



Engineering and Physical Sciences Research Council

Facial expressions Social Signals

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Overview

- Autism and SoCoRo
- Expressive behaviour
- Dynamic facial expressions
- Social signals
- The story so far..





Project aim

Work towards a socially competent robot to deliver social skills therapy to high-functioning autistic adults





Lifespan of high-functioning adults with an ASD





Social impairments

Communication Impairments

Socially Competent ROBOTS Rigid, Repetitive Behaviour





Dynamic interaction approaches

- Grounded Cognition
- Social Signal processing
- Dynamic face processing (cp Ekman's basic emotions)

HONEST SIGNALS

Socially Competent

height forward posture Rehavioural Cues Nonverbal Behavioural interpersonal gesture distance

Vinciarelli, Pantic and Bourlard, "*Social Signal Processing: Survey of an Emerging Domain*", J. Image and Vision Computing, 27(12):1743-1759, 2009



Example of dynamic interaction







Therapy: Behavioural skills training (BST)





Feasible workplace social skills of interest



- Interpreting facial expressions
- Coping with interruptions/ transitions
- Completing timesensitive tasks
- Dealing with feedback



Expressive behaviour

 70% of human comn body language
 Facial expression

Gesture

– Use of hands and arms

Posture

- how we stand

Use of glance Co- eye direction Socially Competent ROBOTS



Ekman's primitive emotions



T T TY

Facial Action Coding System (FACS)

- Definition of muscle groups on the face that perform a visible expressive action
 - 44 of these, eg:
 - 1: Inner brow raiser
 - 6: Cheek raiser
 - 14: Dimpler
- Original use: descriptive
 - coding of expressions from video recordings of interaction
- New use: generative
 - Graphical/robotic facial animation
 - Note: HUMAN faces; animators apply creatively to nonhuman faces





A smile according to FACS

■ AU12

- Change in the nasolabial furrow
- Change in the infraorbital triangle
- Change in the lip corners







Duchene smile

AU12 (Lip Corner Puller) ╋ AU6 (Cheek) Raiser) Associated with happiness







Static v dynamic

- AUs alone more useful for static expressions
 - When is an AU invoked?
 - With what dynamics?
- What can be used to dynamically drive facial expressions?





Russell's classification



Facial Expression

- Brow affected by both arousal and valence
- Lowered brow



- anger, high dominance
- Raised brow
 - sadness, low dominance







Facial Expression

Combination of all



Changes in valence

Negative valence, changes in arousal





Positive valence, changes in arousal



Relevant work

- ROS BML realiser (Rich&Sidner)
 - Event-driven architecture using Petri Nets
 - Closed-loop execution
 - Robot independent
 - Implemented in ROS
 - Open source







Emotions and social signals

Emotion

ROBOTS

- Communicates internal state
- Motivates actions
- Social signal
 - Has interactional semantics
 - Regulatory (eg turntaking, back channel)
 - Communicative non-speech act

Socially Competent



Social signal processing in the workplace









Why robots?







Signal-to-noise ratio



Controlling the Emys head



Joint q1 q2 q3 q4 q5 q6 q7 **q8** q9 q10 q11

Jo	pint name
N	eck pitch (rotation)
Н	ead yaw (rotation)
Н	ead pitch (rotation)
L	ower disc (rotation)
U	pper disc (rotation)
L	eft eyelid (rotation)
L	eft eyebrow (rotation)
L	eft eye (translation)
R	ight eyelid (rotation)
R	ight eyebrow (rotation)
R	ight eye (translation)





