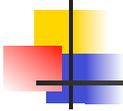# Human-Computer Interaction
IS4300

Today

- Agents & Avatars!

Definitions

- Agent
  - Software Agent
    - "Autonomous, active computer process that does things for you, or on your behalf."
  - Interface Agent
    - Conversational Assistant
    - Chatterbot
    - Embodied Conversational Agent
    - Relational Agent
- Avatar

Software Agent

Get weather forecast every day at 7:00 AM
by fasc
280k   works with

Get a reminder notification if you haven't hit your Fitbit goals by a certain time
by fitbit
12k   works with

Before a calendar event starts automatically post reminder to a Slack channel
by slack
5.5k   works with 31

Get a notification every time an astronaut enters space

Schedule daily or weekly recurring Trello cards

Get a weekly email digest with the songs you liked on Spotify

Conversational Assistant

JUST ASK
amazon echo

Apple Knowledge Navigator

Chatbots

- ELIZA – Weizenbaum 1966
- AIML

```
<category>
   <pattern>WHAT ARE YOU</pattern>
   <template>
      <think><set name="topic">Me</set></think>
      I am the latest result in artificial intelligence,
      which can reproduce the capabilities of the human brain
      with greater speed and accuracy.
   </template>
</category>
```
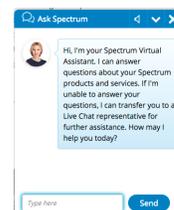
Practical(?) Uses of Chatterbots

next IT

Exercise

- Groups
- Explore one of
    - https://www.alaskaair.com/ "AskJenn"
    - http://www.goarmy.com/ask-sgt-star.html "Launch SGT STAR"
    - https://www.amtrak.com/home "Ask Julie"

- What are its capabilities?
- Do a heuristic evaluation.
- What about doing this for medicine?

Collaborative Agents
Rich & Sidner

Collaborative Agents
Rich & Sidner

History List

(Stopped jointly doing act1 via recipe1)

(Done agent doing act5 via recipe5)

↓

(User doing act6 on value1 via recipe6)

(User doing act8)

(Stopped jointly doing act2 via recipe2)
AGENT: Act3.
USER: Act4.

USER: "Parameter1 of act6 is value1."
USER: Act7.
(User doing act8)

USER: "Propose I do act8."

Focus Stack

Plan Tree

act6 — parameter1 — who — recipe — value1 — user — recipe6 — step1 — step2 — step3 — act7 — who — user — act8 — parameter2 — who — recipe — user

---

Relational Agent Dialogue Representation

- **Hierarchical Transition Networks**

7

Relational Agent
Dialogue Representation

- Hierarchical Task Decomposition Planner

DoConversation

DoGreeting   DoCounseling   DoFarewell

A: "Hello."   U: "Hello."

U: "Hello."
DoGreeting
DoConversation
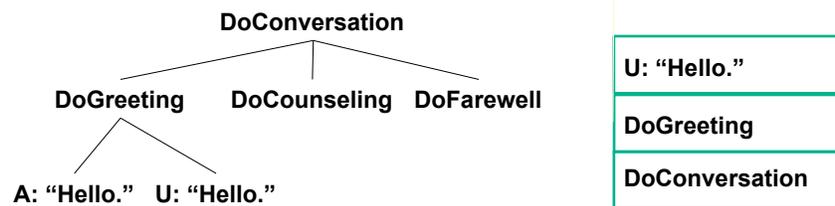
Avatar: Second Life

Embodied Conversational Agents

- recognize and respond to verbal and non-verbal input
- generate verbal and non-verbal output.
- use conversational functions such as turn taking, feedback, and repair mechanisms.
- can negotiate conversational process, as well as contribute new propositions to the discourse.

Motivation

- Intuitive
- Multi-modal
- Social

Empirical Studies: Posture Shifts

Cassell, Nakano, Bickmore, Sidner &Rich. "Non-Verbal Cues for Discourse Structure." ACL '01

Posture shifts with respect to discourse segment

	Monologues (0.06/s)			Dialogues (0.07/s)		
	ps/s	ps/int	energy	ps/s	ps/int	energy
Inter-dseg	0.340	0.837	0.832	0.332	0.533	0.844
intra-dseg	0.039		0.701	0.053		0.723

Resulting Models

	Gesture		
New Topic Level	**NONE**	**POINT**	**REGION**
No Change	80.8%	13.1%	6.1%
PAGE	63.6%	13.6%	22.7%
SECTION	48.3%	32.8%	19.0%
ITEM	31.2%	65.9%	2.9%

Nurse Gaze
Speaking, not gesturing: gaze at document 65%
Speaking and gesturing: gaze at document 83%

Relational Agents

- Interface agents designed to establish long-term social-emotional relationships with users.
- Why?
- How?

