case studies in design informatics

Lecture 14: Affective Interaction

design informatics

NRlabs
neuropolitics research

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Speech + music + motion video + subtitles = emotionally overwhelming?

Copyright 2008 (CC–SA–NC) Henderson's Visual Cognition Lab @ Edinburgh University
(e–mail visual.cognition@ed.ac.uk for information)
02:58/03:00
Frame: 5346

Multisensory combinations

- Reinoso Carvalho, Felipe, Velasco, Carlos, Van Ee, Raymond Van Ee, Leboeuf, Yves, & Spence, Charles (2016). Music influences hedonic and taste ratings in beer. [Original Research]. *Frontiers in Psychology*, 7 doi: 10.3389/fpsyg.2016.00636.

- Sellaro, Roberta, van Dijk, Wilco W., Paccani, Claudia Rossi, Hommel, Bernhard, & Colzato, Lorenza S. (2015). A question of scent: lavender aroma promotes interpersonal trust. [Original Research]. *Frontiers in Psychology*, 5(1486) doi: 10.3389/fpsyg.2014.01486.

Tactile ink

"revolutionary ink, created by a series of small raised dots on the surface of the can, gives the consumer a better feeling in the hand, enhanced grip and allows the brand to appear more refreshing and recognizable." Claims to improve taste. Associated physical feeling with mental feeling. Create a complex embodied experience.

Beer glass

- Pretentious Glass Company:
  - Beer tastes better in the right glass.
  - Rate the glasses in four categories: aroma, taste, aesthetic, and, ergonomics.
  - Aromatic Beer Glass: designed specifically to highlight any aromatic beer with a high ABV, such as Belgiums and Barleywines. The design includes a glass mountain on the inside centre of the glass, which helps create a higher surface tension on the surface of beer once beer has been poured into the glass.

[http://uproxx.com/life/matthew-cummings-pretentious-beer/]

Immersive & Gunn

Independent Scottish brewer Innis & Gunn is serving virtual reality along with its beer in an experiment being rolled out in more than 50 pubs across the UK.

The brewery worked with cognitive neuroscientist, Dr. Jacob Jolij, an expert on how brains creates experiences, and developed two short films to complement each beer and impact the taste perception. "A taste experience is not just a matter of chemistry and biology. Whenever you take a sip of your favourite beer you do not just taste the water, the grains, and the hops, but your brain adds in your previous memories, surroundings, and expectations."

Emotional design

- Don Norman argues:
  - Complex machines with emotions will be more understandable to us than complex ones without them.
  - We predict and explain each other's behaviour by reference to their thoughts and feelings.
  - People who appear to have no feelings are very hard to predict or explain.
  - So, having understandable emotions would make machines easier to interact with.
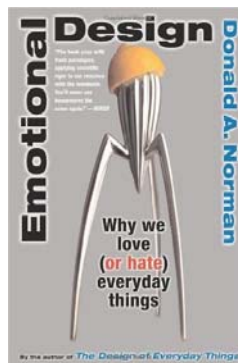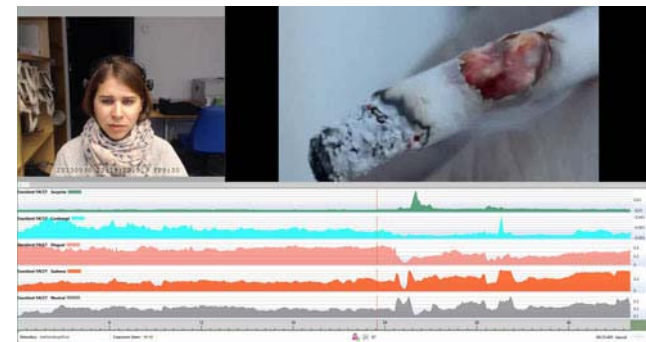

The Emotient Module

Image showing the integration of stimuli, face of the participant & Emotient emotion channels in time line.
http://imotionsglobal.com

Facebooking learning?

