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Social Signal Processing

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Outline

Social Signal Processing

Conflict Detection

Automatic Personality Perception

Conclusions

Outline

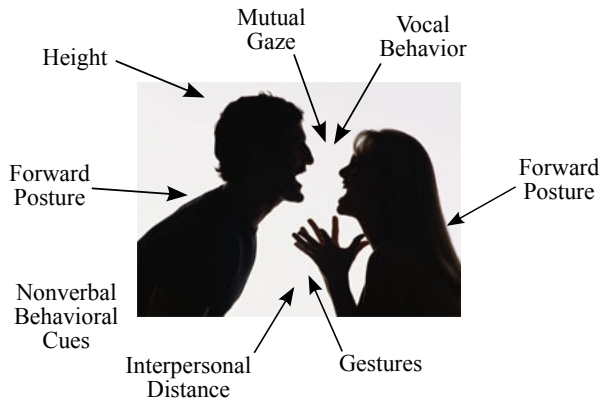Social Signal Processing

Conflict Detection

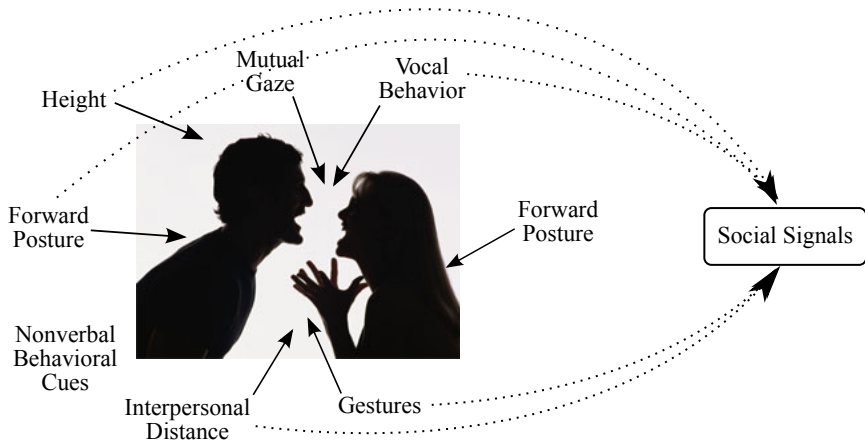Automatic Personality Perception

Conclusions

Nonverbal Communication

Nonverbal Communication

Height

Mutual Gaze

Vocal Behavior

Forward Posture

Forward Posture

Nonverbal Behavioral Cues

Interpersonal Distance

Gestures

Nonverbal Communication

Height

Mutual Gaze

Vocal Behavior

Forward Posture

Forward Posture

Social Signals

Nonverbal Behavioral Cues

Interpersonal Distance

Gestures

Social Signal Processing

SSP studies signals [...] that

The "Belfast Declaration": http://sspnet.eu/about/

Social Signal Processing

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> ► are produced during social interactions;

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- are produced during social interactions;
- that either play a part in the formation and adjustment of relationships and interactions between agents (human and artificial)

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Social Signal Processing

SSP studies signals [...] that

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- or provide information about the agents;

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- and that can be addressed by technologies of signal processing and synthesis.

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Conflict: **What?**

[Conflict is a] mode of interaction [where] the attainment of the goal by one party precludes its attainment by the others.

C.M. Judd, "*Cognitive Effects of Attitude Conflict Resolution*", Journal of Conflict Resolution, 22(3):483-498, 1978.

Conflict: **Where?**

Source:	Canal 9
Number of Clips:	1430
Clip Length:	30 seconds
Total Length:	11 hours and 55 minutes
Subjects:	138 (5 moderators)
Subjects per clip:	at least 2
Assessors:	$10 \times$ clip (MTurk)
Questionnaire Items:	15
Total annotations:	214,500

S.Kim et al., "*Automatic Detection of Conflicts in Spoken Conversations*", Proc. of IEEE International Conference on Audio, Speech and Signal Processing, 2012.

Conflict: How?

The atmosphere is relaxed
People wait for their turn before speaking
One or more people talk fast
One or more people fidget
People argue
One or more people raise their voice
One or more people shake their heads and nod
People show mutual respect
People interrupt one another
One or more people gesture with their hands
One or more people are aggressive
The ambience is tense
One or more people compete to talk
People are actively engaged
One or more people frown

The assessors (10 per clip) answer a questionnaire
including 15 items associated to 5-points Likert scales.

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The questionnaire includes two layers, the "Inferential" (I) and the "Physical" (P) one.

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$+$

The inferential score (sum over inferential questions) accounts for how the assessors interprete the clip.

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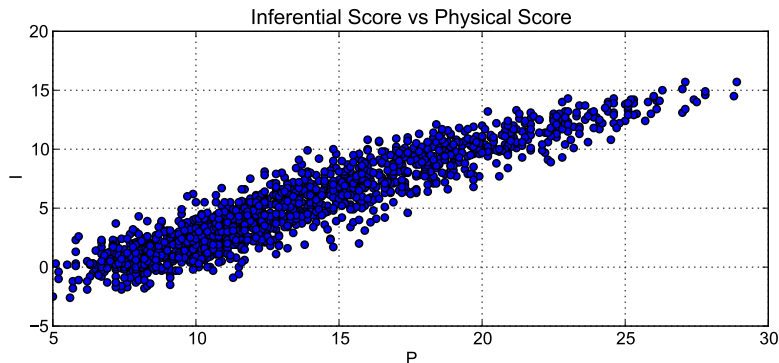The ambience is tense
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The physical score (sum over physical questions) accounts for what the assessors observe in the clip.