How? Relationship Theories and Behavior

- **Social Psychology**
  - Social penetration theory / self-disclosure
  - Meta-relational communication
  - Continuity behaviors
- **Helping & Psychotherapy**
  - Unconditional positive regard
  - Empathic listening

– **Sociolinguistics**
  - Politeness theory
– **Linguistics / Conversation Analysis**
  - Structure & function of social dialogue
– **Communication**
  - Comforting behavior
  - Nonverbal immediacy behavior
– **Change Over Time**
  - Increasing common ground
  - Increasing intimacy
  - Decreasing politeness

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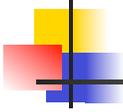
Relational Agents

- Key elements of infrastructure
  - User identification
  - Hierarchical transition network-based dialogue management
  - Persistent memory
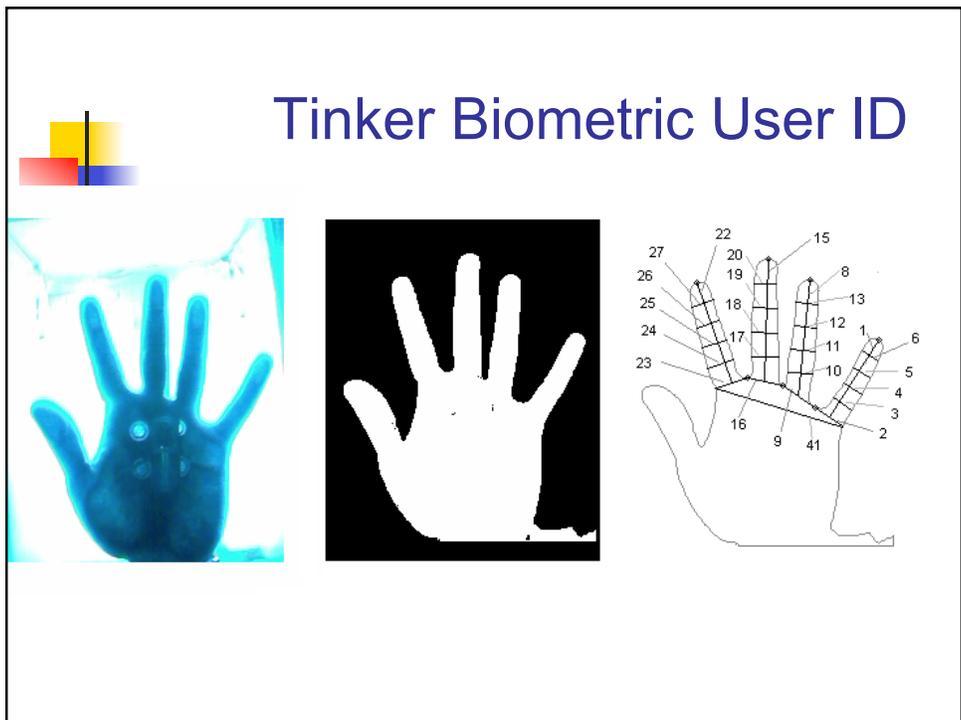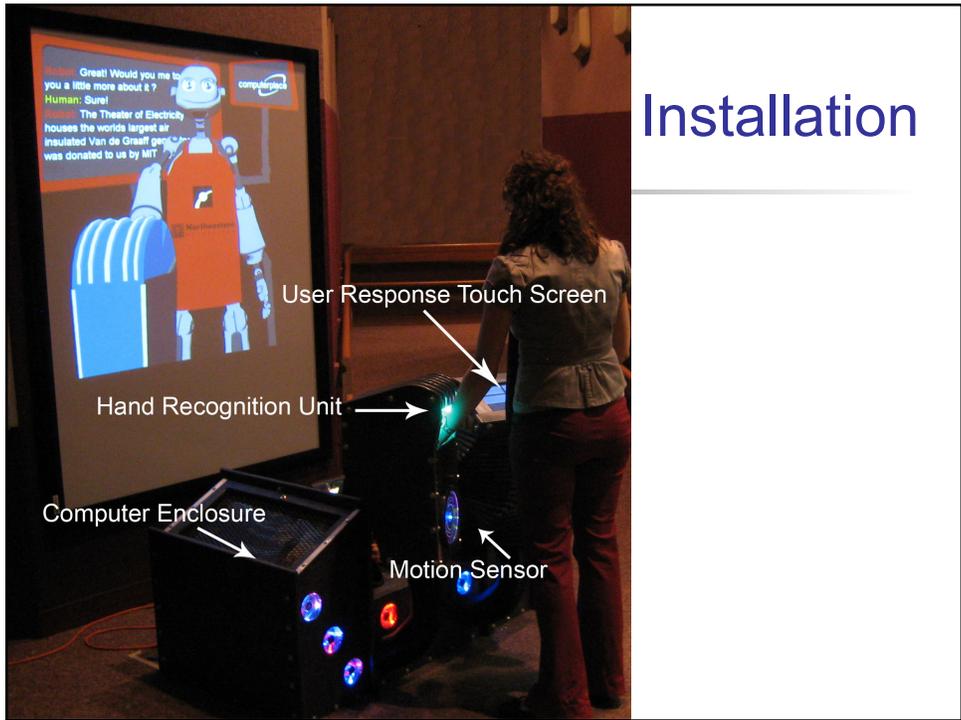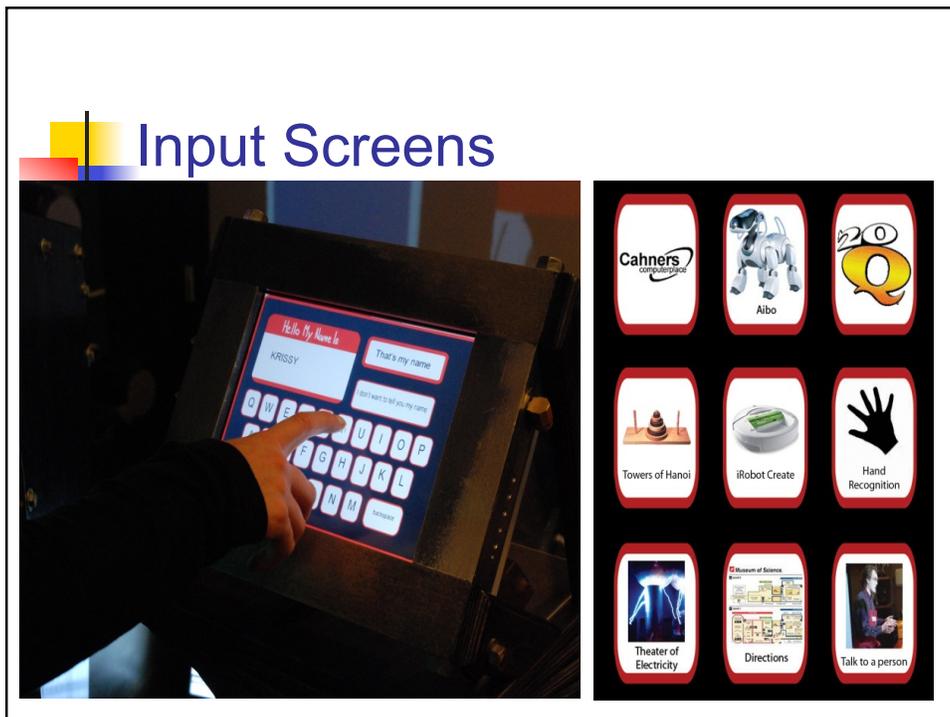 - Verbal and nonverbal channels for conveying affective information
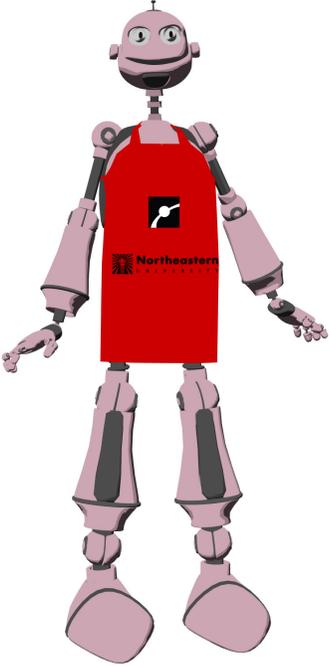
Tinker

- Virtual Guide to the Boston Museum of Science
- Gives directions, descriptions of exhibits, talks about her own implementation
- Recognizes return visitors using biometrics
- Works in a VERY noisy environment.

Tinker Development

- Analysis of videotaped interactions between museum staff and visitors.
- Script development.
- Character development.
- Biometric sensor (for relationship).
- Installation development.

