

# The Future of Communication between Virtual and Real Bodies

**Justine Cassell**

Director, Human Computer Interaction  
Carnegie Mellon University



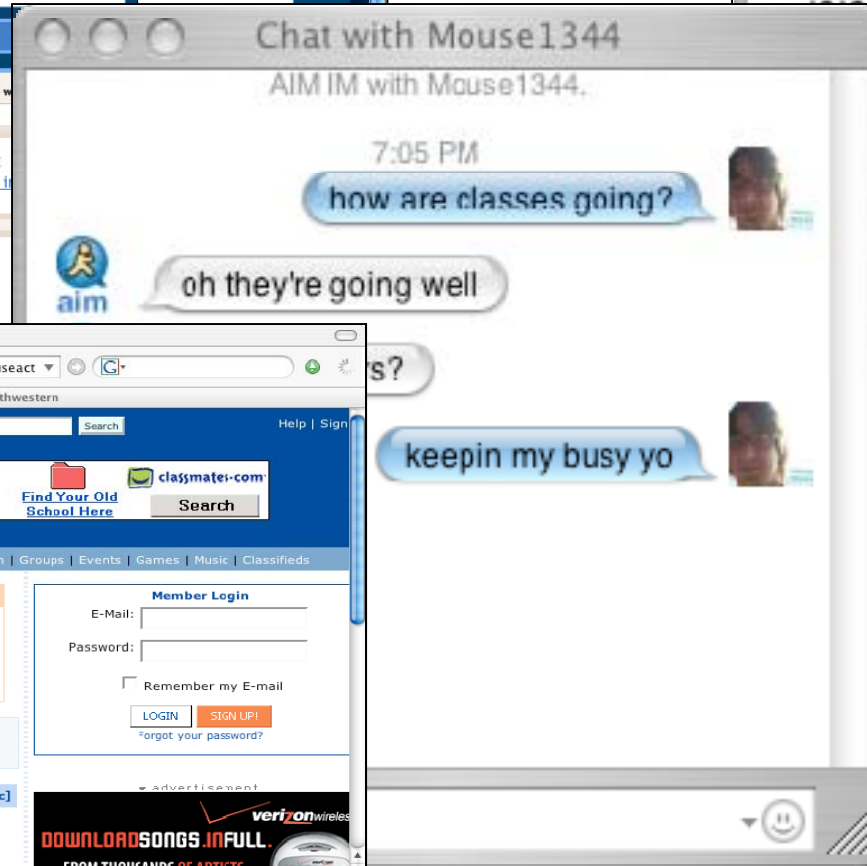