Predicting frustration

- Predicting when a person might be frustrated can provide an intelligent system with important information about when to initiate interaction.
- For example, an automated Learning Companion or Intelligent Tutoring System might use this information to intervene, providing support to the learner who is likely to otherwise quit, while leaving engaged learners free to discover things without interruption.
- The paper presents the first automated method that assesses, using multiple channels of affect-related information, whether a learner is about to click on a button saying ''I'm frustrated.''

Kapoor et al. (2007) set up
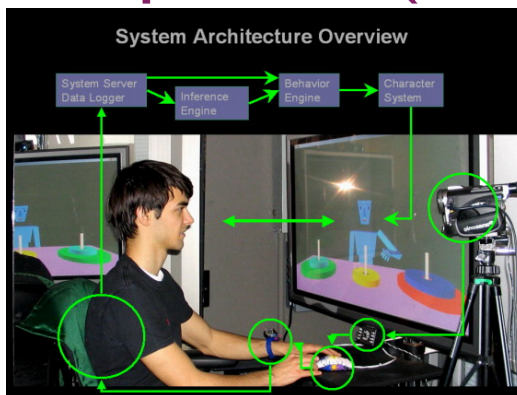
System architecture with (from right to left): video camera, Blue-Eyes camera, pressure-sensitive mouse, skin conductance sensor, and pressure-sensitive chair.

Modules to extract (a) facial features and (b) posture features.
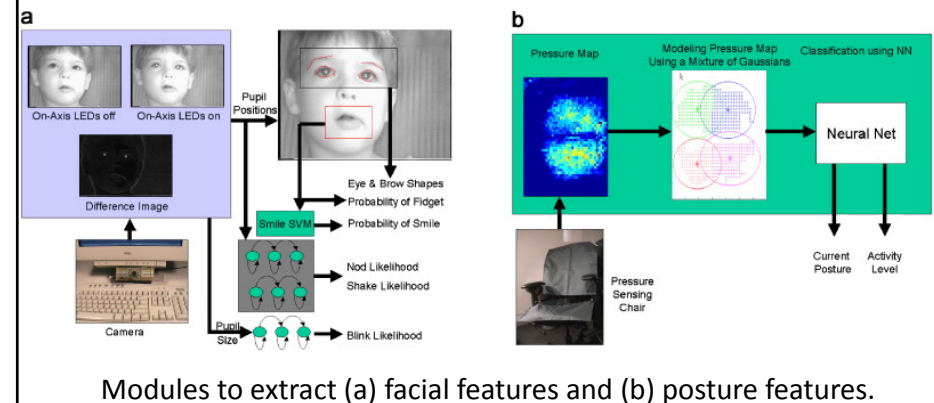
Kapoor et al. results

- The new method was tested on data gathered from 24 participants using an automated Learning Companion.
- Their indication of frustration was automatically predicted from the collected data with 79% accuracy (chance 58%).
- The new assessment method is based on Gaussian process classification and Bayesian inference.
- Its performance suggests that non-verbal channels carrying affective cues can help provide important information to a system for formulating a more intelligent response.

Kappor et al. predictors
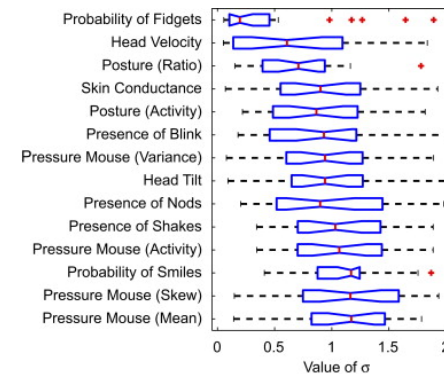
Boxplots: A low value corresponds to high discriminative power of the feature.

Automatic detection of human interest

Schuller, Björn, Müller, Ronald, Eyben, Florian, Gast, Jürgen, Hörnler, Benedikt, Wöllmer, Martin, et al. (2009). Being bored? Recognising natural interest by extensive audiovisual integration for real-life application. *Image and Vision Computing, 27(12), 1760-1774. doi: http://dx.doi.org/10.1016/j.imavis.2009.02.013.*

- Commercial applications (sales and advertisement systems or virtual guides).
- Curiosity detection, e.g. for topic switching, in infotainment systems, or in customer service systems.
- Interest detection in meetings or (children's) tutoring systems.