Installation

User Response Touch Screen

Hand Recognition Unit

Computer Enclosure

Motion Sensor

# Tinker Biometric User ID

Input Screens

Dialog Scripts

- Content tailored to user's computer literacy level.
- All topics have
  - Reference title, used to assist in user identification ("Were we just talking about the Theatre of Electricity?")
  - Follow up for return visits ("How did you like the show?")
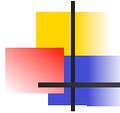
Usability Study

- 72 visitors observed; interviews conducted with 34 visitors, aged 5-55.
- 46% return visitors identified by hand ID, another 31% by name.
- Many usability issues with hand reader and dialogue turn-taking identified.
- Most (62%) enjoyed the system:
  - "Wow, she remembers me! This is so cool!"
  - "I liked that Tinker remembered what she talked about last time."
  - "Interesting, a whole new way of interacting with the museum."
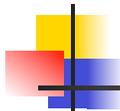
Biometric Evaluations

- 5-hour observation, 63 visits, 19% repeats.
  - Total re-identification success rate 41.7%
- 8-hour observation, 16 visitors interviewed.
  - Biometric re-identification success 56.3%
  - Total re-identification success rate 93.8%

Status

175,000 interactions over 5 years

Current Study

■ Does relational behavior (warmth, humor, personal connection, etc.) make a difference in a virtual docent?

• Hypotheses:
  – **H1**. Increases liking and improves attitude towards agent.
  – **H2**. Increases engagement, and thereby
  – **H3**. Increases learning

Relational Behavior

- Empathy *"I am sorry to hear that. I hope you can find some part of the museum that interests you."*
- Getting Acquainted *"Are you from Boston?"*
- Reference to Common Ground *"Be sure to take your kids to the exhibit."*
- Reference to Shared Values and Beliefs *"I like the Red Sox too."*
- Humor *"So, you could have three purple heads and be twelve feet tall and I would not know the difference!"*
- Form of Address
- Expressing Liking of the User and the Interaction and Desire to Continue *"It has been great talking with you. I hope to see you again."*


Study Methods

1. New visitor randomized to RELATIONAL or NON-RELATIONAL.
2. Conduct interaction with Relational behavior on or off.
3. At end of conversation, visitor asked if over 18, whether they would like to participate in a study, and consented.
4. Self-report measures administered.
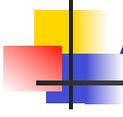
Attitudinal Measures

| Measure	Question	Anchor 1	Anchor 5
SATISFACTION	How satisfied are you with this exhibit?	Not At All Satisfied	Very Satisfied
CONTINUE	How much would you like to talk to Tinker again?	Not At All	Very Much
LIKE	How much do you like Tinker?	Not At All	Very Much
RSHIP	How would you describe Tinker?	A Complete Stranger	A Close Friend
LIKEPERSON	How much is Tinker like a person?	Just like a computer	Just like a person
LEARNFROM	How much do you think you learned from Tinker?	Nothing	A lot
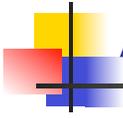
Additional Measures

- Engagement
  - total interaction time
  - number of visits to Tinker during the day
- Learning
  - five-item, multiple-choice knowledge test
  - *e.g., "How can Tinker recognize you?", correct answer "Looking at my hand."*
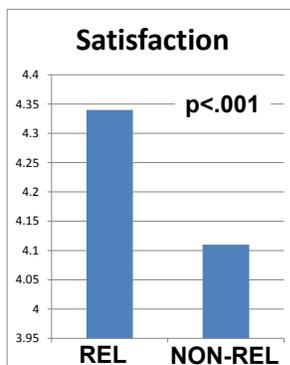
Participants

- 1,607 visitors over 2 years
- Equal number of males and females.
- Computer Literacy

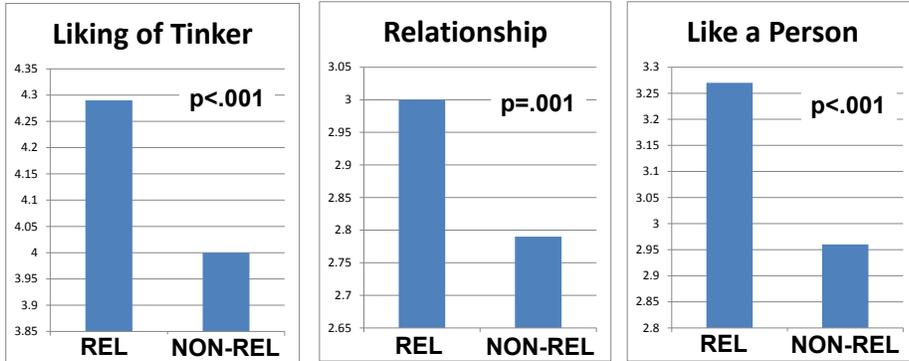| Color	Legend	Value
	Inexperienced	42%
	Expert	30%
	No report	29%
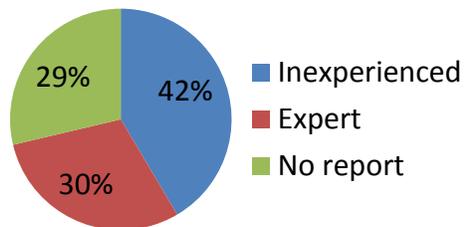
Results:
Overall Satisfaction

- Hypothesis supported.

