Human-Computer Interaction
IS4300 – HCI

Overview for Today

- Humans / Human Factors / Cognitive Psyc
- Guest talk on Affective Computing
- Project Brainstorming

Humans

Dix Ch 1

Human Factors

- A body of scientific facts about human capabilities and limitations.
- The study of how humans behave physically and psychologically in relation to particular environments, products, or services.
- aka *Ergonomics*
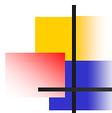
Human Factors Highlights

- Inputs
  - Visual
  - Auditory
  - Haptic
  - Olfactory
  - Taste
  - Vestibular
- Outputs
  - Motor (hands, feet, head, gaze, speech, …)
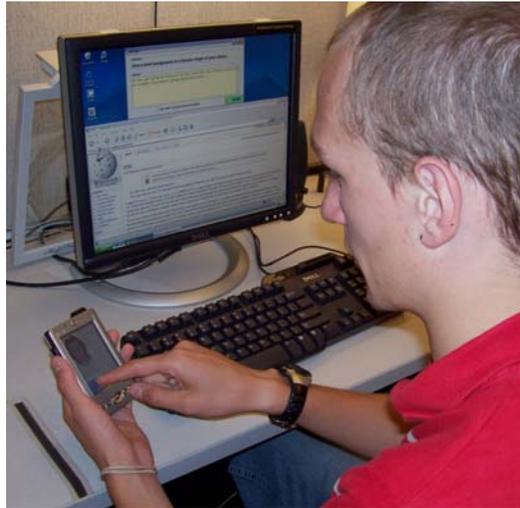 - Neural

Visual Human Input
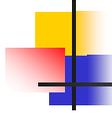
Human Vision

- Why can't you use color alone as an output modality?
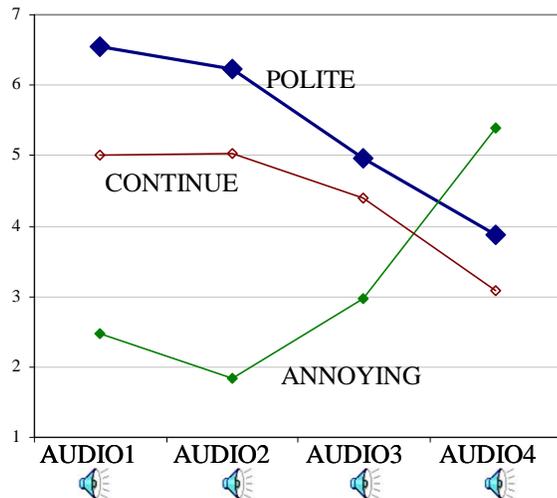
- 8% males and 1% females color blind

