

# Using Non-Verbal Information to Augment Designs of Language-based Interactions

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# About Me

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**PhD & Postdoc, Cornell (3.5 years)**

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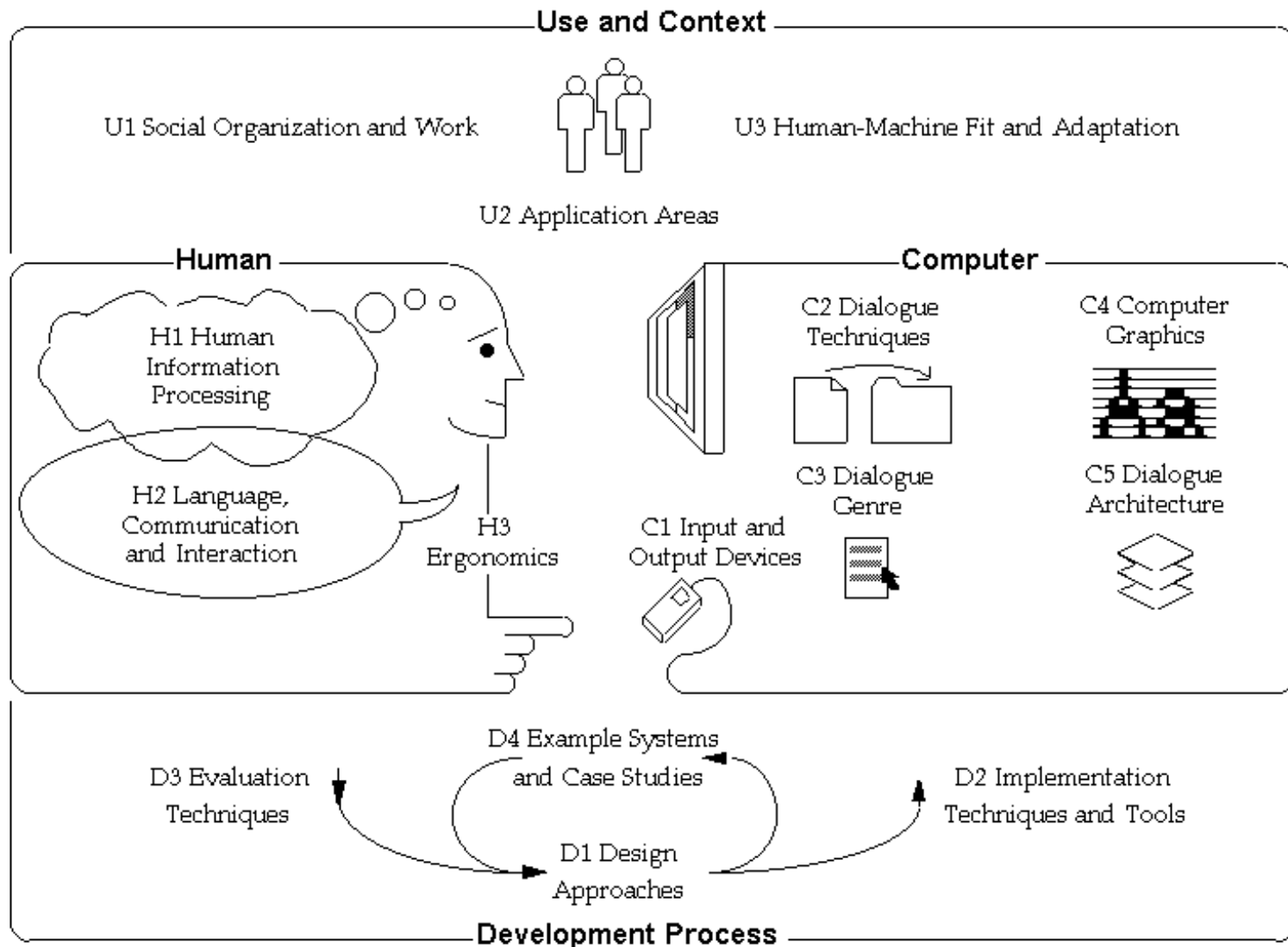
**Human-computer interaction w/ focus on social technology**

- ACM CSCW Steering Committee
- ACM CHI Associate Chairs (2014, 2015, 2016)
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- Chinese CHI Steering Committee & Program Co-Chairs (2014, 2015)



