Computational Modeling of (un)Cooperation: The Role of Emotions

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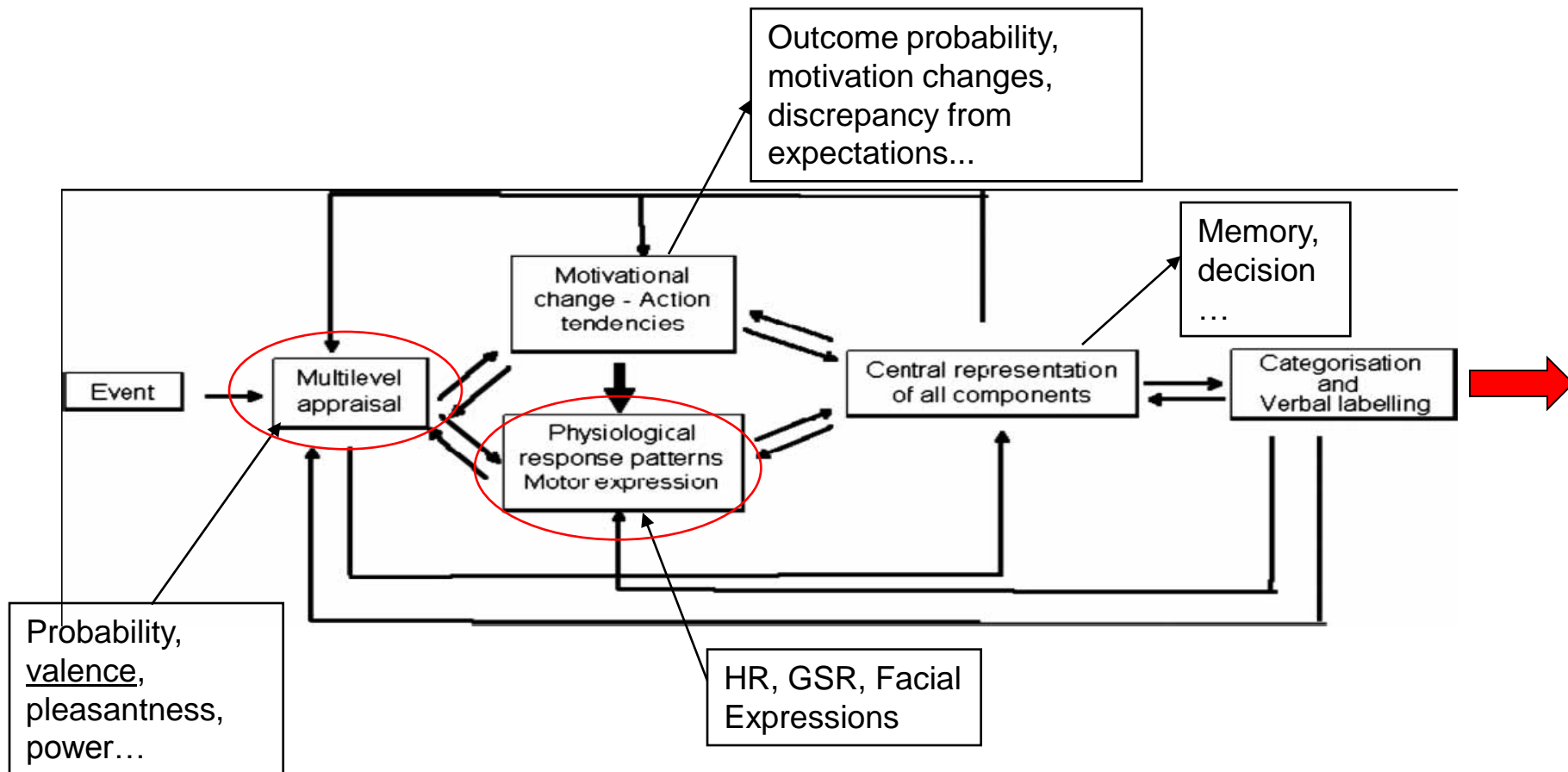# Emotions and Cooperation in Dialogues

-Elicitation and collection of cooperative and uncoperative interactions

-Psychophysiological (emotive) data

-Multimodal annotation of cooperative and emotive features

State of the Art on Emotions
Emotion Assessment

Basic Emotions vs Appraisal Theory of Emotions

Outcome probability, motivation changes, discrepancy from expectations...