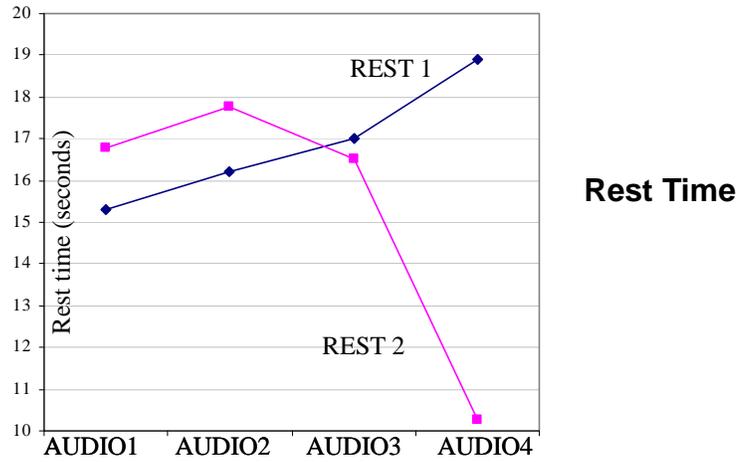# Auditory Human Input

Interruption Studies: Wrist Rests

Results – Study 1 Self-report Measures

POLITE

CONTINUE

ANNOYING

AUDIO1   AUDIO2   AUDIO3   AUDIO4

N=29

Results – Study 1
Behavioral

Rest Time

Haptic Human Input
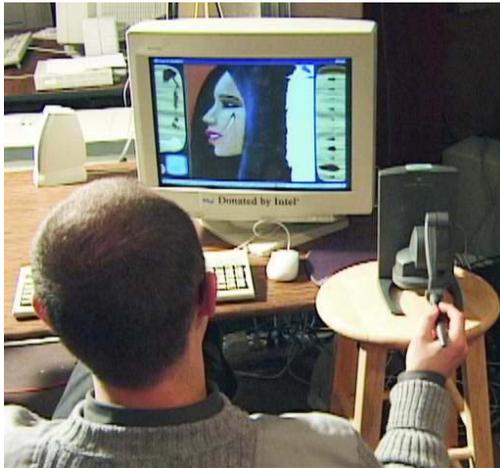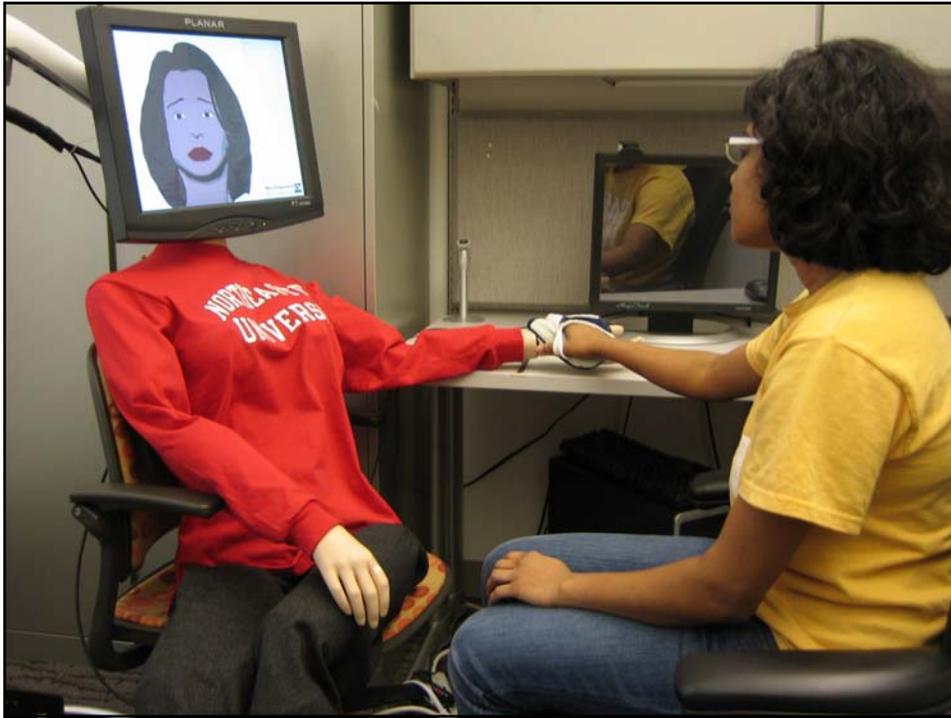
Empathic Touch
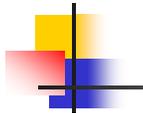
Estimated Marginal Means of Change in WAI Over Baseline