# *A Quick Overview of Human-Computer Interaction, HCI*

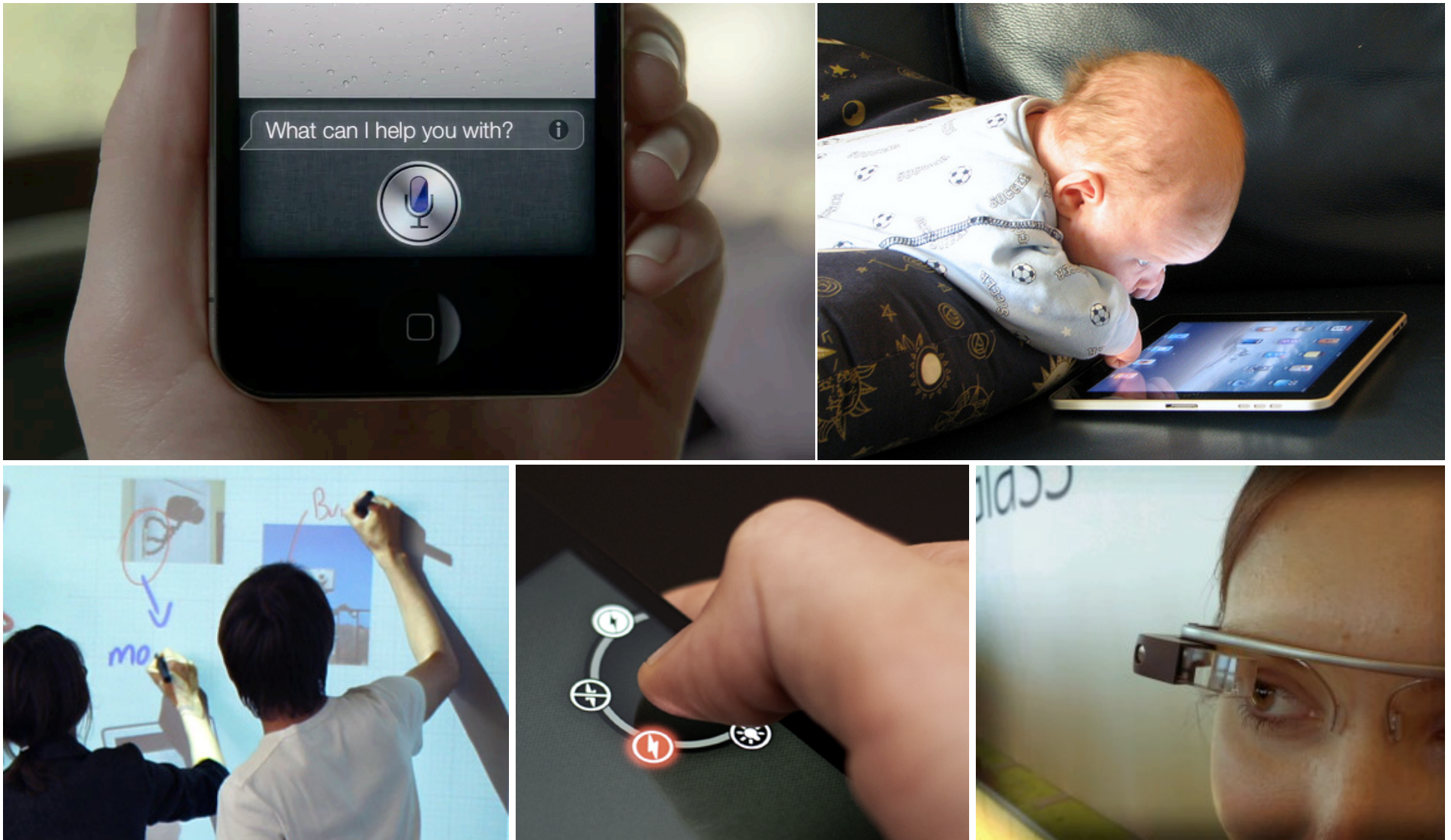
# HCI: Studying Existing and Possible Relationships between Computers and People



ACM SIGCHI Curricula 1996



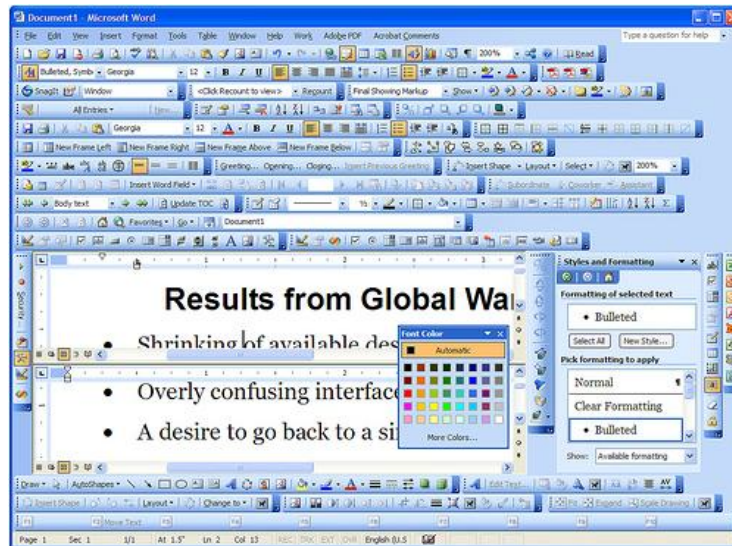
## The two “senses” of Human-Computer Interaction: From interface ...