Satisfaction

p<.001

REL   NON-REL

Results:
Relationship

- All Hypotheses supported.

Liking of Tinker

p<.001

REL   NON-REL

Relationship

p=.001

REL   NON-REL

Like a Person

p<.001

REL   NON-REL

Results:
Engagement

- All Hypotheses supported.

Desire to Continue

p<.001

REL   NON-REL

Session Length

p<.001

REL   NON-REL

Sessions

p=.008

REL   NON-REL
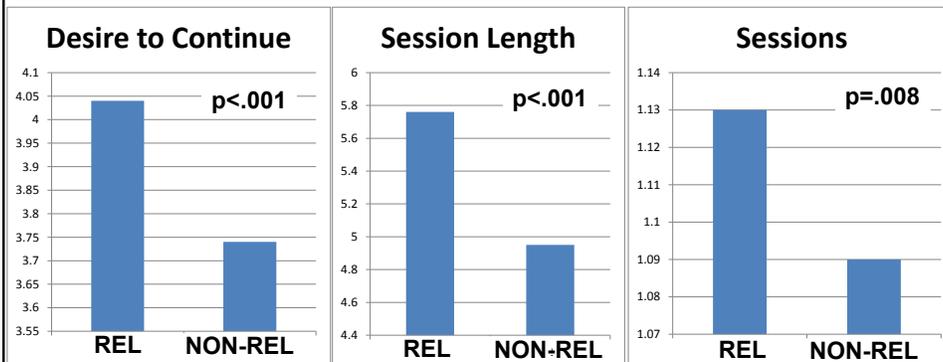
Results:
Learning

- All Hypotheses supported.

Learned From Tinker

p<.001

	REL	NON-REL

(bar chart: y-axis from 3.2 to 3.7, REL ≈ 3.65, NON-REL ≈ 3.36)

Knowledge

p=.019

	REL	NON-REL

(bar chart: y-axis from 2.1 to 2.35, REL ≈ 2.3, NON-REL ≈ 2.17)
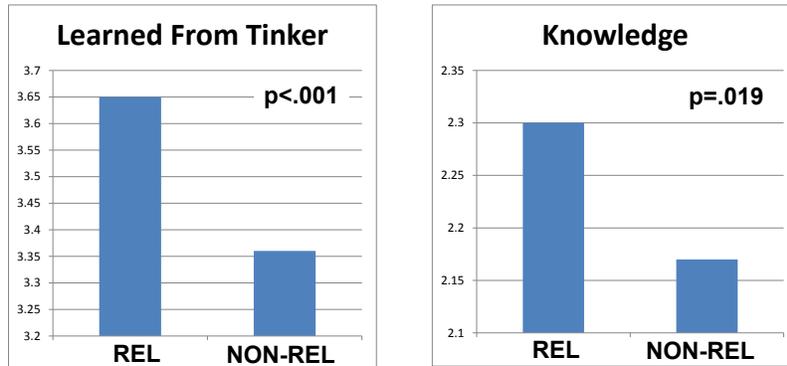
Engagement Mediates Learning

.04

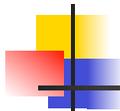| RELATIONAL vs. NON-RELATIONAL	.11 →	Engagement	.15 →	Learning
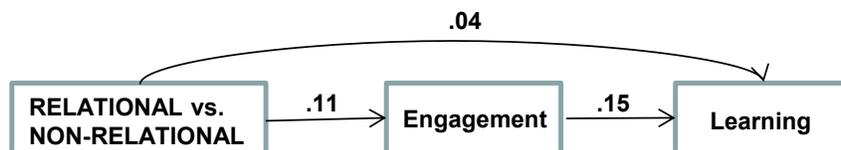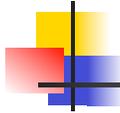
Exercise

- Project Groups

- Design a (embodied) conversational agent for your app.
- What would it do?
- What users would it appeal to?

To do

- Read
  - CSCW (Benyon Ch 16).
  - Expert evaluation & Heuristic Evaluation (review Benyon Ch 10; Pinelle paper)

- Project
  - P6 – First software prototype
  - Must be running and distributable by Monday
  - Your classmates will be evaluating