Touch Receptivity
— NotReceptive
— Receptive

NotReceptive

Receptive

Estimated Marginal Means

0.80
0.60
0.40
0.20
0.00

No Touch   Touch

Study Condition
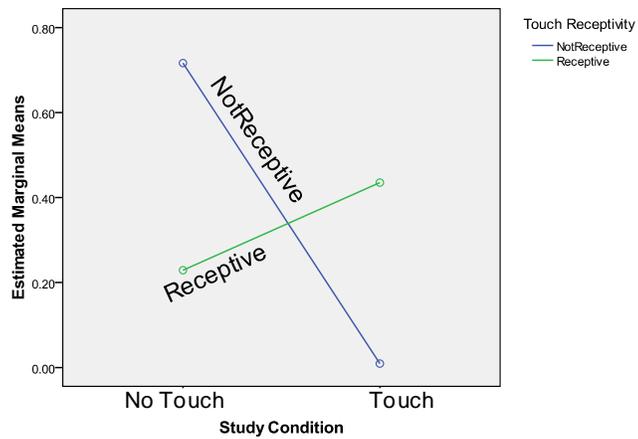
Vestibular Human Input

Olfactory Human Input
Jofish Kaye

Taste Input
Tongueduino
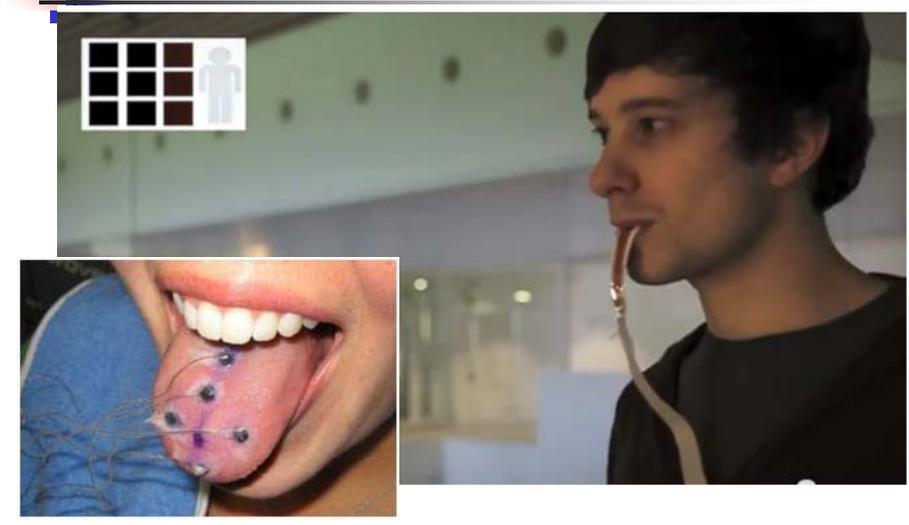
BCI
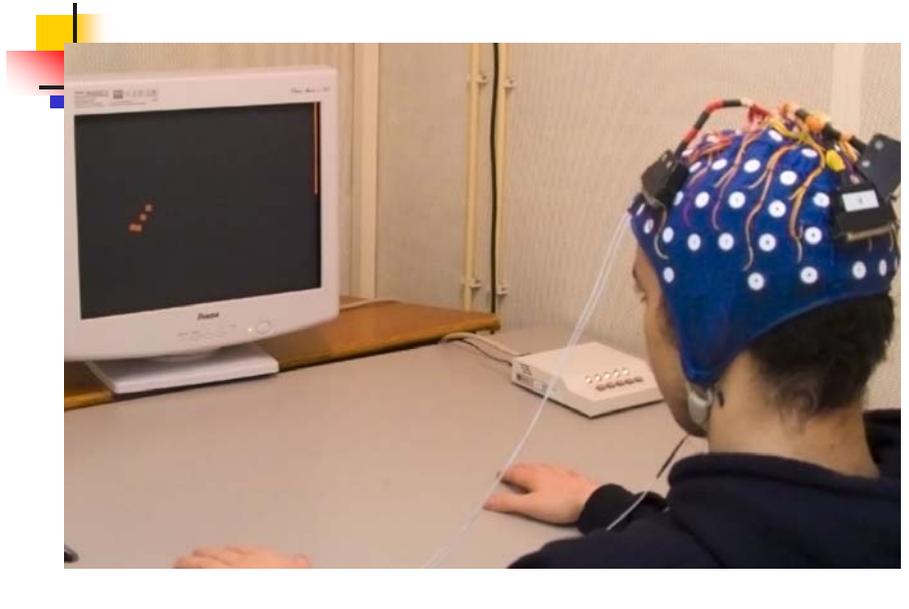
Motor: Computer Input

Now ubiquitous examples…

Head

Gaze

Gaze tracking

Other aspects of the Human Information Processor

Emotions & Affective Computing

- "Computing that relates to, arises from, or deliberately influences emotions"