# Communication



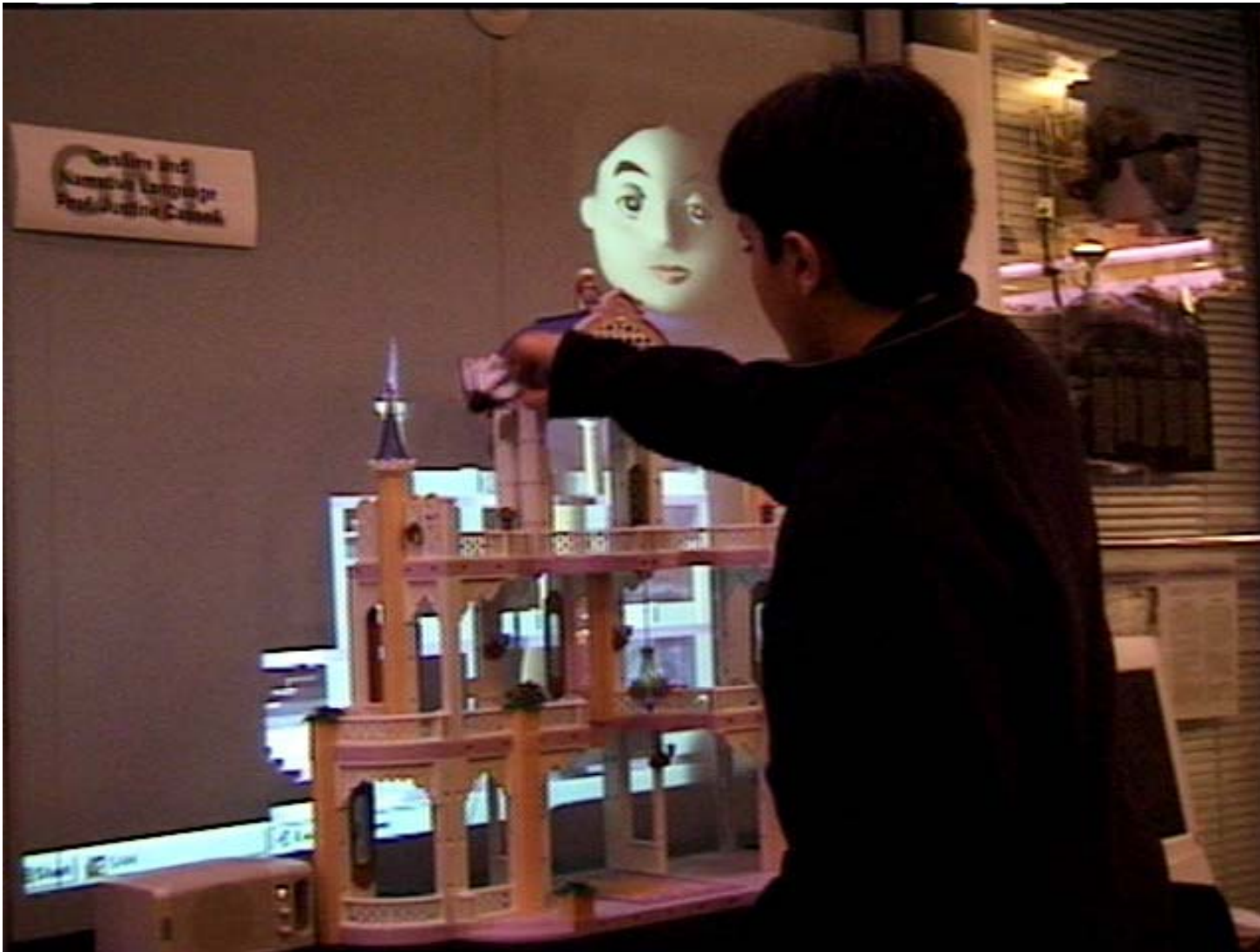
# Collaboration



# Communication?



# Collaboration?



Justine Cassell

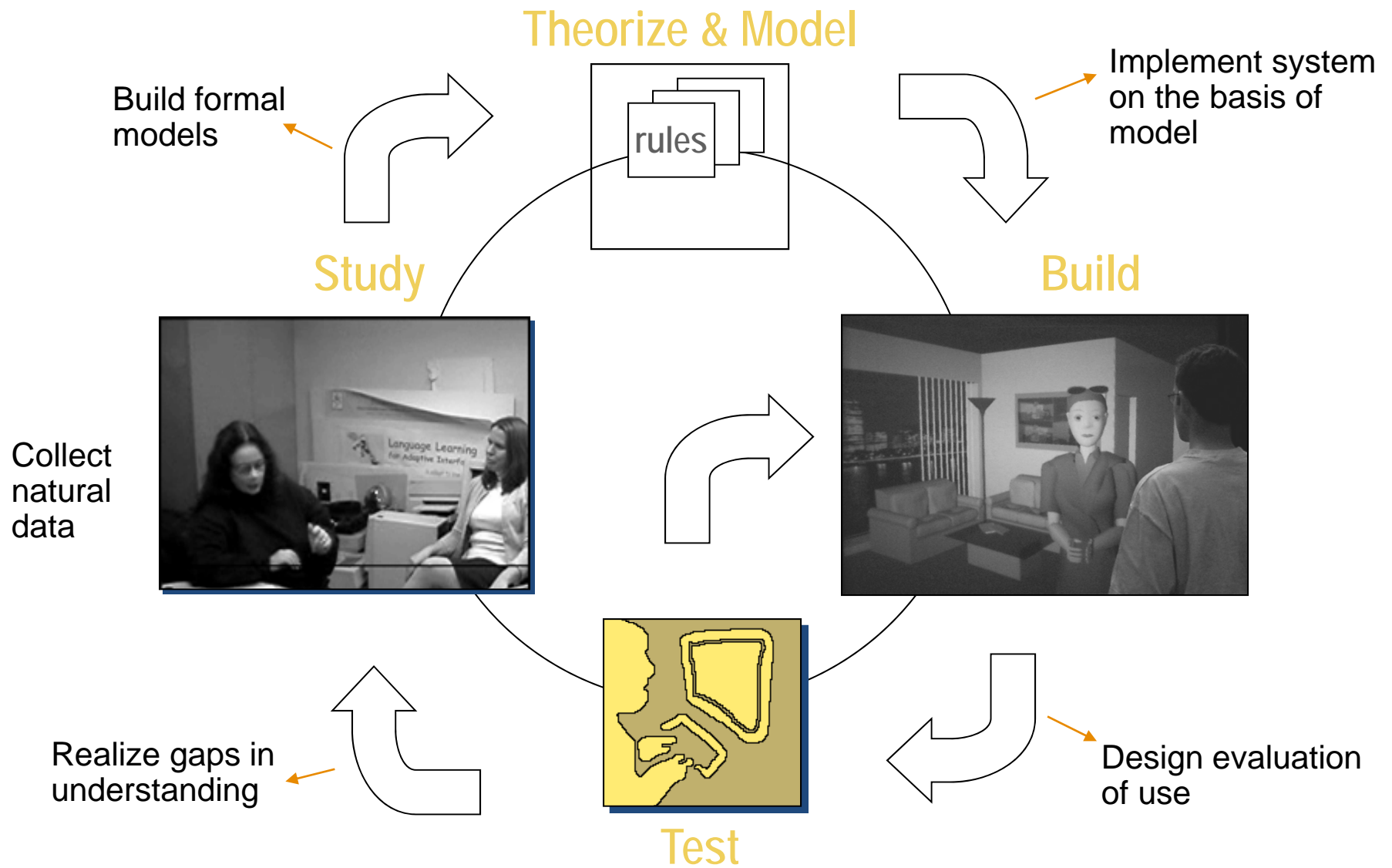
# Is this a *Dystopic* Vision of the Future?