5 levels of interest (Schuller et al, 2009)

- LOI-2: *Disinterest* (subject is tired of listening and talking about the topic, is totally passive, and does not follow the discourse).
- LOI-1: *Indifference* (subject is passive, does not give much feedback to the experimenter's explanations, and asks unmotivated questions, if any).
- LOI0: *Neutrality* (subject follows and participates in the discourse; it can not be recognised, if she/he is interested or indifferent in the topic).
- LOI1: *Interest* (subject wants to discuss the topic, closely follows the explanations, and asks some questions).
- LOI2: *Curiosity* (strong wish of the subject to talk and learn more about the topic).

Examples (Schuller et al, 2009)

LOI2
LOI1
LOI0

Example video frames (for better illustration limited to the facial region here) for Level of Interest 0–2 taken from the *AVIC* database. Two subjects in gender balance were chosen from each of the three age groups.
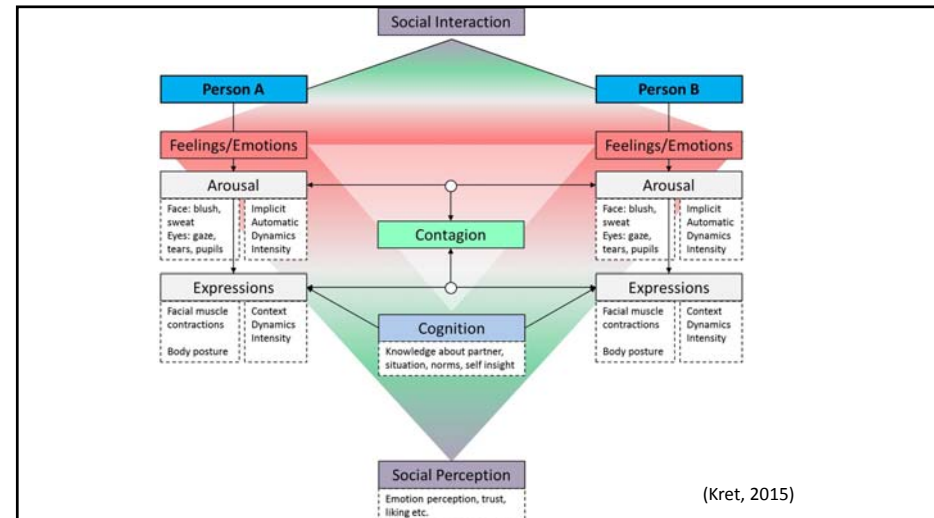
Rapport

Three essential components:
1. Mutual attentiveness (e.g. mutual gaze);
2. Positivity (incl. smiles and head nods, back-channelling);
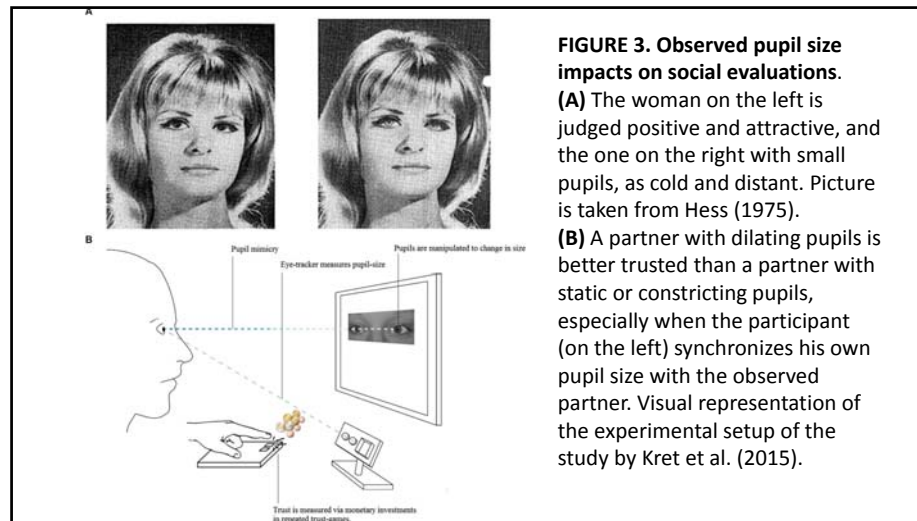3. Coordination (synchronised movements, alignment).