    - Picard
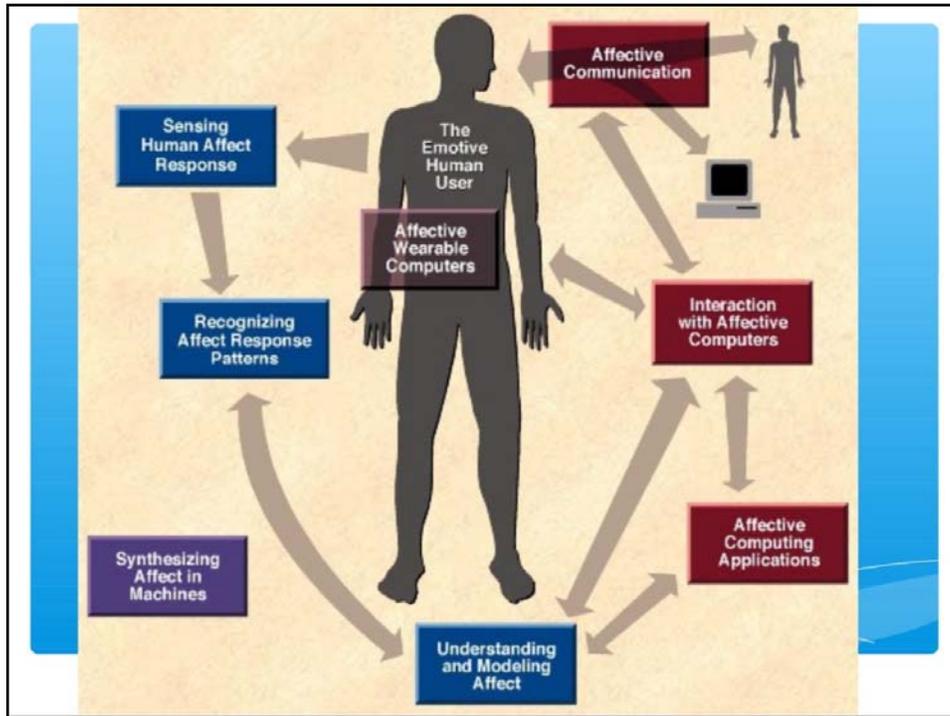
Affective Computing
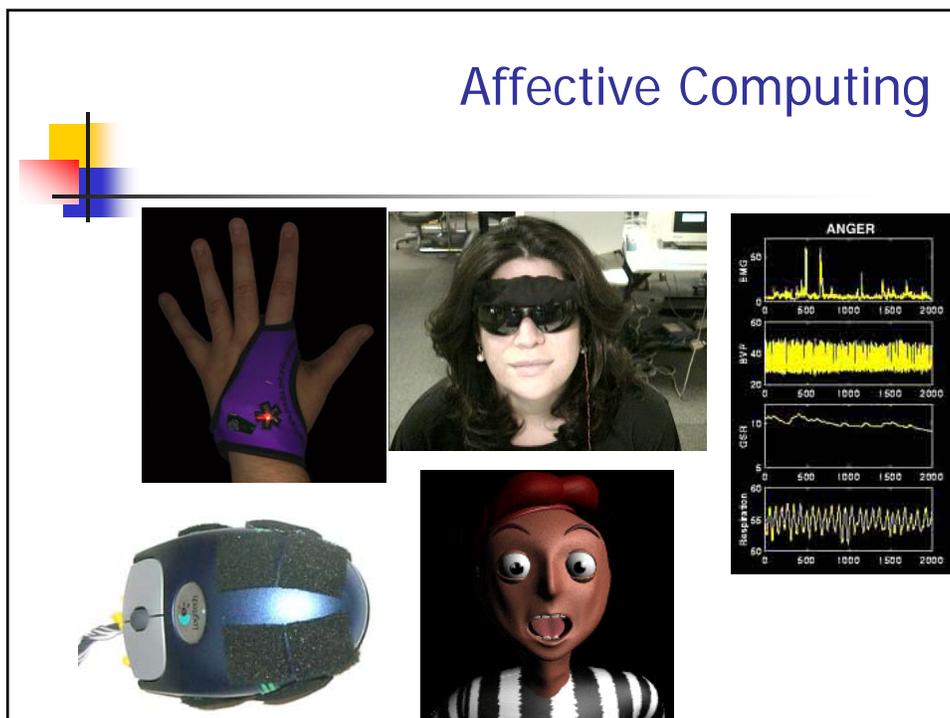
Affective Computing

IS4300

Lazlo Ring

What is Affective Computing

- The study and development of devices that react to a users emotional state

- Computer systems that…
  - Express emotion
  - Detection or response to human emotion