- Are we losing the skills of face-to-face communication and collaboration?
- How do we save those skills that are most representative of our human existence?
- Can the study of human bodies be used to develop new kinds of virtual communicating bodies?
- How can cross-cultural analysis, developmental psychology, linguistics, sociology (. . .) inform the development and understanding of new communication technologies?

# Today's Talk

- Studying what is human, to build the virtual human.
  - The role of the body in communication
  - Social chit-chat
- Representing what is most human in virtual humans
  - Culture
- Using virtual humans to understand and teach typical human behavior.
  - Virtual peers for children with autism

# Methodology



# Study of the Body in Communication



Results on Contributions of Speech and Gesture to Communicative Goals

Major Communicative Goal	Gesture Type	Semantic Features in Speech	Semantic Features in Gestures	Accuracy in Data
Introduce a single Object	Complementary	Existence	Shape, Location	78.8% (26/33)
Introduce multiple Objects	Complementary	Existence, Number	Relative Position	100.0% (9/9)
Describe the configuration of multiple objects	Complementary	Existence	Relative Position, Shape	93.8% (15/16)
Describe location of an object	Redundant	Location	Location	80.0% (20/25)
Describe a general impression	Redundant (Metaphoric)	Impression	Impression	100.0% (6/6)
Describe the shape of an object	Redundant	Shape	Shape	100.0% (5/5)

So: sometimes gestures indicate the same thing as speech, and sometimes they indicate *different but complementary* features of meaning. These are predicted by the communicative goals of the utterance.

# The Virtual Real Estate Agent (REA)



Cassell, J. and Stone, M. (2000) "Coordination and Context-Dependence in the Generation of Embodied Conversation." *International Natural Language Generation Conference*.