Tickle-Degnen, Linda, & Rosenthal, Robert (1990). The nature of rapport and its nonverbal correlates. *Psychological Inquiry, 1(4), 285-293.* doi: 10.1207/s15327965pli0104_1.

Autonomic responses

- Unconscious responses and signals.
- Subtle, yet visible (like microexpressions):
  - Gaze
  - Tears
  - Eyeblinks
  - Blushing
  - Pupil-mimicry (interactive pupilometry)

Kret, Mariska E. (2015). Emotional expressions beyond facial muscle actions. A call for studying autonomic signals and their impact on social perception. [Review]. *Frontiers in Psychology, 6(711)* doi: 10.3389/fpsyg.2015.00711.

(Kret, 2015)

FIGURE 3. Observed pupil size impacts on social evaluations. **(A)** The woman on the left is judged positive and attractive, and the one on the right with small pupils, as cold and distant. Picture is taken from Hess (1975). **(B)** A partner with dilating pupils is better trusted than a partner with static or constricting pupils, especially when the participant (on the left) synchronizes his own pupil size with the observed partner. Visual representation of the experimental setup of the study by Kret et al. (2015).
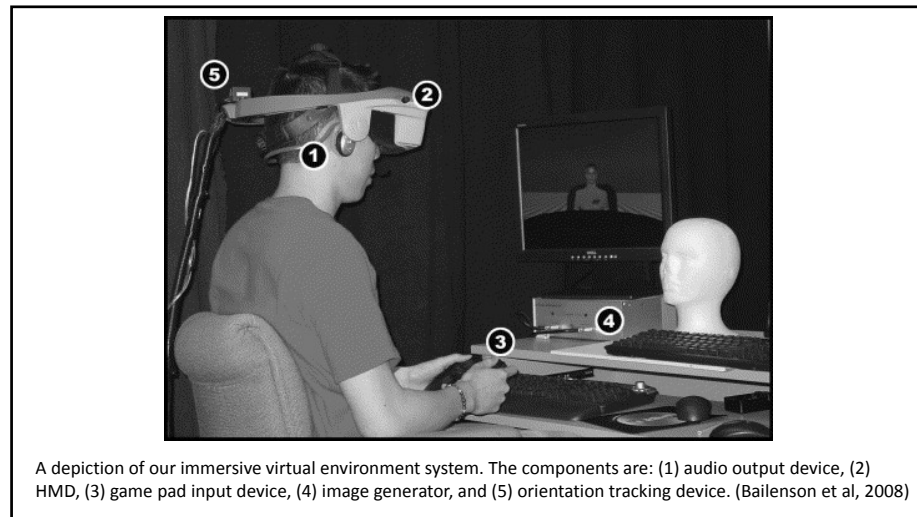
Humanity recognition from head movements

Bailenson, J. N., Yee, N., Patel, K., & Beall, A. C. (2008). Detecting digital chameleons. [Article]. *Computers in Human Behavior, 24(1), 66-87. doi: 10.1016/j.chb.2007.01.015.*

- Behavioural Turing Test: human controlled avatar or artificial agent?
- Conversations are characterized by an interactional synchrony between verbal and nonverbal behaviours … people who mimic the verbal … and nonverbal behaviours … gain social advantage
- Examined how effective people were at explicitly detecting mimicking computer agents and the consequences of mimic detection in terms of social influence and interactional synchrony
- "how will people react to an interactant when they know that interactant's behavior is a direct mimic of their own?"
- "convergence behavior, designed to increase social integration, actually backfires when it is detected."

A depiction of our immersive virtual environment system. The components are: (1) audio output device, (2) HMD, (3) game pad input device, (4) image generator, and (5) orientation tracking device. (Bailenson et al, 2008)

Bailenson et al. results

- When the computer agent mimicked them, users were significantly worse than chance at identifying the other human.
- A.I. mimickers were more likely to pass the Turing Test than actual humans!
- Explicit detection of the mimic caused the agent to be evaluated poorly in terms of trustworthiness and the warmth factors.