	Emys DOF	AUs	PAD (Boukricha et al., 2009)	PA (Grammer & Oberzaucher, 2006)	PA (Hadar, 2015)	PA (Snodgrass, 1992)	
	q7 and q10 (eyebrows)	AU1 (inner brow raiser)	Negative pleasure, negative dominance	Low medium pleasure, low high arousal		Negative pleasure, low arousal	
		AU2 (outer brow raiser)	High arousal, positive dominance	Positive pleasure		Positive pleasure, high arousal	
		AU4 (brow lowerer)	Negative pleasure, positive dominance	Negative pleasure, high arousal	Low pleasure	Negative pleasure, med/high arousal	
	q6 and q9 (eyelids)	AU5 (upper lid raiser)	High arousal	High arousal, positive pleasure	High arousal	Negative pleasure, high arousal	
		AU7 (lidstight)		Negative pleasure		Negative pleasure, med arousal	
		AU41 (lid droop) AU42 (slit) AU43 (eye closed)	Negative pleasure, positive dominance, low arousal	Negative pleasure, low arousal			
		AU44 (squint) AU45 (blink) AU46 (wink)				Positive pleasure, med arousal	
Co So Ro	q3 (head pitch)	AU53 (head up)	Positive dominance				
Socially Compet ROBOTS		AU54 (head down)	Negative pleasure, positive dominance, low arousal				LRIOT WATT JNIVERSITY

Expressions and AUs



1: Head up, jaw drop





3: Wink, head left



4: Upper lid raiser, jaw drop







6: Chin raise, head down



7: Brow lowerer, chin raise





Experiment 1: Example trial















Experiment 2

Autism-Spectrum Quotient (AQ)

1. I prefer to do things with others rather than	definitely	slightly	slightly	definitel
on my own.	stree	agree	diagree	disagree
2. I prefer to do things the same way over and	definitely	slightly	slightly	definite
over again.	agree	stree	diagree	diagree
3. If I try to imagine something, I find it very	definitely	slightly	slightly	definite
easy to create a picture in my mind.	albee	afree	dupe	diagree
4. I frequently get to strongly absorbed in one	definitely	slightly	slightly	definite
thing that I lose sight of other things.	allow.	stree	diagree	disagree
5. I often notice small tounds when others do	definitely	slightly	slightly	definite
Rof.	stree	stree	фирн	фияры
6. I usually notice car number plates or similar	definitely	slightly	slightly	definite
strings of information.	agree	agree	disagree	disagree
7. Other people frequently tell me that what I've	definitely	slightly	slightly	definite
said is impolite, even though I think it is polite.	aftee	1 East	бырн	disagree
8. When I'm reading a story, I can easily	definitely	slightly	slightly	definite
imagine what the characters might look like.	agree	agree	disagree	diagree
9. I am fascinated by dates.	definitely	slightly	slightly	definite
	sîzee	stree	diagree	disagree
10. In a tocial group, I can eatily keep track of	definitely	slightly	slightly	definitel
several different people's conversations.	sthes.	shee	awhee	andree
11. I find social situations easy.	definitely	slightly	slightly	definite
	stree	afree	quibe	qualities
12. I tend to notice details that others do not.	definitely arras	slightly	slightly	definitel
	-pro	-	andher	andhere
 I would rather go to a library than a party. 	agree	silibulà	disagree	definitel disagree
14. I find making up stories easy.	definitely	slightly	slightly	definite
5438788354545454589557777483289575	stree	stree	dista	disagree
15. I find myself drawn more strongly to people	definitely arrest	slightly	slightly	definite
Chan to Churge.	44.6	-	anthe	andree
16. I tend to have very strong interests which I	definitely	slightly	slightly	definitel
get uptet about it I can't pursue.	stree	whee	mybee	antre
	and the second se	1.1.1	distate	Artician
17. I enjoy social chit-chat.	definitely agree	agree	diagree	diagree