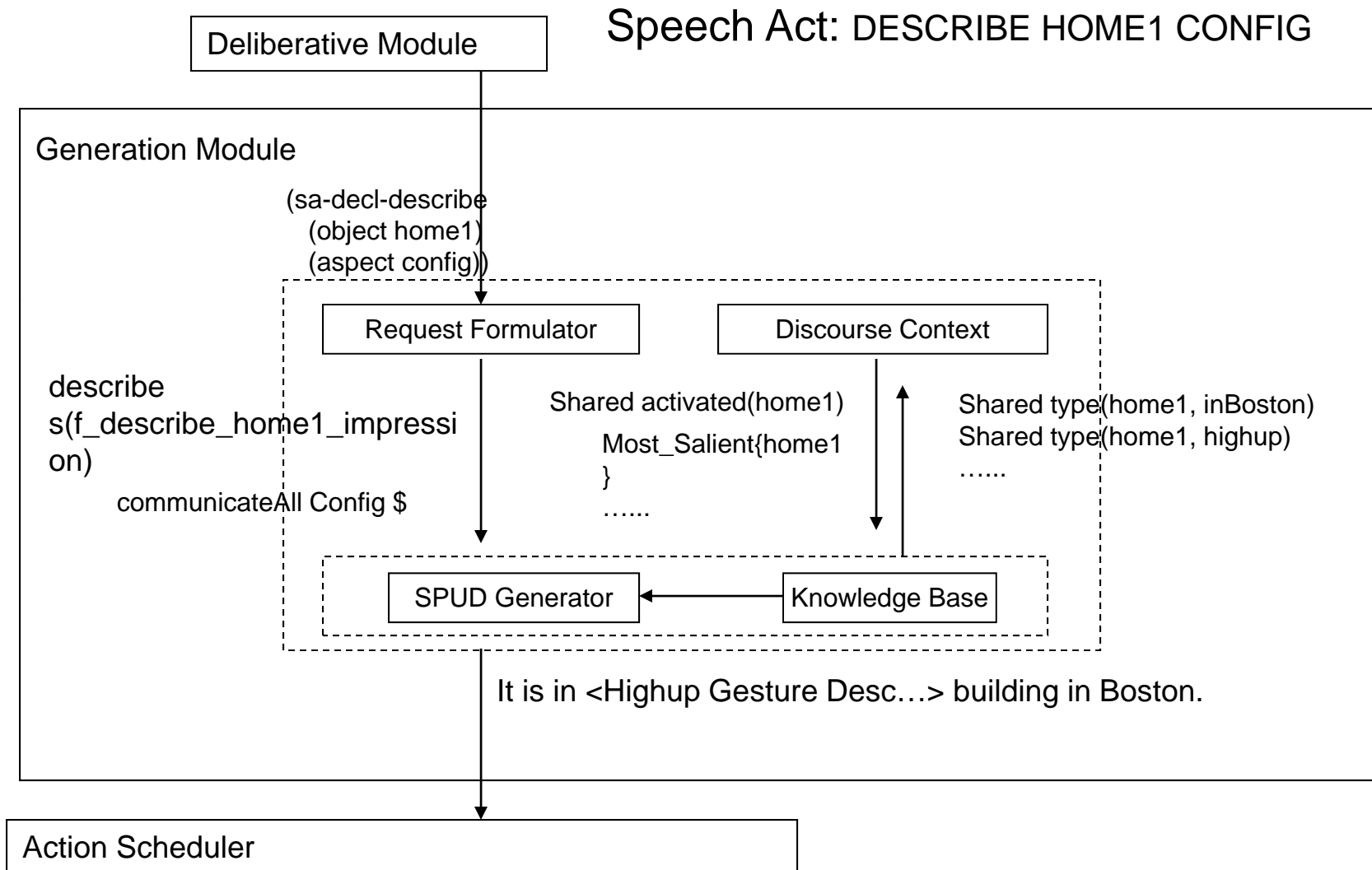
# Natural? Realistic?



Final Fantasy

REA does not seem as **lifelike** as *Final Fantasy*. But REA is more **alive**. REA acts from her own mind.

# Generating Speech and Gesture



# Implications

- The body plays an intrinsic role in communication.
- But there are flaws: language and nonverbal behavior alone don't make a virtual being human.
- There needs to be a social element.

