VSI Workshop  
Janssoone, T., Clavel, C., Bailly, K. and Richard, G. *Using temporal association rules for the synthesis of embodied conversational agents with a specific stance*. IVA 2016



**Questions?**

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**Spontaneous speech and opinion detection: mining call-centre transcripts.**  
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Dubuisson Duplessis, G., Charras, F., Letard, V., Ligozat, A.-L., and Rosset, S. (2017).

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Moilanen, K. and Pulman, S. (2007).

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