get a word in edgeways.	stas	stas	graftee	disagree
19. I am fascinated by numbers.	definitely arree	slightly	slightly disarree	definitely disarree
20. When I'm reading a story, I find it difficult to	definitely	slightly	slightly	definitely disarree
21. I don't narticularly micy reading fiction.	definitely	shehrly	shehrly	definitely
and a second second second	agree	afree	diagree	disagree
22. I find it hard to make new friends.	definitely	slightly	slightly	definitely
	agree	agree	disagree	disagree
23. I notice patterns in things all the time.	definitely	slightly	slightly	definitely
	agree	agree	disagree	disagree
24. I would rather go to the theatre than a	definitely	slightly	slightly	definitely
muteum.	agree	agree	disagree	disagree
 It does not upset me if my daily routine is	definitely	slightly	slightly	definitely
disturbed.	agree	agree	disagree	disagree
 I frequently find that I don't know how to	definitely	slightly	slightly	definitely
keep a conversation going.	agree	agree	disagree	disagree
27. I find it easy to "read between the lines" when	definitely	slightly	slightly	definitely
someone is talking to me.	agree	agree	disagree	disagree
 I usually concentrate more on the whole	definitely	slightly	slightly	definitely
picture, rather than the small details.	agree	agree	disagree	disagree
29. I am not very good at remembering phone	definitely	slightly	slightly	definitely
numbers.	agree	agree	disagree	disagree
 I don't usually notice small changes in a	definitely	slightly	slightly	definitely
situation, or a person's appearance.	agree	agree	disagree	disagree
31. I know how to tell if someone listening to me	definitely	slightly	slightly	definitely
is getting bored.	agree	agree	disagree	disagree
32. I find it easy to do more than one thing at once.	definitely	slightly	slightly	definitely
	agree	agree	disagree	disagree
33. When I talk on the phone, I'm not sure when it's my turn to speak.	definitely	slightly	slightly	definitely
	agree	agree	disagree	disagree
34. I enjoy doing things spontaneously.	definitely	slightly	slightly	definitely
	agree	agree	disagree	disagree
35. I am often the last to understand the point of a joke.	definitely	slightly	slightly	definitely
	agree	agree	disagree	disagree





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Experiment 2: Example trial





Experiment 3: Office induction day

- High-functioning adults to complete technical interview.
- Will complete a set of computer-based clerical tasks
- Pilot scenario with human-human role play to determine robot capabilities
- Experiment parameters
 - Robot play role of boss or colleague
 - Robot will give the user feedback
 - Robot will interrupt participant mid-task to request assistance





Conclusions

- Designing social signals is tricky
 - Context-dependent
 - Where context is not just task
- Dynamic expressions support levels of difficulty
- Eventual aim social signal practice in workplace-related scenario





QUESTIONS?

Related work

- One-to-one employment assistance programs boost employability (Mawhood & Howlin, 1999).
- Autistic children interact more empathically with robots (Wainer et al., 2014)
- Simulating social/work scenarios with virtual characters improve social skill outcomes of young autistic adults (Kandalaft et al., 2013).



Fig. 2

VR screenshot of the interview scenario in which the participant (interviewee) is questioned by the confederate therapist (interviewer) while the coach therapist (in the doorway) observes and provides feedback





Old slides





Social skills training for highfunctioning adults with an ASD



Pilot experiment in Glasgow Science Centre









Robots and

- Work with autistic children shows this extends to robots.
- Possibly because robots are simplified, more predictable, and non-judgmental social interaction partners.
- Can these preferences be leveraged to help autistic adults seeking employment?



Fig. 1 A subject interacting with Zeno. Markers used for motion capture are visible

Zeno: Wijayasinghe et al. <u>(</u>2016)



Fig. 1 KASPAR is a child-sized humanoid robot and was developed to study human-robot interaction by the Adaptive Systems Research Group at the University of Hertfordshire

Fig. 6 Four different facial expressions that KASPAR can make. Clockwise from *the top left*, they are: neutral, small, medium, and large smiles [9]

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KASPAR: Wainer et al.









Therapy: Behavioural skills training (BST)

- BST is a behaviourist training strategy that involves stages of:
 - Instruction
 - Modelling
 - Rehearsal
 - Feedback

to teach a new skill.





Targeting social skills for employment





ROBOTS

Outrea



Edinburgh robot could help autistic adults find work



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A robot which teaches people key facial expressions could help boost the employment outlook for autistic adults, researchers have claimed.







This Is No Ordinary Drawing, Zoom In And Look Carefully To See How It Was Madel



What They Found Here Looks Like It's From A Different Planet



Megahype: This invention storms the Internet











Socially **T** Competent

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