Classifying Emotion
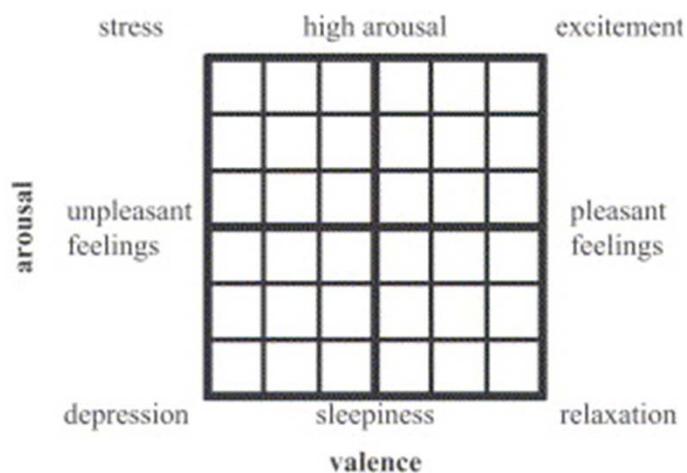
How Does a Computer Detect Emotion?

- Computer vision
  - OpenCV/SHORE detect face and analyze for images for valence
- Audio Processing
  - Detect depression from speech patterns
- Sensors
  - Heart rate sensors can detect arousal
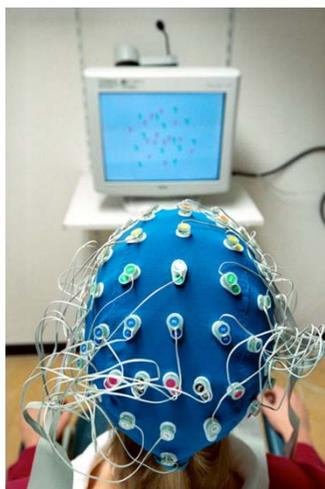
How Does a Computer Express Emotion

- Non-Verbal Behavior
  - Facial Expressions of Emotion
- Verbal Behavior
  - Providing empathic responses
  - Reacting to a users actions

Addressing Loneliness and Isolation in Older Adults

Proactive Affective Agents Provide Better Support

By Lazlo Ring, Barbara Barry,
Kathleen Totzke, Timothy Bickmore

ACII2013

The Aging Population: Older Adults

◻ Older adult are one of the fastest growing populations: Estimated to triple in size by 2050 to 1.5 billion

◻ 40% of Older Adults experience loneliness
  ◻ Loneliness has been linked to increased rates of cardiovascular diseases and death

◻ Socially Isolated Older Adults have 3 times the 5-year mortality rate.

Addressing the Issue

◻ A social support system for older adults that utilizes affect detection and management could be the "killer app" for affective computing.

◻ In this study we explored creating such a system through the use of an embodied conversational agent that was deployed in participants homes for a week.

Related Work: ECA for Older Adults

- Embodied Conversational Agents (ECA) are animated characters that interact with users through verbal and non-verbal behavior such as prosody and hand gestures.

- Bickmore et al. have explored using ECA's to promote exercise in older adults.
  - Elderwalk study
  - Virtual Laboratory

Related Work: Agents that Provide Social Support for Older Adults

- Mival et al. used AIBO (a robotic dog) to provide artificial companionship to older adults.

- In a precursor study Vardoulakis et al. used a Wizard of Oz based ECA system to provide social support to isolated older adults.

Related Work: Agents that Respond to Affect and Mood Over Time

- Few studies have looked at agents that respond to longitudinal user affect.

- We previously found:
  - An inter-conversational affective variable (mood) is required to assess arousal and valence in taped interactions.
  - Tailoring a message to a users mood is significantly more effective than randomly delivered messages.

Related Work: Agents that Manage User Mood

- Klein – Empathic feedback from an Agent is significantly better than venting about a frustrating experience.

- Bickmore & Schulman – Empathic accuracy is more important than expressiveness in empathic interactions with an agent.

Design Guidelines:

- ◻ Provide companionship and social support:
  - ◻ Focusing on proper empathetic feedback.

- ◻ Provide Loneliness and Depressive Symptoms Interventions:
  - ◻ Encouragement of positive affect and physical activity.

Tanya

- ◻ ECA for isolated older adults

- ◻ Deployed on a Touchscreen Computer

- ◻ Features:
  - ◻ Synthesized voice
  - ◻ Hand gestures
  - ◻ Head nods
  - ◻ Posture shifts
  - ◻ Facial affect

Hi Tanya.

Hi Tanya, great to see you.

Excuse me?