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Inference vs Physical

Inferential Score vs Physical Score

The correlation between Inferential and Physical score is 0.95 (*p*-value << 0.01).

Physical Measurements

- ► Turn duration statistics
- ► Speaker adjacency statistics
- ► Overlapping speech statistics
- ► Turn keeping/stealing ratio
- ► Prosody statistics

Regression Performance

	BLR	GPR	GPR*	SVR	SVR*
Manual	0.80	0.80	0.81	0.80	0.81
Automatic	0.71	0.76	0.71	0.71	0.74
Auto w.o.s.	0.78	0.78	0.77	0.77	0.77
Manual	2.27	2.27	2.22	2.29	2.27
Automatic	2.71	2.44	2.70	2.71	2.58
Auto w.o.s.	2.42	2.38	2.43	2.44	2.41

- ▶ Bayesian Linear Regression (BLR)
- ▶ GP Regression with Radial Basis Function (GPR) and Automatic Relevance Determination (GPR*)
- ▶ Support Vector Regression with linear (SVR) and RBF kernel (SVR*)

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Personality: What?

[Personality is the latent construct accounting for] individuals' characteristic patterns of thought, emotion, and behavior together with the psychological mechanisms - hidden or not - behind those patterns

D.Funder, "*Personality*", Annual Review of Psychology, 52:197-221, 2001.

The Big Five (I)

*The Big Five Personality Factors appear
to provide a set of highly replicable
dimensions that parsimoniously and
comprehensively describe most
phenotypic individual differences*

G.Saucier and L.R.Goldberg, "*The Language of Personality: Lexical
Perspectives on the Five-Factor Model*", in "The Five-Factor Model of
Personality", J.S.Wiggins (ed.), pp. 21-50, 1996.

The Big Five (II)

- Extraversion: Active, Assertive, Energetic, Outgoing, Talkative

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- ▸ Openness: Artistic, Curious, Imaginative, Insightful, Original, Wide interests

Personality: How?

This person:
- is reserved
- is generally trusting
- tends to be lazy
- is relaxed, handles stress well
- has few artistic interests
- is outgoing, sociable
- tends to find fault with others
- does a thorough job
- gets nervous easily
- has an active imagination

B.Rammstedt and O.P.John, "*Measuring personality in one minute or less*", Journal of Research in Personality, 41:203-212, 2007.

Personality: Where?

|	
Number of Samples	640
Length:	10 seconds
Total Length:	1 hour 46 minutes
Subjects:	322
Scenario:	Random news segments
Language:	French
Assessors:	$11\times$sample
Total answers:	70,400

G.Mohammadi and A.Vinciarelli, "*Automatic Personality Perception: Prediction of Trait Attribution Based on Prosodic Features*", IEEE Transactions on Affective Computing, to appear, 2012.
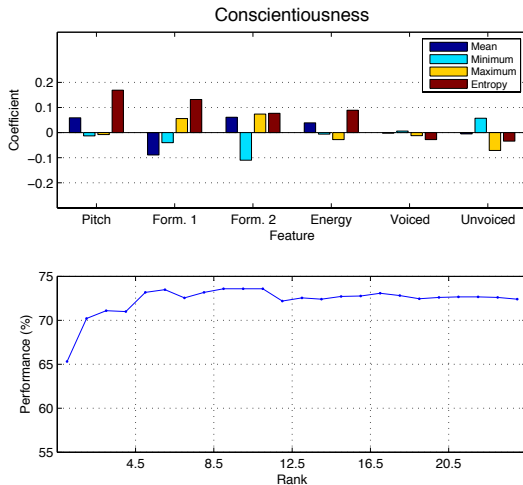
Prosody and Personality

Trait	$n \geq 6$	$n \geq 7$	$n \geq 8$
Ext.	73.0 (100.0)	76.3 (77.6)	78.7 (57.3)
Agr.	62.7 (100.0)	63.7 (67.2)	69.5 (40.9)
Con.	72.7 (100.0)	78.8 (67.0)	82.4 (38.1)
Neu.	67.7 (100.0)	70.3 (68.4)	74.3 (38.9)
Ope.	59.8 (100.0)	68.8 (55.1)	74.0 (22.8)

The Logistic Regression weights the features according to the influence they have on the decision

Extraversion
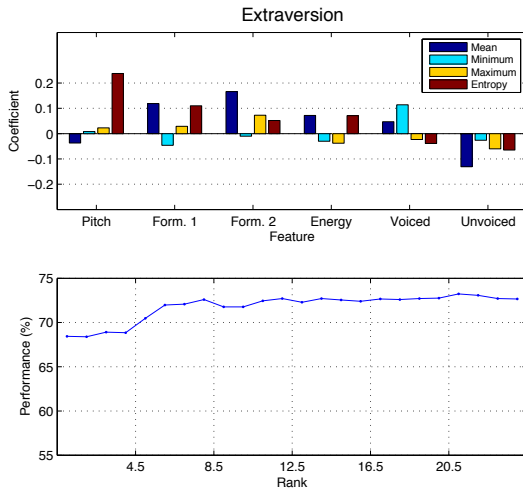
Conscientiousness

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- ▸ Nonverbal communication is the physical, machine detectable trace of social and psychological phenomena

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- The integration of human sciences and machine learning allows the development of socially intelligent agents

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- More information on the portal of the Social Signal Processing Network: www.sspnet.eu

Thank You!