Memory, decision ...

Motivational change - Action tendencies

Event

Multilevel appraisal

Physiological response patterns Motor expression

Central representation of all components

Categorisation and Verbal labelling

Probability, valence, pleasantness, power...

HR, GSR, Facial Expressions

State of the Art on Emotion (Annotation)

- Problem-> low agreement in emotion ratings (for a review Callejas and Lopez-Cozar, 2008)

- Annotation of emotions relies on too generic features (e.g. basic emotions or "cover classes", e.g. Russell & Barrett, 1999)

- Emotional words and their connected concepts influence emotion judgments and their labeling (for a review, see Feldman Barrett et al., 2007)

State of the Art on (un)Cooperation

- Notion of cooperation is not crisp *(Folklinguistic* - Davies, 2006)

- <u>Paul Grice</u> (1975, 1989) described the **cooperative principle:**

'*make conversational contribution such as is required, at the stage at which it occurs, by the accepted purpose or direction of the talk exchange*'

- <u>Clark</u>'s "collaborative principle"

- Zip's inspired "Principle of Parsimony (Least Collaborative Effort" (<u>Shadbolt</u>, 1984))

- What happens when cooperation breaks down?

Research Questions

- HYPOTHESIS:
- Negative emotion disrupts cooperation (Sunfey et al., 2003)
- Seeing the other's face in interaction improves cooperation (e.g. Argyle, 1990)

- **research question 1:** *Are psychophysiological measures, specifically heart rate, predictors of cooperation?*

- **research question 2:** *Is facial expression a predictor of cooperation?*

- **research question 3:** *Is eye contact a predictor of cooperation?*

Rovereto Emotion and Cooperation Corpus

Dialogue Elicitation

Stazione degli autobus

vigneti

Maso Nichelini

Monte Baffoni

vigneti

Fiume Leno

Chiesa dell'Adagio

Monte Poldi

vigneti
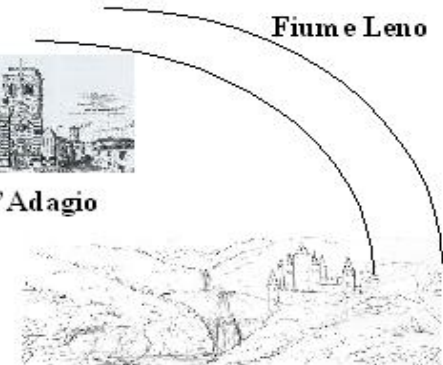
Castello di Rovereto

Stazione degli autobus

Monte Zaffoni

Fiume Leno

Monte Toldi

Maso Michelini

vigneti

Chiesa di San Biagio

vigneti

Castello di Rovereto

RECC
Dialogue Data Collection

EXPERIMENTAL CONDITIONS:

- Traditional Map Task

- Modified (Giver or Follower Confederate) Map Task

  ->elicitation of frustration and anger (Anderson et al., 2005)

- Screen/short barrier condition (no eye contact /eye contact condition)-> different levels of cooperation

RECORDED DATA:

- ECG, HR, GSR

- Audio and video recording

RECC
Corpus Description

- 20 interactions, 12 with confederate, 240 mins audio video and psychophysiological recordings

- We firstly record participants *baseline* for 5 minutes

- Then we record the psychophysiological outputs during task (Newton &Bane, 2002; Anderson et al., 2005 for HR)