# Study of Social Chit-Chat

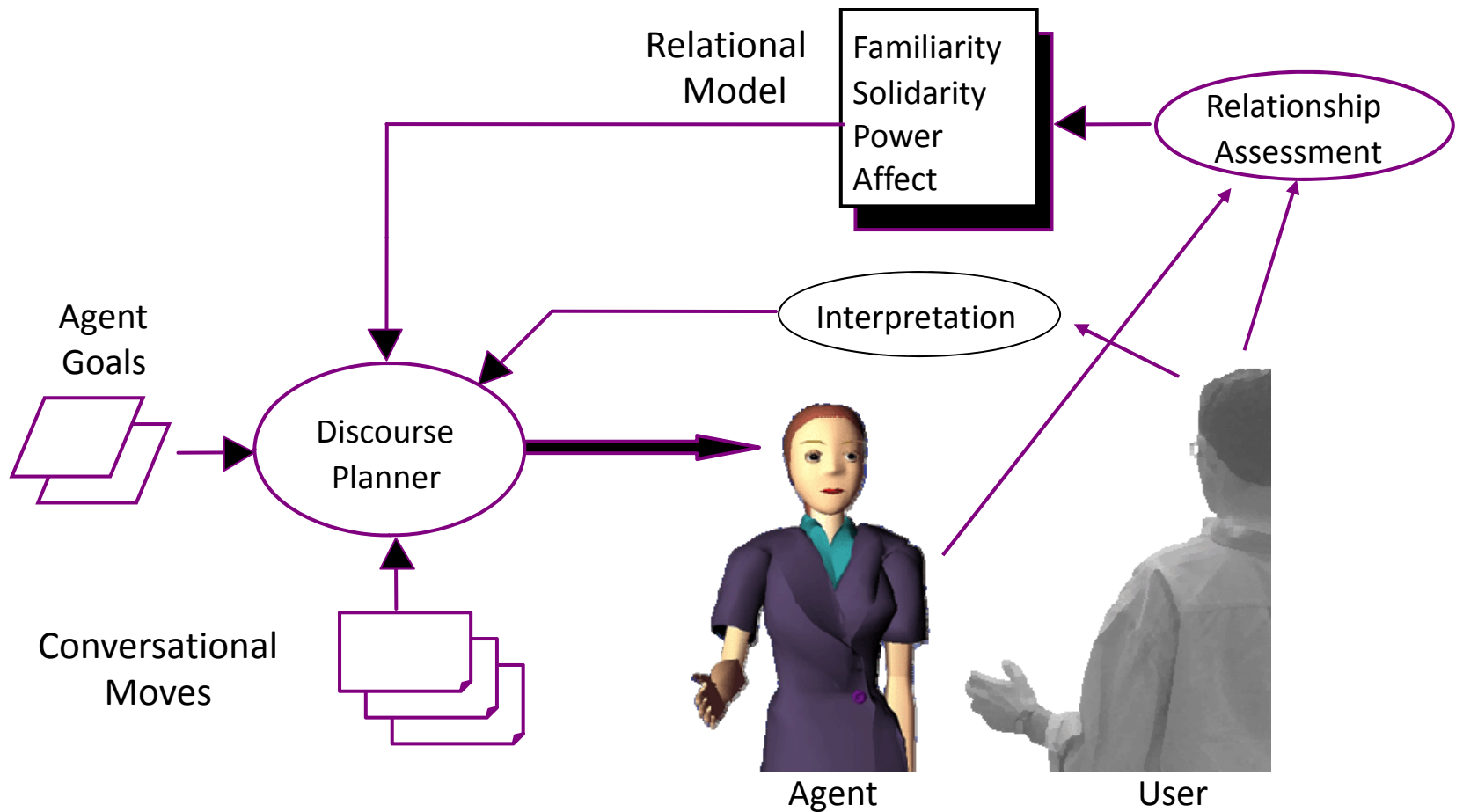


Work with Tim Bickmore

# Relational REA



# Social Computational Architecture



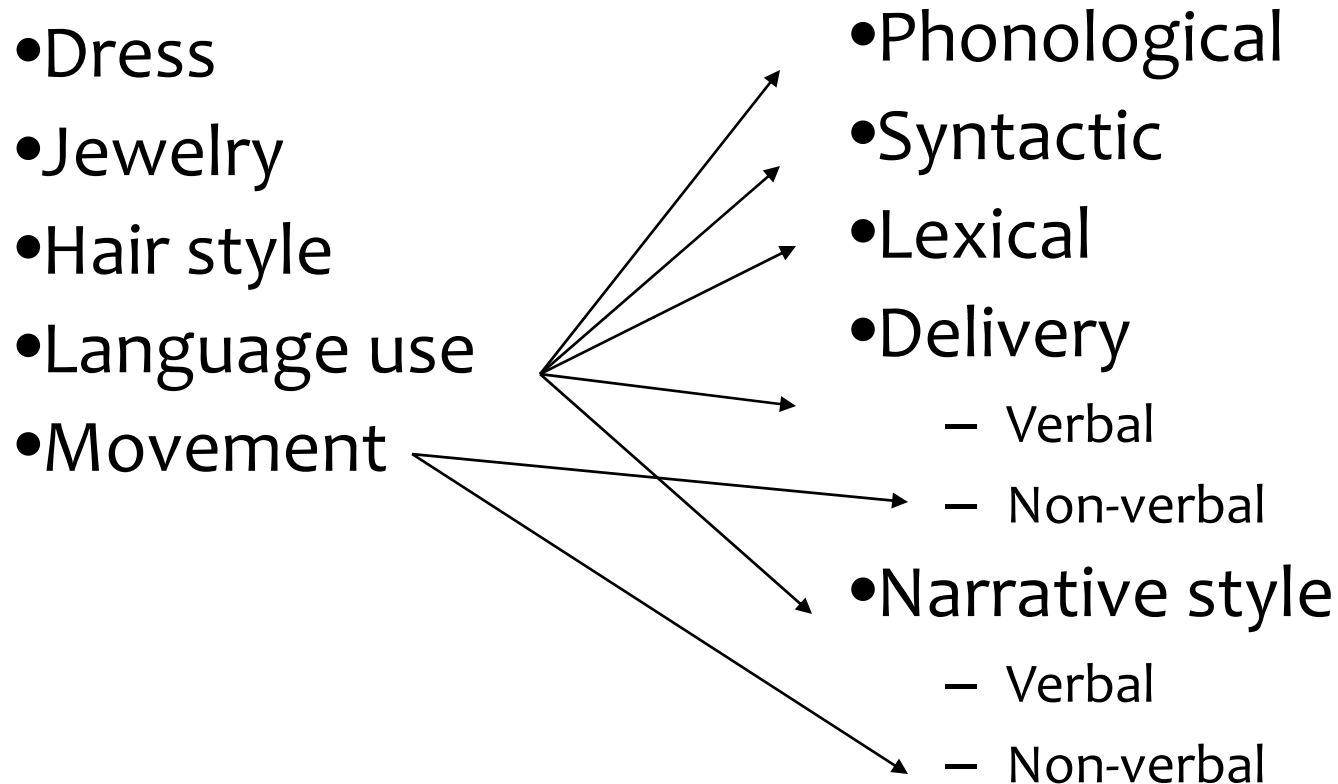
## Quotes from Participants

- Introvert : “REA exemplifies some things that some people, for example my wife, would have sat down and chatted with her a lot more than I would have. **Her conversational style seemed to me to be more applicable to women, frankly, than to me. I come in and I shop and I get the hell out.** She seemed to want to start a basis for understanding each other, and I would glean that in terms of our business interaction as compared to chit chat. I will form a sense of her character as we go over our business as compared to our personal life. Whereas **my wife would want to know about her life and her dog, whereas I really couldn't give a damn.**”
- Extrovert: “I thought she was pretty good. You know, I can small talk with somebody for a long time. **It's how I get comfortable with someone, and how I get to trust them, and understand how trustworthy they are,** so I use that as a tool for myself.”

# Implications

- Social chit-chat behavior is important for establishing trust, especially for extroverts
- Social chit-chat works to establish trust in virtual humans as well as real humans
- But, social chit-chat is not just made of words
- The whole body plays a role in building rapport and trust
- Are these behaviors the same in every person?

# Axes of Identity Construction



# Population: African American English Speakers

AAE dialect is an important way of representing cultural identity



- f /θ , v /ð & t /θ
- Deletion of the copula/auxiliary
- Subject-Verb Agreement
- Habitual *be*
- Remote past *been*

- Not all African Americans use AAE
- Not all African Americans use AAE in all contexts
- African Americans are not the only ones to use AAE
- The majority of African Americans use some AAE to signal identity in some contexts
- When/why/do children dialect-switch?
- Do nonverbal behavior also change?
- If dialect use is about identity, how do we teach use of the mainstream code in the classroom?
- How do we use the answers about language and identity to implement communication dynamics for VPs?