Upshot

- Sophisticated algorithmic mimicry may provide one means of achieving this personality adaptation automatically without having to parse and understand personality.
- For example, mimicry of verbosity, greeting phrases, speech patterns, expressiveness, and intonation may provide a very good approximation for apparent personality for computer agents.
- Illusion – no need for understanding or meaning.

Affective embodied agents

Beale, R., & Creed, C. (2009). Affective interaction: How emotional agents affect users. [Article]. *International Journal of Human-Computer Studies, 67(9), 755-776. doi: 10.1016/j.ijhcs.2009.05.001.*

- Reviews "the influence of synthetic agent emotion on user attitudes, perceptions and behaviour."
- Four main domains:
  - video games,
  - education/learning,
  - behaviour change,
  - collaboration.
- Questions:
  - How do we respond to synthetic displays of happiness, sadness, frustration and fear?
  - Can we catch emotions from computers?
  - What do we think of agents that act ''caring'' towards us when we are feeling down?

Beale & Creed, 2009

- Consider also:
  - Types of emotion expressed
    - Basic or complex ("cognitive")
  - Representation of emotion
    - Modality
  - Method for expression
    - Temporally discrete or continuous
- It is not sufficient to simply ask whether emotional agents are better or worse than unemotional agents.
- Instead, a better question is that of which kind of emotional expression, expressed in which way, influences which elements of a user's perceptions and behaviour?

Beale & Creed, 2009

In learning environments:

- People are more accepting of an agent that acts as a friendly peer as opposed to one that takes a more authoritative teaching role.
- While the incorporation of emotional expression into an embodied teaching agent rarely has a negative impact on an interaction, it clearly does not always have a positive effect on a learning experience.
- However, it seems that if an agent plays the role of a supportive and friendly colleague during learning, this can potentially enhance perceptions of emotional agents and lead to better educational experiences.

Beale & Creed, 2009

Suggestions for future work:
- Longitudinal studies
  - E.g. behaviour change
- Wider range of emotion
  - E.g. Pride?
- Negative emotions
  - E.g. Should tutors ever look angry?
- Emotion contagion
  - E.g. can agents affect us via our mirroring their affect?
- Gender effects
- Better agents
- Younger users
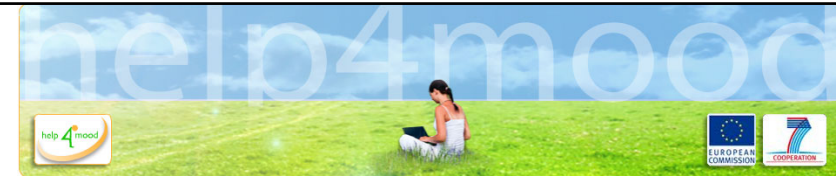
Help4Mood

Informatics Case Study: contact Colin Matheson [Colin.Matheson@ed.ac.uk]
- Depression is a major problem, recovery tracking can be very unreliable, and adherence to treatment is often patchy.
- Help4Mood aimed for treatment in the patient's home using unobtrusive actigraphy and daily self-reports.
- The project researched the use of animated characters to **engage** patients and emotion modelling to tailor interactions and promote **adherence**.

Help4Mood

- Daily interactions with a Virtual Agent: users track how they are feeling and work through brief, simple exercises based on principles of cognitive behaviour therapy.
- Assess the effect of depression on overall activity through a Personal Monitoring System that collects activity and sleep data; the effect of depression on fine motor skills is assessed through simple games and speech tasks during the session with the Virtual Agent.
- The Decision Support component of Help4Mood plans sessions, making sure they are varied and interesting, and distils the data collected through the Virtual Agent and the Personal Monitoring System into a one-page overview that shows how the user is doing.
- Users and their clinicians can then use this overview to discuss progress and plan further treatment.