- The confederate at mins 4, 9 and 13 acts a script (frustration/anger elicitation in follower; Anderson et al., 2005)

- *"You driving me in the wrong direction, try to be more accurate!"*
- *"It's still wrong, this can't be your best, try harder! So, again, from where you stop"*
- *"You're obviously not good enough in giving instruction*

RECC
Corpus Collection

- BIOPAC MP150

- ECG is recorded by Ag AgC1 surface electrodes fixed on partecipant's wrists, low pass filter 100 Hz, 200samples/s

- HR is derived atomatically from ECG

- GSR is recorded with Ag AgC1 electrodes attached to the palmar surface of the second and third fingers of the non dominant hand, 200samples/s

- 2 Canon digital cameras and 2 free field Sennheiser halfcardioid microphones
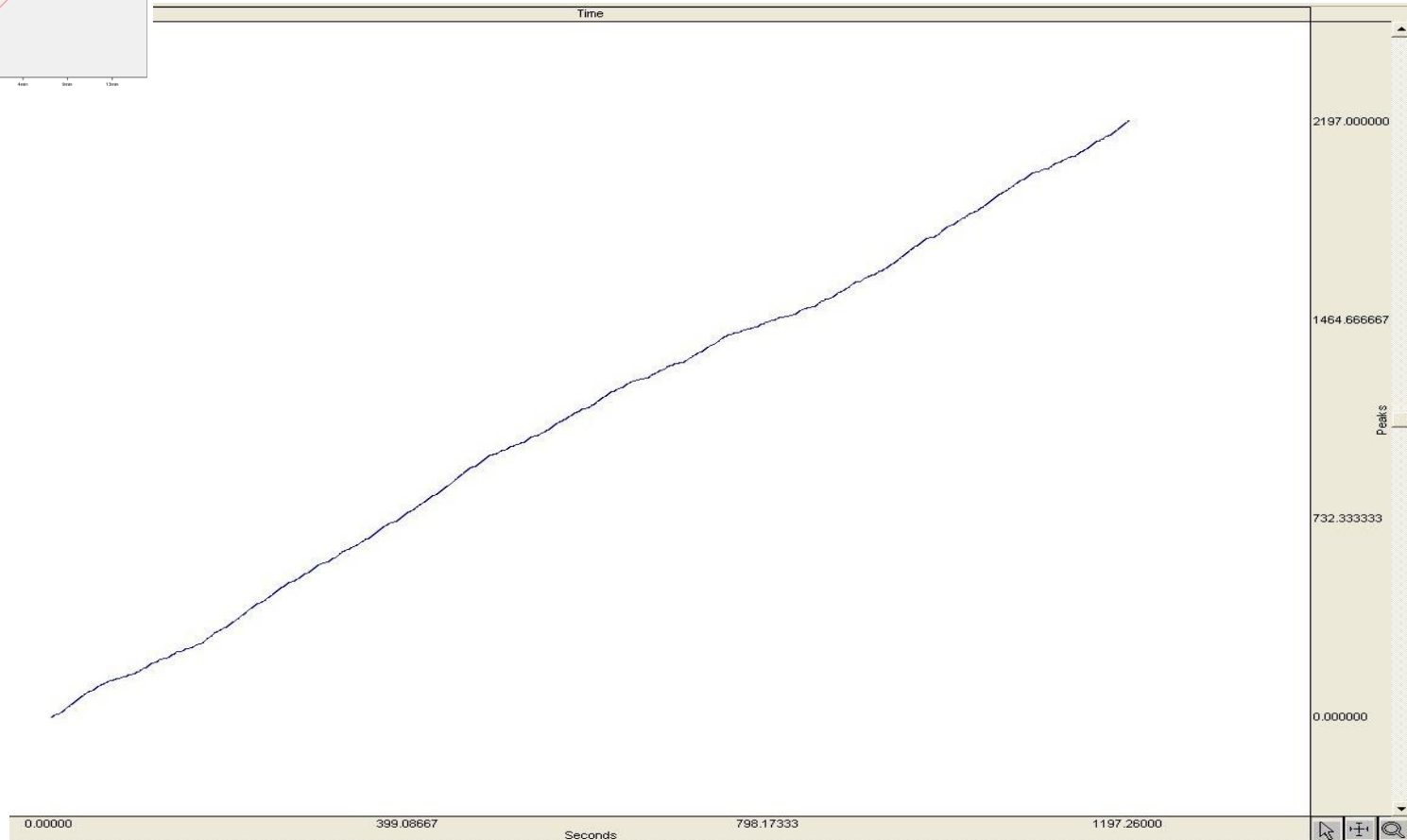
Anova 1X5 HR/Time (p<0,0001)
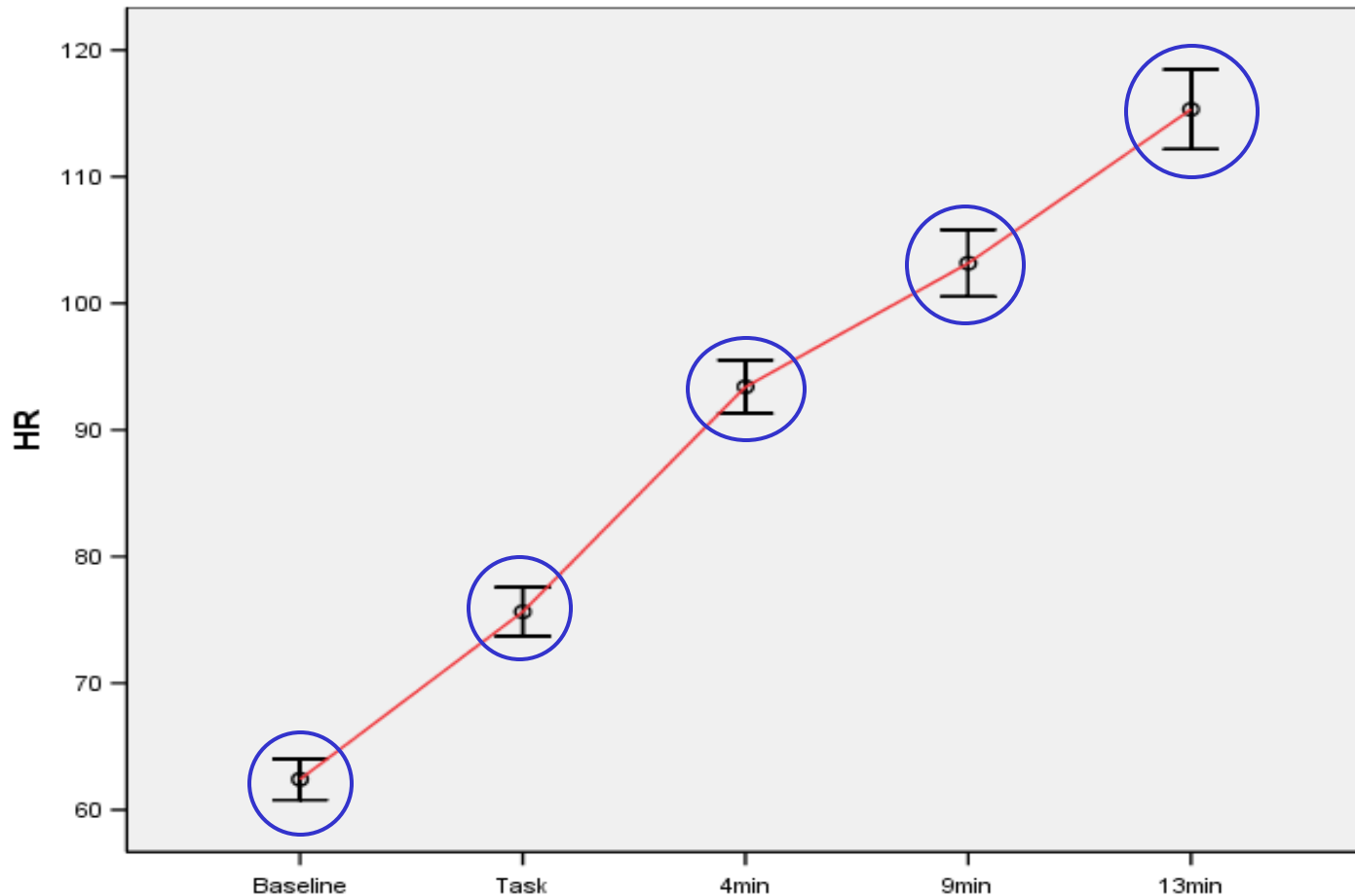
Time	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	62,413	,704	60,790	64,036
2	75,644	,840	73,707	77,582
3	93,407	,916	91,295	95,519
4	103,169	1,147	100,525	105,813
5	115,319	1,368	112,165	118,473