Northeastern
Relational Agents Group
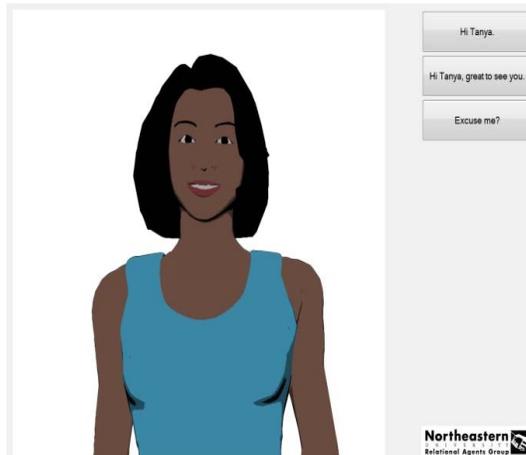
Tanya: System Content

- Affective Assessment:
  - "How are you?"
  - Appropriate empathic feedback

- Social Dialogue:
  - Local Sports chat to build companionship

- Loneliness and Depression Interventions:
  - Anecdotal stories to encourage positive affect
  - Physical activity promotion

Tanya: Example Interaction

Exploring Proactive Interactions

- Passive
  - Older adults have to initiate conversations with agent
- Proactive
  - Agent calls out to the older adult when sensed
  - Active from 9am to 9pm
  - Would only trigger at most once a minute

Hypothesis

- Isolated older adults will…
  - use the Proactive system significantly more.
  - be significantly more satisfied with the proactive system.
  - be significantly less lonely after interacting with the Proactive system after a week.

Measures

- Loneliness
  - UCLA Loneliness Scale at Intake and Debrief
  - 5 point Likert scale after each interaction

- Affective State, Satisfaction with Agent, Relationship Status and Comfort using Agent
  - 5 point Likert scales after each interaction

- Open-ended Feedback
  - Diary Sheets
  - Semi-structured interview at Debrief

Participants

- Eligibility:
  - 55 years or older
  - Live alone
  - Score less than a 3 on the PHQ2

- 14 participants, 7 for each condition(Passive/Proactive)
  - 3 Male, 11 Female

- 12 Eligible
  - 1 due to technical issues, 1 due to being an outlier

Methods

1. Intake and Initial lab screening
2. Randomly assigned to either Passive or Proactive
3. In-home setup of touchscreen system
4. Debrief and semi-structured interview one week later

Results: Usage and Acceptance

☐ **Total interactions:** 196

☐ **Frequency**: 15.9 (SD 8.1) per week

☐ **Duration**: 140 (SD 26) seconds

☐ **Satisfaction**: 4.4 (SD 2.3)
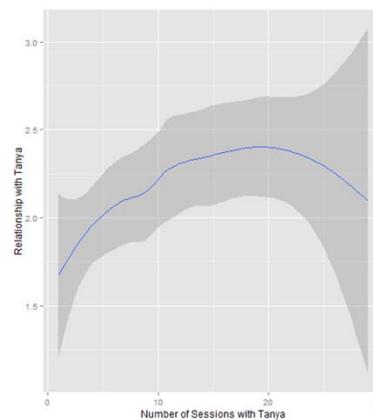
☐ **Ease of Use**: 1.9 (SD 1.5)

Results: Comfort vs. Number of Interactions

□ **The more they interacted with the agent the more comfortable they were with it**
  □ Pearsons r = .4, p < .05
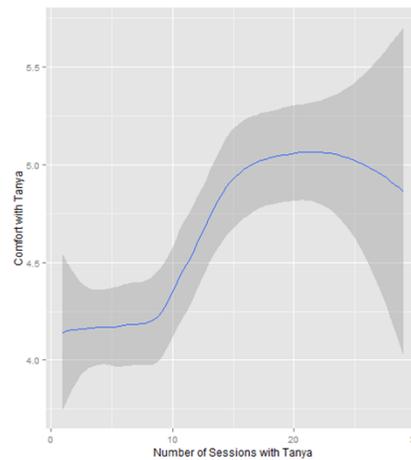
Results: Relationship vs. Number of Interactions

□ **The more they interacted with the agent the better their relationship was**
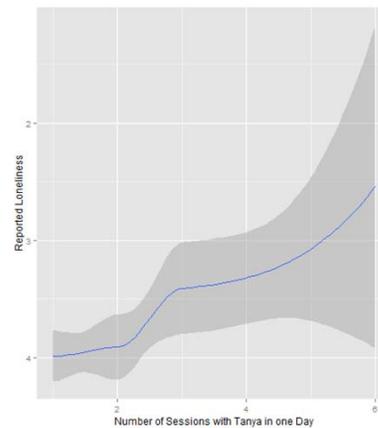 □ Pearson r =.2, p < .05