**HCI as a topic:** “Interaction” in the sense of input and output between machines and people.

... to problem solving and value creation in the real world

Identifying & fixing usability problems



Persuasive (behavioral change) computing



Applications of HCI  
(not all the same as  
HCI applications)

**HCI as a discipline:** “Interaction” in the sense of designing, appropriating technologies based on user needs, goals, constraints, and characteristics.



# 30+ Years of the HCI Community

## ACM SIGCHI:

9 Turing Award Winners / 188 ACM Fellows

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ACM Special Interest Groups

**SIGCHI** Special Interest Group on Computer-Human Interaction

The ACM Special Interest Group on Computer-Human Interaction is the world's largest association of professionals who work in the research and practice of computer-human interaction. We are an interdisciplinary group of computer scientists, software engineers, psychologists, interaction designers, graphic designers, sociologists, and anthropologists, just to name some of the domains whose special expertise is needed to bear in this area. What brings us together is a shared understanding that designing useful and usable technology is an interdisciplinary process, and when done properly it has the power to transform persons' lives. SIGCHI has over 60 active local chapters across five continents, to promote local support networks for HCI professionals. SIGCHI members receive registration discounts to SIGCHI-sponsored and co-sponsored conferences, a subscription to "Interactions" magazine, and a print and online subscription to the "SIGCHI Bulletin." SIGCHI membership also grants access to all SIGCHI publications in the ACM Portal.

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# *Language-based Interactions as an HCI Problem*

# The Origin of Language-based Interactions

People use language to communicate as one common way of social, interpersonal interactions

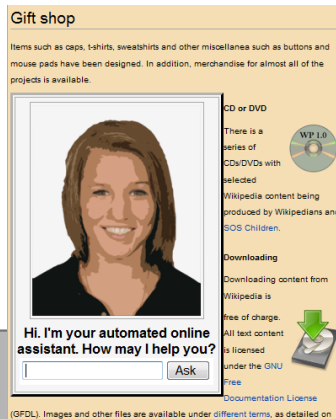
- A joint, collaborative effort on message exchange
- One states, another follows
- One asks, another responds
- An important basis for work, learning, relationship building etc.



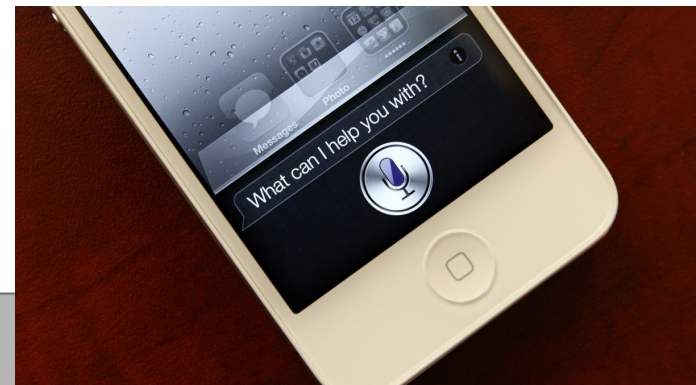
# User Interface as Communication *Metaphor*

When considering the design of machine-user interface, it's useful to consider it as a type of *communication* (between human and system)