# Building a Bridge Together



# Playing Teacher and Student



# Summary of Results: Child~Child Interaction

<u>Task</u>	Bridge	Teacher/Student	
<u>Role</u>	Peer	Teacher	Student
<u>Dialect</u>	+ Higher rate of AAE	- Lower rate of AAE + Higher rate of science talk	
<u>Nonverbal Behavior</u>	+ Hand actions + Gaze at Toy - Minimal head movements	+ Gesture + Types of gesture + Increase gaze at Peer & Elsewhere + Head movements (teacher head tilts)	

# Resulting Virtual Peer



# Summary of Results: Child~Virtual Peer

	<b>Building</b>	<b>Classroom</b>	
<b>Measures</b>	<i>Peer</i>	<i>Teacher</i>	<i>Student</i>
<b>MLU</b>	3	7.98*	5.73*
<b>DDM</b>	0.164	0.042	0.084



Sophistication (MLU) of child's speech is greatest in classroom task with Virtual Peer (VP), especially when child is teacher.

Amount of MAE is highest in classroom task – especially when VP is teacher.

VP has an effect on children's talk and action

# Implications

- Virtual humans must have **minds** (to generate language and gesture), they must have **hearts** (to generate relationship-building behavior), they must fit into **communities** (to represent culture and identity).
- Sensitive study of language use and identity allows us to build technologies that support rather than denying culture and identity.
- Sensitive interface design allows us to learn about language use and identity in ways useful even in the absence of technology

# Teaching Social Behavior in Autism

- Autism is characterized by a triad of impairments, in
  - Reciprocal social interaction
  - Communication
  - Imagination
- Do people with autism *know* more than they *show*?
- How do we teach the use of social skills to people with autism?

Dissertation work by Andrea Tartaro

# Virtual Peers

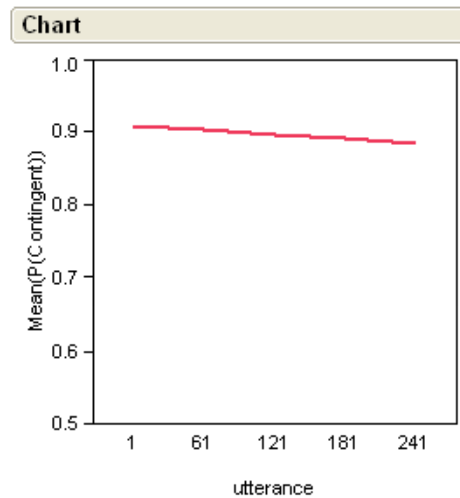
## as Assessment & Intervention



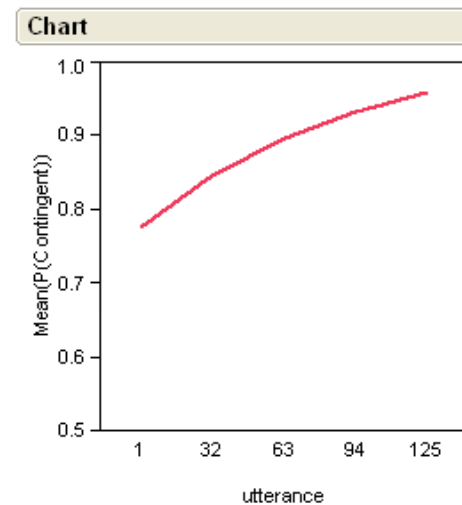
Work with Andrea Tartaro

# Results: Contingency

Child uses more & more social behaviors when interacting with the virtual child, but not when interacting with the real child.

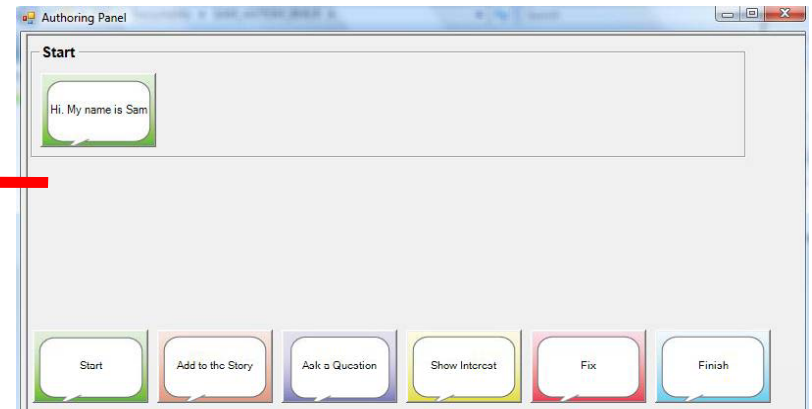


Child with autism  
with Typical Peer



Child with Autism  
with Virtual Peer

# Authorable Virtual Peers



Current research allows children with autism to program the virtual peer as a way of understanding which social behaviors are appropriate.