Results: Satisfaction vs. Time of Day

- **Participants enjoyed talking to the agent more in the morning**
  - ANOVA $F_{(2,151)} = 2.56$, $p < .1$
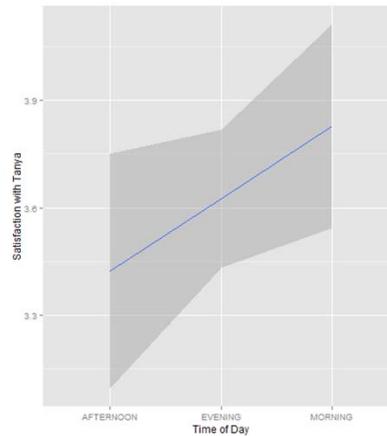
Results: Loneliness vs. Number of Interactions Per Day

- **Participants talked for longer with the agent when lonely**
  - $t(153) = p < .1$

Results: Proactive/Passive

	Proactive	Passive	p <
Frequency	18 (5.67)	13.8 (9.14)	.4
Duration	135.57 (21.42)	135 (20.58)	.96
ΔUCLA Loneliness Score	3.57 (6.1)	-.8 (2.77)	.13

Results: Proactive/Passive Continued

Diary Measure (Likert Scales)	Proactive	Passive	p <
Comfort: 1 – Very Uncomfortable 5 – Very Comfortable	4.59(.8)	4.33 (.85)	.1
Satisfaction: 1 – Very Unsatisfied 5 – Very Satisfied	3.95 (1.08)	3.14 (1.26)	.05
Happiness: 1 – Very Sad 5 – Very Happy	3.89 (.9)	3.26 (1.17)	.05
Loneliness: 1 – Very Lonely 5 – Not at all lonely	4.02 (.87)	3.54 (1)	.05

Qualitative Results:

- Diary sheets and semi-structured interviews were coded at the end of the study

- Coded for Affective state:
  - Based on Fredickson's categories of positive affect and Ekman's expanded list of emotions

- Coded for social themes of:
  - How they considered their relationship with the agent
  - Discussions with others about the agent

Results: Affective State

- *"I've had this cough for 3 or 4 days and she you know, she seemed to genuinely respond to that."*
  - Feeling cared for

- *"I struggle with walking. It helped me by hearing her encourage me to walk every day."*
  - Feeling cared for

- *"She was great. She was upbeat and friendly and seemed sincere."*
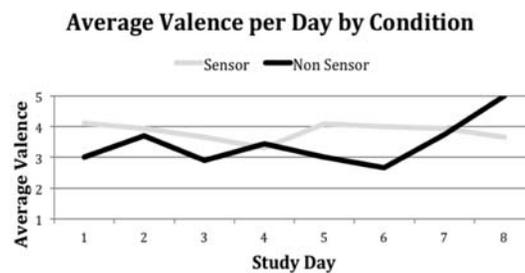 - Joy

Results: Social Support

- *"It was kind of strange and it was kind of comforting to know that there was someone to say hi to you in the morning."*
  - Relationship with Agent

- *"Yeah, I considered her a friend. I mean, you become, not attached, but ya know I was looking forward to going home."*
  - Relationship with Agent

- *"You know it sort of relieved the solitude a little even though I knew it was an animated voice and not a real person."*
  - Helped with loneliness

Conclusion

- We created a system that both assessed and managed affect in users through dialogue.

- System was found effective at decreasing loneliness in isolated older adults

- Compared Proactive vs. Passive interactions with participants
  - Proactive version was significantly more effective

Study Limitations

- Small sample size

- Did not encourage social communication with others.