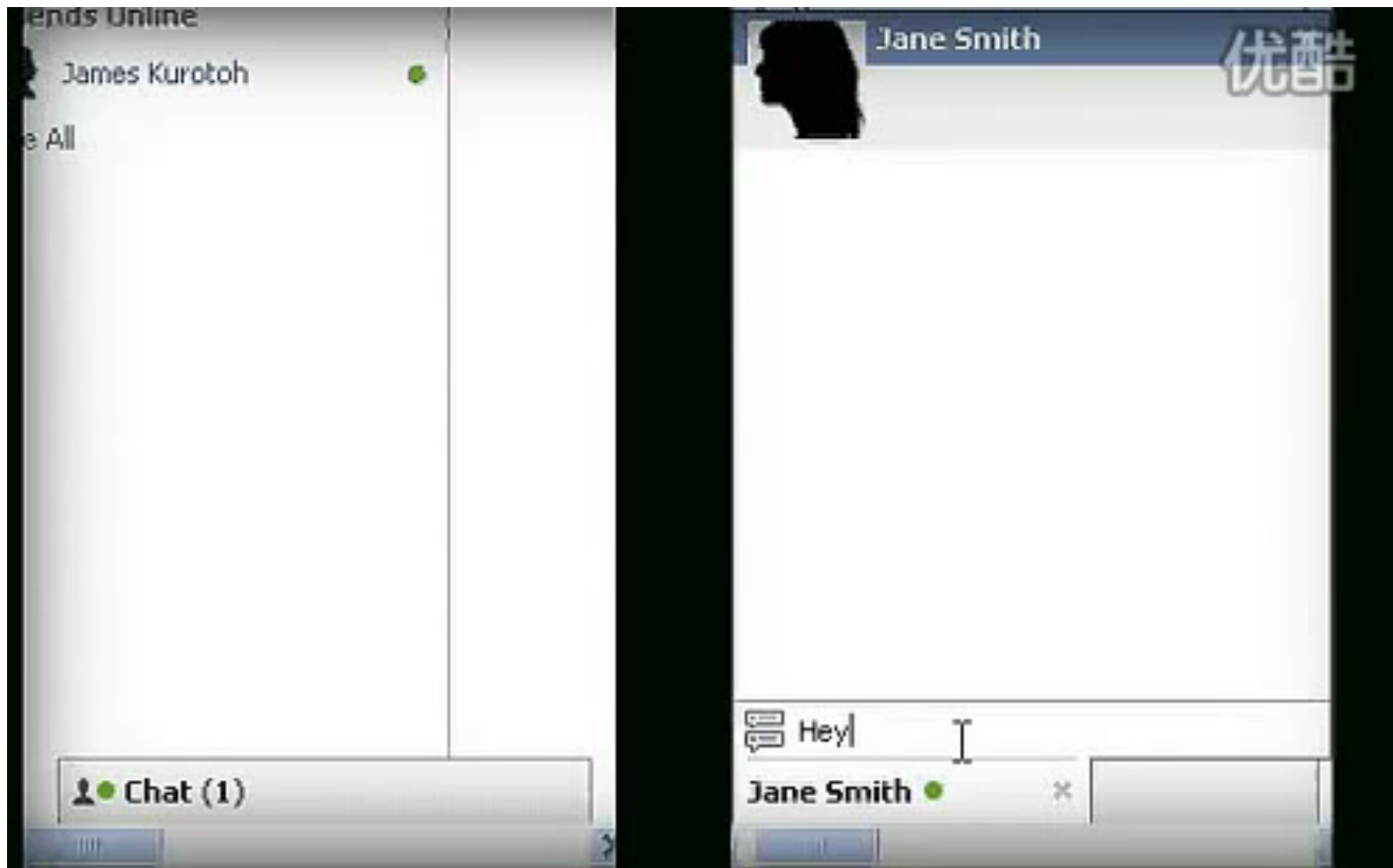
- Language as a model of design. Command-line interface, dialogue system, search user interface etc.
- But, numerous problems at the level of interaction and human factor can emerge...



Wang



What's the longest distance in the world?  
世界上最遠的距離是什麼？





# Observations from Human-Human Communication

## Human as both the producer and consumer of messages

- *Problem of overloading due to multitasking*

## Norm of conversational interaction

- Ideally, we expect quality, quantity, relevance and manner in conversations (Grice's maxims)
- *Problem of imperfect processing*  
Practically, either human or machine can be poor at any of these (can we always express clearly and efficiently, and stay relevant?).

## Requirement of linguistic/communication skills

- Training/learning may be required
- Barriers between educational levels, professions, languages and cultures.

