Emotional Intelligence in Agents and Interactive Computers

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This character barges into your office when you're busy. He doesn't apologize, and doesn't notice you are annoyed.

He offers you useless advice. You express more annoyance. He ignores it.

He continues to be unhelpful. The clarity of your emotional expression escalates.

He ignores it.

(this goes on)

Finally you tell him explicitly "Go Away"

He winks, and does a little dance before exiting.



...doesn't notice you are annoyed. [Doesn't recognize your emotion] You express more annoyance. He ignores it. [Doesn't respond appropriately to emotion] He winks, and does a happy little dance before exiting. [Not clever about expressing emotion.]

Skills of Emotional Intelligence:

- Expressing emotions
- Recognizing emotions
- Handling another's emotions
- Regulating emotions
- Utilizing emotions

if "have emotion"

(Salovey and Mayer 90, Goleman 95)

Skills of Emotional Intelligence:

Expressing emotions

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Emotion is like weather:

Wind velocity, humidity, temperature, barometric pressure, precipitation

Occasionally, a unique combination of these creates a storm, a tornado, a blizzard, or a hurricane.

(adapted from J. Kagan, 1978)

" Emotion recognition"

• Expressions, behaviors

"Flared nostrils, tightened lips, a quick sharp gesture, skin conductivity=high; probably she is angry "

Situation, reasoning

That was an important goal to her and Bob just thwarted it again. She is likely to feel angry toward Bob Can we teach a chair to recognize behaviors indicative of interest and boredom? (Mota and Picard)







What can the sensor chair contribute toward inferring the student's state: *Bored vs. interested?*







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Results (on children not in training data, Mota and Picard, 2003): 9-state Posture Recognition: 89-97% accurate High Interest, Low interest, Taking a Break: 69-83% accurate











Fully automatic computer recognition of six natural facial "action units" (sans calibration or human initialization) (Kapoor and Picard, 2002)





PUPIL DILATION

Fully automatic computer recognition of six natural facial "action units" (sans calibration or human initialization) (Kapoor and Picard, 2002)

also: nods, shakes, mouth fidgets



PUPIL DILATION

Mouse pressure may change with frustration & stress

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(Dennerlein, et al., International Ergonomics Association '03 links frustration to physical risk factors)

Challenge project: Automated Learning Companion

The Learning Companion infers and responds to a student's affective state - "watching especially for signs of frustration and boredom that may precede quitting, for signs of curiosity or interest that tend to indicate active exploration, and for signs of enjoyment and mastery, which might indicate a successful learning experience."

Future "Learning Companion" agent to sense and respond to affect





Understanding *HOW* something was spoken (Fernandez, PhD 2003)



Emotions give rise to changes that can be sensed

Distance Sensing:

Up-close Sensing:

Internal Sensing: Face, voice Posture Gestures, movement, behavior

Temperature Respiration Pupillary Dilation Skin conductivity ECG, EEG, Blood pressure

Hormones Neurotransmitters

. . .



Simultaneously examine physiology and behavior for recognizing level of stress: up to 96% accurate, across 12 drivers. (Healey and Picard, IEEE Trans on Intell Transp Sys, to appear)



Research joint w/Jen Healey and Yuan Qi, incorporating new spectral estimation technique for assessing changes similar to heart rate variability, influenced by cognitive and emotional load



Stress is evident for this person when: driving through city turning around at toll booth hearing siren

New algorithm: analysis of heart-rate variability via realtime spectrum estimation with missing and irregularly sampled data (Qi and Picard, ICASSP 2001)

Voice (in car) that responds to affect of driver improves performance

Driver Affect/	Нарру/	Нарру/	Upset/	Upset/
Car Voice	Enthused	Subdued	Enthused	Subdued
Number of	2	8.3	9.6	6.3
accidents				
Minutes driver	5.8	4.2	3.9	4.7
spoke				

Jonsson, I.-M. and Nass, C. (2004) Effects of driver emotion and car voice emotion on actual and perceived driving performance. Stanford CA: Stanford Univ.

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"Badday.mpg"



Human – computer interaction is affective



•Four out of five have seen colleagues hurling abuse at their PCs

• Three quarters admit that they swear at their computers.

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(Mori survey in UK, 1250 users)
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Goal:

Help relieve user frustration

Strategy:

- 1. Recognize situation as frustrating
- 2. Is user willing to talk? If so:



Practice active listening, with empathy and sympathy

"Sorry to hear your experience wasn't better"

"This computer apologizes to you for ..."

- Allow for repair...

Evaluation:

Build it. Test this "AFFECT-SUPPORT" with 70 subjects against two control conditions: IGNORE and VENT.

Instructions	
How fructrated do you think you got playing the game	-
all things considered?	
O 10 (The most frustrated I have ever felt in my life while playing a game)	
0 9	
08	
● 7	
0 6	
05	
0 4	
03	
O 2	
01	
 O (Absolutely not frustrated at all) 	
Okay	
	-
	11

Instructions	<u> </u>
Wow, it sounds like you felt really frustrated playing this game.	*
ls that about right?	
Yes No	



Results: responding to user emotion

Subjects receiving AFFECT-SUPPORT showed a significant *behavioral* effect of reduced frustration compared with both the IGNORE and VENT control groups (p< 0.01)

Holds across age, gender, arousability

(Klein, Moon, Picard, IWC 2002)

Need: Long-term handling of social-emotional interaction

Idea: **Relational Agent**, a software character that deliberately tries to build a *long-term social-emotional* relationship with you



Experiment: Build a Relational Agent that people interact with ~daily for a month; compare it to "non-relational" agent that otherwise looks and acts the same. (Bickmore & Picard, ToCHI to appear)

Relational Skills include:

- Sensitivity to your affective state -Empathy and understanding
- Remembering previous interactions
 - What you liked/disliked, etc.
- Immediacy behaviors
 - Knowing when to move close/away

Significant effects of Relational skills in agent:



- "Laura and I respect each other." (p<.001)
- "Laura and I trust one another." (p<.001)
- "I feel Laura cares about me..." (p<.001)
- "I feel Laura appreciates me." (p=.009)
- "I believe Laura likes me." (p<.001)
- Liking of Laura. (p=.007)
- Desire to continue working with Laura. (p=.001)

Differences held both after 7 days and after 27 days

Empathetic responses



Successful handling of emotion





"Impacts and ethical implications?"

People interacting with agents vs. with control increased physical activity

Relational agent also increased bonding, sense of "caring", liking, trust, and desire to keep using

Empathetic responses may facilitate greater use of cognitive resources



•Wentzel et al "Perceived Caring"

- •Riskind "Stoop to Conquer"
- •Jonsson & Nass

Concerns (besides privacy)

- Deception, machines that "feel/care"
- People prefer machines to people
- Manipulation vs. support of feelings
- Computational prozac
- Wind out of sails
- Baudrillard, of Lascaux cave paintings: *"The duplication is sufficient to render both artificial"*

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Papers and projects/details: http://affect.media.mit.edu