Help4Mood architecture
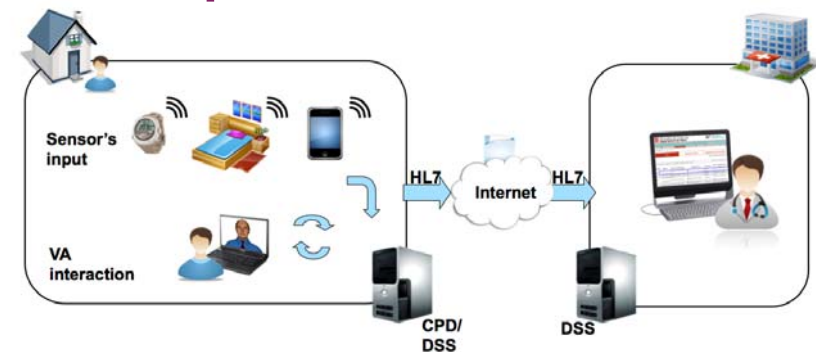
Supports the treatment of people who are significantly affected but are still able to live at home and may also be working.

Help4Mood actigraphs

The Texas Instruments eZ430-Chronos is a highly integrated, wireless development system that provides a complete reference design for developers creating wireless smart watch applications. Chronos is a reference platform for many applications, such as wireless watch systems, personal displays for personal area networks, wireless sensor nodes for remote data collection, and other applications.

Example Virtual Agent interface
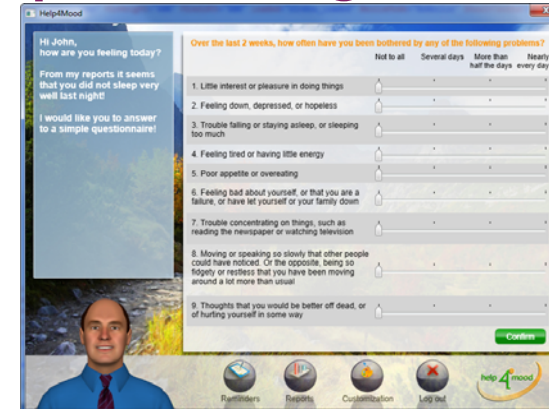
Choice of Virtual Agents

H4M emotion engine: FAtiMA

- FearNot Affective Mind Architecture.
- Targets empathic agents.
- Open source software based on *appraisal theory.*
  - Hierarchical organisation of 22 emotion types (joy, distress, pride, happy-for, etc.).
  - Assesses events against goals, standards and attitudes.
  - Based on personality and memory.
- Evaluates the emotional impact of possible actions.

Virtual Agent evaluation (source: Colin Matheson)

- One patient felt the VA was not sufficiently realistic.
- Another requested less realism, and would have been happy with a cartoon animal.
- Some participants saw arrogance, while others found the VA very empathic:
  - "In the last session, I even touched the screen and thought that I will miss her."
  - "I was looking at his features and reactions when he was moving or looking up the screen, where I had to write something, and I imagined I was speaking to a psychologist. And it was rather comforting."

Smiling

Ochs, M., Niewiadomski, R., Brunet, P., & Pelachaud, C. (2012). Smiling virtual agent in social context. [Article]. Cognitive Processing, 13, 519-532. doi: 10.1007/s10339-011-0424-x.

- A smile is one of the simplest and most easily recognized facial expressions.
- Embodied Conversational Agents usually only have one kind of smile (happy) but Ochs et al. test three:
  - Amused, polite, embarrassed.
- Two types of facial expression were created according to Ekman's description (Ekman and Friesen 1975).
  - The first expression corresponds to a felt emotion of happiness (including an amused smile).
  - The second one corresponds to the other expression (e.g., disgust) masked by unfelt happiness.
- Smiles built from:
  - (1) the amplitude of the smile, (2) the mouth opening, (3) the symmetry of the lip corners, (4) lip press, (5) cheek raising, (6) the duration of the smile, and (7) the velocity of the onset and the offset of the smile.


The figure is a screenshot of the *E-smiles-creator.* In section 1, at the *top* is a description of the task: the smile that the user has to create (e.g., an amused smile). In section 2, on the *left* side, a video is showing, in loop, the virtual agent animation. In section 3, on the *right* side is a *panel* with different smile parameters (e.g., the duration) that the user may change to create the smile (the video on the *left* changes accordingly). In section 4, at the *bottom* is a Likert scale that enables the user to indicate his level of satisfaction with the smile created.