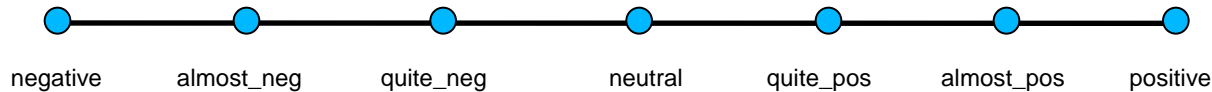! Emotion elicitation timing allows a full recovery of the psychophysiological state (Anderson et al., 2005)
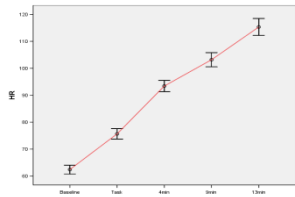
GSR: Peaks/Time

Number of positive peaks detected over time

Emotion Valence
(Bradley & Lang, 1994)

Participants report on a rank scale the valence of the emotions felt during the task

| negative | almost_neg | quite_neg | neutral | quite_pos | almost_pos | positive |

Ratings of emotion towards the interlocutor (14 subjects):
- 43% quite negative
- 29% almost negative
- 14% negative
- 14% neutral

Analysis:
Corpus Annotation

- Annotation of cooperation

- Annotation of emotion

- Speech turn management

- Gaze direction (to the interlocutor/to the map)

Annotation of Cooperation Computation of Effort

(Shadbolt, 1984)

A speaker will try to choose the approach which will be the least effortful – and therefore the most risky – that is still likely to succeed

The **high risk** approach makes the assumption that speakers share knowledge before starting the interaction. If it is not the case, a effortful repair sequence must take place

The **low risk** approach takes more effort initially, as it settles down a larger common ground but is more likely to succeed at the first attempt.

The **Trade-off** between the two strategies is the opportunity to save some effort against the possibility of having to engage in a potentially more effortful repair sequence.

Annotation of Cooperation:
RECC Coding Scheme

Instructions (Cooperation Typology)	Cooperation Level
No answer to question: no answer given when required	-2
Inappropriate reply : failure to introduce useful information when required	-2
No Spontaneous Add/Repetition of Instruction: information is not spontaneously added or repeated after a check	-1
Giving Instructions: task baseline	0
Acknowledgment: a verbal response which minimally shows that the speaker has heard the move to which it responds	1
Question answering (Y/N): Yes-No reply to a check	1
Check: questions (function or form) which solicit other understanding of information already offered	1
Repeating Instructions: repetition of an instruction following a check	1
Question answering + adding information: Yes-No reply + new information introduction	2
Spontaneous info/description adding: introduces new information relevant to the task	2

-The basic unit of analysis is the dialogue "move"

-*check, question answering* and *giving instruction* "moves"as measures of knowledge sharing (i. e. grounding)