# In Conclusion

- Studies of real humans can play an important role in the development of future communication technologies.
- Studying future communication technologies can shed light on human behavior.
- Communication between real and virtual humans can be important for teaching
- We need not fear losing the human when we gain the virtual human!

# History Repeats Itself



Droz Writing Boy (1772)

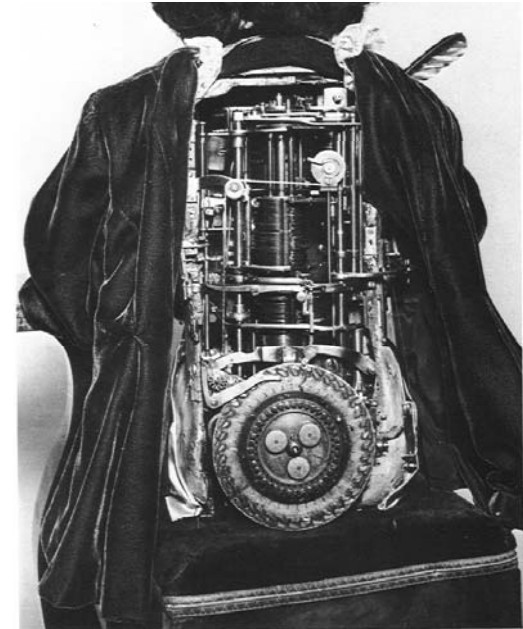


Planche 2.

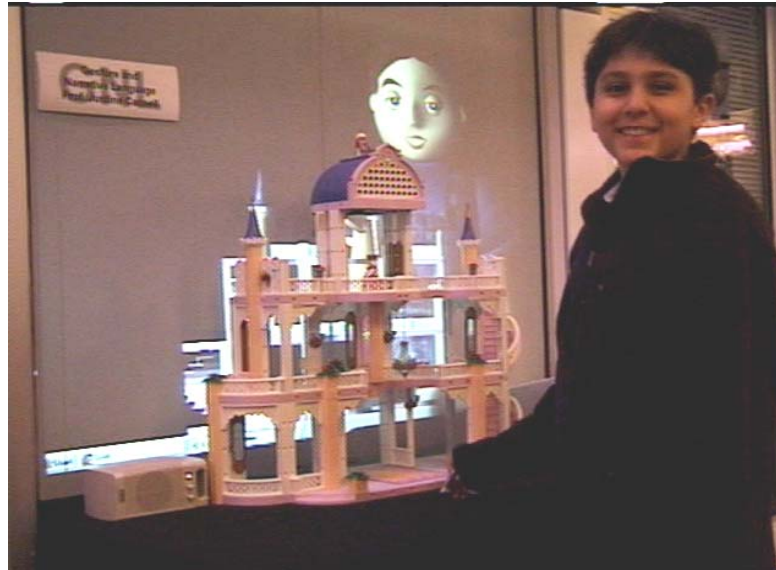
The story of the **automaton** had struck deep root into their souls and, in fact, a pernicious **mistrust of human figures** in general had begun to creep in.

Many lovers, to be quite convinced that they were not enamored of wooden dolls, would request their mistresses (...) not merely to listen, but also sometimes to talk, in such a manner as presupposed **actual thought and feeling**.

"The Sandman" E.T.A. Hoffmann (1817)

# With the participation of

- Miri Arie
- Rachel Baker
- John Borland
- Margaret Echelbarger
- Brooke Foucault
- Kathleen Geraghty
- Alastair Gill
- Alberto Gonzalez
- Francisco Iacobelli
- Andrea Tartaro
- Paul Tepper



<http://www.justinecassell.com/>

***Thanks for funding to NSF HCC, NSF ALT,  
Cure Autism Now, Autism Speaks***