- Did not account for longitudinal changes in affect

- Limited Content

Average Valence per Day by Condition

Sensor ── Non Sensor

Y-axis: Average Valence (1–5)
X-axis: Study Day (1–8)

Future Work: Skype Buddy

- Encouraging communication between isolated older adults and their social network

- Skype integrated into the system

- Agent facilities video calls between isolated older adult and friend/family member

- Currently in the field

Future Work: Story Acquisition

- Exploring the idea of real time assessment of affective state and Positive Psychology interventions

- Positive Psychology intervention delivered via an agent
  - Identifying (and using) signature strengths

- Connection between sensed and reported affect

- Connection between invention effectiveness and affect

- To be fielded shortly

Future Work: AlwaysOn

- A one month intervention for isolated older adults

- Joint effort with WPI

- Greatly expanded content

- Improved agent expressiveness

- Compared to a Robot version of the system

Acknowledgements

- Special thanks to Candace Sinder and the entire WPI team for their collaboration on the AlwaysOn project.

Questions?

- Lazlo Ring: lring@ccs.neu.edu

Other aspects of the Human Information Processor

Fitt's Law

- Time to hit a target on the screen

  $a + b \times \log_2(\text{distance/size} + 1)$
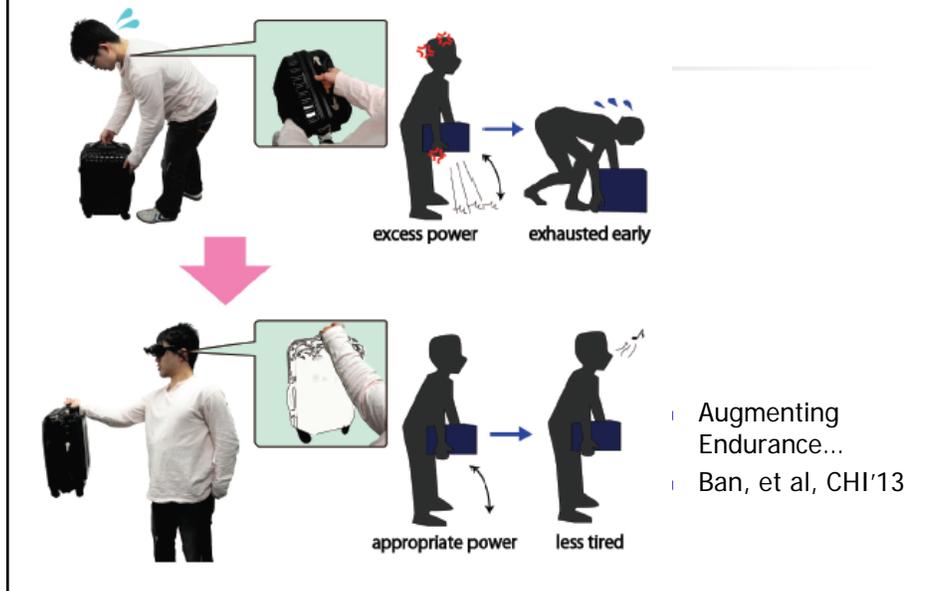
Human Memory

- People only have a limited amount of working memory (aka STM)
  - 7+/-2 chunks

- Implications for interface design?

Implications of STM flushing

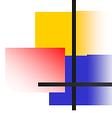Early ATMs gave the customer money before returning their bank card...

Tricking Perception

excess power — exhausted early

appropriate power — less tired

- Augmenting Endurance...
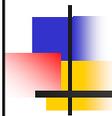- Ban, et al, CHI'13

Vision

- How can you tell if your display will suffer from optical illusions, or cause users to become dizzy or nauseous?
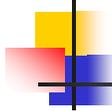
- Test it with real users!

Individual Differences

- People vary significantly in all types of physical and mental ability, knowledge, skills and values.

- **Your user is not you**

- Know your user.

Term Projects

Project Guidelines

- Must have a substantial UI
- UI must be interactive
- Creative, original, non-obvious is better
- Ideas: research papers & past CHI, UIST, IUI, and bibliography

Projects

- Each project should have 1-2 members
- Ideally multi-disciplinary
- In one week (9/19)
  - Send me a brief description of your project and partner (if any)
  - I'll reply with "OK" or suggested tweaks
- On 9/23 – project proposal due
  - 1-2 pages
  - Sketch would be nice
  - Who are your users? What need does it fill?

HW I1
Project Brainstorming

- Pick 3 areas you would be interested in
- In order of preference
  - A UI sketch(!)
  - A paragraph describing the app

Prep for Next Week

- Ethnography
- Read
  - Computers (skim Dix Ch 2).
  - Doing observational studies, Fetterman
  - Sample research papers
- Do Homework I2 (Project Brainstorming)
- Start teaming up…