-We attributed to each move a cooperation level (*Principle of Least-Effort*)

Emotive Facial Expression:
PCA Processing of Emotions
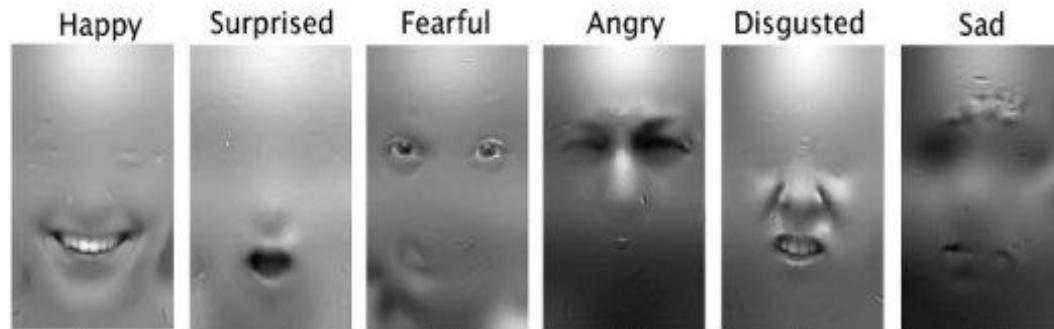
From Smith et al. 2005, *Phsychological Science*

Eyebrow signals:

- **Eyebrows up:** up

- **Eyebrows very up:** +up

- **Eyebrows frowned:** fr

- **Eyebrows very frowned: +**fr

- **Normal shape:** --

- **One eyebrow up:** 1up

Mouth signals:

- **Corners up:) +)**

- **Corners down: (+(**

- **Lower lip biting**

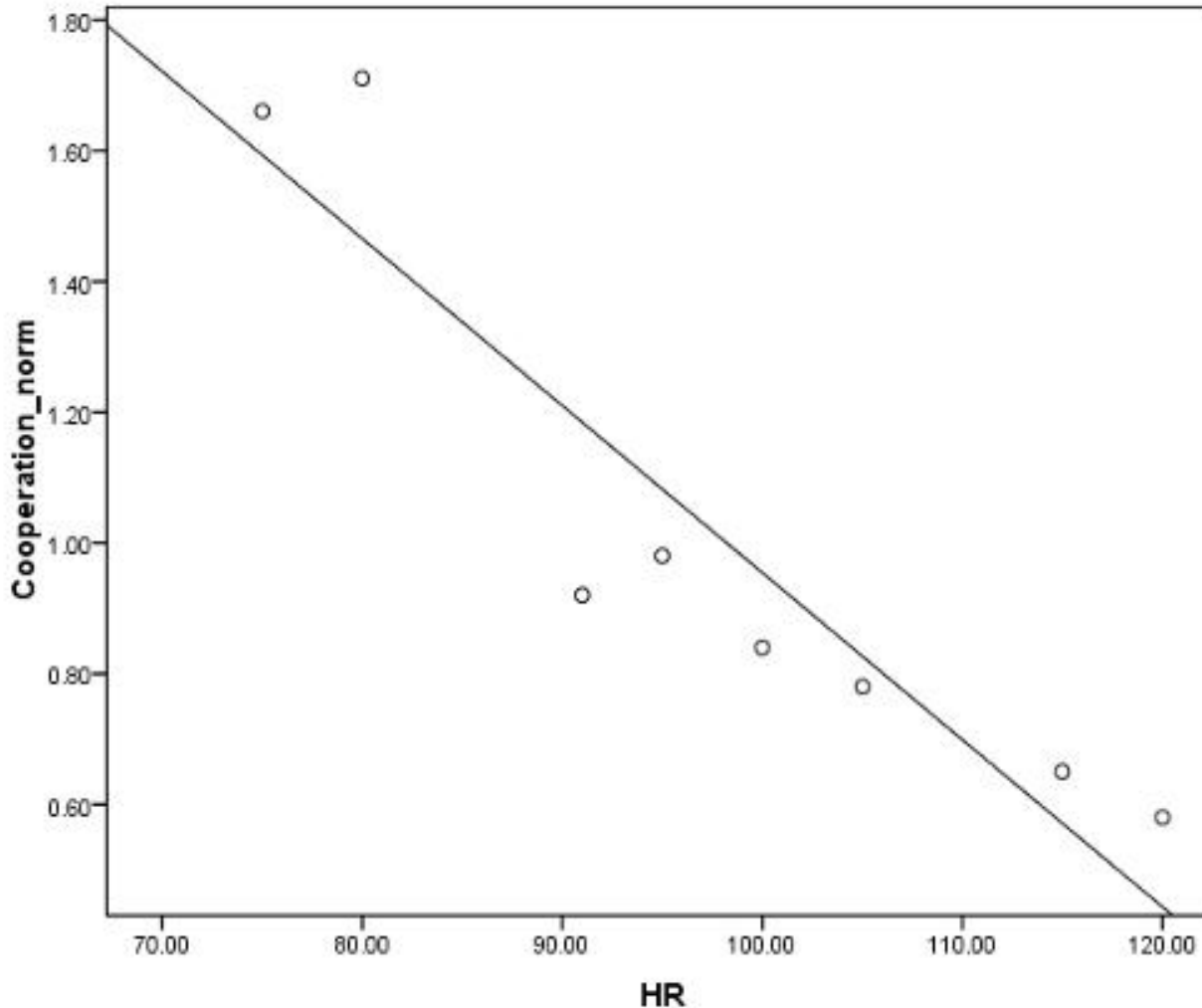- **Closed lips: -**

Coding Scheme Implemented in ANVIL

Results:
Reliability Study

- 6 annotators, Italian native speakers, 2 with previous experience

-Cooperation agreement (giver: 0.82, p<0.01; follower: 0.83, p<0.01)

 - Upper facial display (0.86, p<0.01)

 - Lower facial display (0.81, p<0.01)

RQ1
Is HR Predictor of (un)cooperation?

A negative linear regression between cooperation and HR is found.

Negative emotion elicitation (*uncooperative utterances*) reduce the level of cooperation in the other participant.

RQ2
Is Facial Expression Predictor of (un)cooperation?

Logit model

Cooperation is predicted by:

- Eyebrows in normal position **- -**

- Mouth with smile **)** or open smile **+)** and **lower lip biting**

Is Facial Expression Predictor of (un)cooperation?

- **Uncooperative behavior had no facial predictors**

This is consistent with Sherer & Heiner (2007)

->facial expressions are not "*readout*" of motor programs but indicators of mental states and evaluation processes

-> personal differences led to very different response to externally induced "*disadvantages*" (Van Mechelen & Hennes, 2009)

Thanks for Your Attention

Computation of Effort
(Shadbolt, 1984-Davies, 2006)

- ***Speakers will avoid unnecessary effort***: commitment to doing the work necessary to the task, they are not expected to do any *more* than that

- ***Speakers will improve at tasks:*** speakers should have the ability to *learn*

- ***Speaker effort will decrease:*** as speakers learn, they will determine what effort is absolutely necessary to the task + grounding

Computation of Effort
(Davies, 2006)

• Davies (2006) tested the Principle of Cooperation on 16 HCRC Map Task dialogues;

•Davies' attempt to estimate cooperation from a narrow set of indicators to a sort of data-driven set (a coding scheme);

• She tried to distinguish among the levels of effort that participants invested on their utterances. This is reflected in a weighting system.

Effort Level	Positive Weighting	Negative Weighting
Level 1 – Minimum Effort	+1	-4
Level 2 – Moderate Effort	+2	-3
Level 3 – Medium Effort	+3	-2
Level 4 – High Effort	+4	-1