Contingency table of the smile's characteristics and the smile types

Variable	Value	Amused (%)	Embarrassed (%)	Polite (%)
Size	Small	16.40	73.10	67.70
	Big	83.60	26.90	32.30
Mouth	Close	14.40	81.8	76
	Open	85.60	18.20	24
Symmetry	Symmetric	59.90	40.50	67.10
	Asymmetric	40.40	59.10	32.90
Lip press	Pressed	92.2	25.4	69.4
	Non-pressed	7.8	74.6	30.6
Cheek Raising	No	21.6	59	58.9
	Yes	78.4	41	41.1
Onset/offset	Short	33.4	28.9	30.3
	Average	30.3	39.6	37.1
	Long	36.3	31.50	32.6
Duration	Short	15.6	43.6	42.9
	Long	84.4	56.4	57.1

(Ochs et al, 2012)

Synthetic facial social attributions
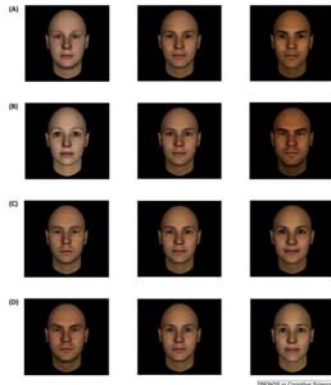
Faces generated by data-driven computational models of evaluations of **(A)** competence, **(B)** dominance, **(C)** extroversion, and **(D)** trustworthiness. The face in the middle column represents an average face in the statistical model. Faces in the right column are 3 standard deviations (SD) above the average face on the respective trait dimension; faces in the left column are 3 SD below the average face on that same dimension.

Olivola, Christopher Y., Funk, Friederike, & Todorov, Alexander (2014). Social attributions from faces bias human choices. *Trends in Cognitive Sciences, 18(11), 566-570.* doi: http://dx.doi.org/10.1016/j.tics.2014.09.007.

Review (journal special issue)

Hudlicka, E. (2003). To feel or not to feel: The role of affect in human-computer interaction. [Article]. *International Journal of Human-Computer Studies, 59(1-2), 1-32.* doi: 10.1016/s1071-5819(03)00047-8.

- Introduction to special issue.
- Draws together the disciplines:
  - Neuroscience (bases), cognitive psychology (uses), AI (models).
- Lots of useful references, and an orienting framework.

Review article

Pantic, M., & Rothkrantz, L. J. M. (2003). Toward an affect-sensitive multimodal human-computer interaction. [Review]. *Proceedings of the IEEE, 91(9), 1370-1390.* doi: 10.1109/jproc.2003.817122.

- Major survey paper, covering physiology, visual (facial) and auditory (speech) modalities
  - Rapid behavioural signals communicate messages including: affective states, emblems (wink), manipulators (scratch, put), illustrators (brow raise), regulators (nods).
  - Recognise from 10ms audio, 40ms video.
  - Notes face features (up to 98% acc), speech features (70-80% acc), compared with (eg) 17% baseline.
  - Notes drive toward bimodal recognition.
- Notes:
  - Most work assumes clean, posed input;
  - ignores task and communicative context;
  - accepts "late integration".
- Acceptance of affective HCI depends on user-friendliness and trustworthiness.

Affective evaluation

Picard, Rosalind W., & Daily, Shaundra Bryant (2005). Evaluating affective interfaces: alternatives to asking what users feel. *Paper presented at the CHI '05 Extended Abstracts on Human Factors in Computing Systems.* [http://affect.media.mit.edu/pdfs/05.picard-daily.pdf]

- Survey of body-based measures
- Looks to task-based measures
  - Positive affect improves creative problem solving.
  - Negative affect improves analytical (bottom-up) reasoning.
  - So, assess task performance to measure affect (typography).
  - Ask "how long did you think you took?" (longer = worse).
  - Ask "how often do you think you were interrupted (more = worse).