# So Maybe Just Avoid Language?

## Multimedia/multimodal approach

### Video conferencing

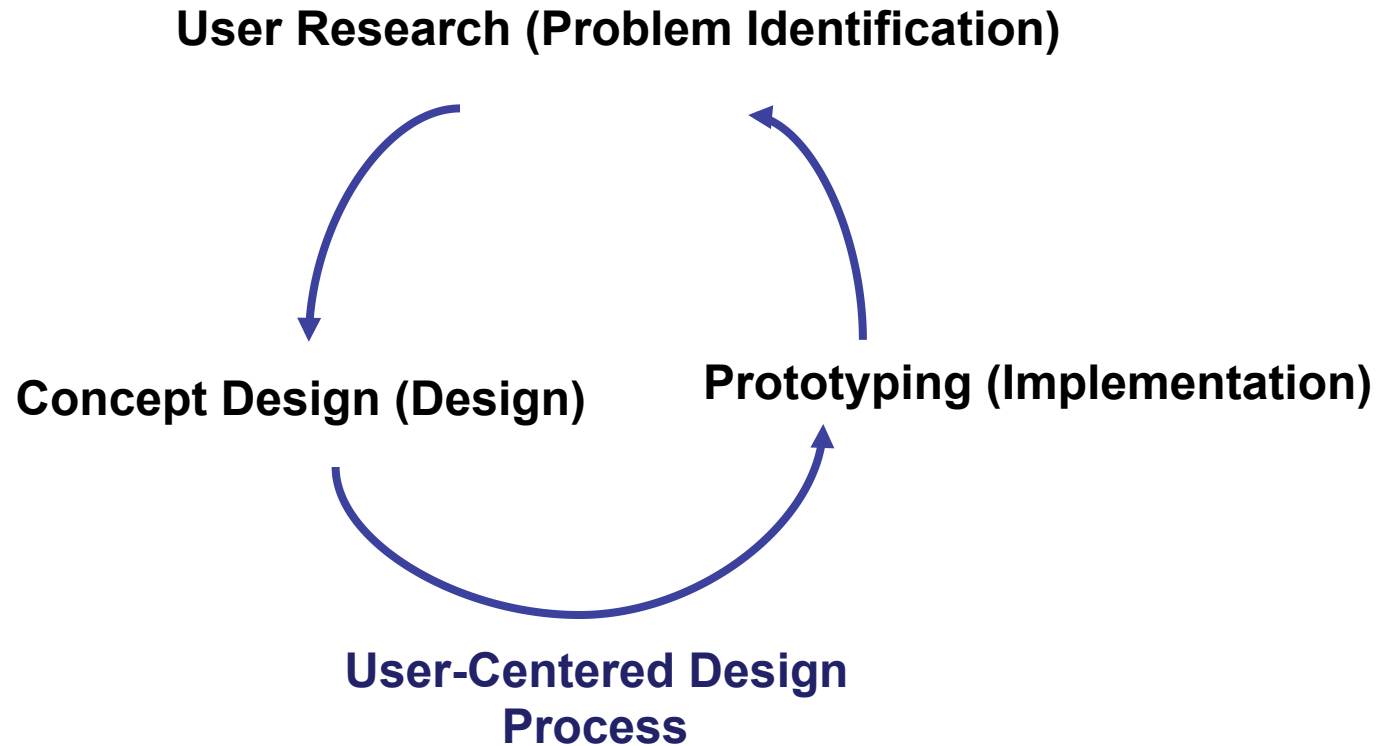
- Mimicking face-to-face communication
  - “The bigger, the better”
- Does it work? Sometimes.
  - Adoption is not guaranteed.  
Privacy and other social concerns
  - Video alone cannot deliver meaning



### Using signs/gestures

- Signs as language (still need learning)
- Gestures can be ambiguous

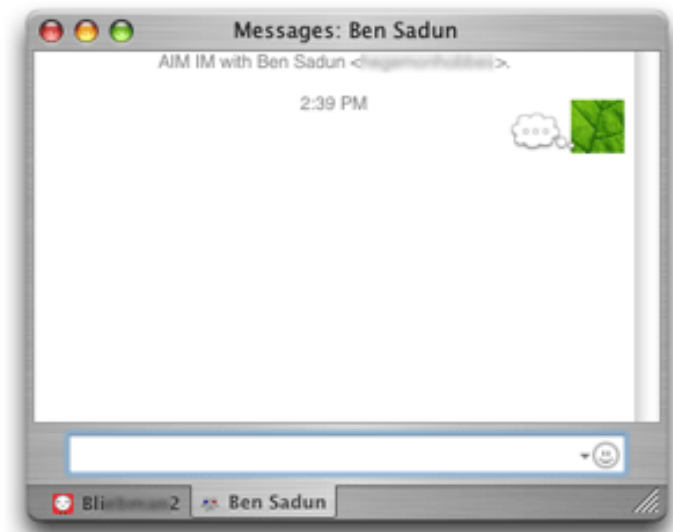
# Applying Design Thinking



# Design Approach: Small Tweak, Huge Impact

Designs of interaction can work better when features and constraints of human communication are understood and considered.

Ex. Non-verbal *awareness indicator* that makes “typing” visible in instant messaging.



**Identify key problems to solve. Introduce suitable non-verbal information in designs.**

# *Grounding Communication*

# How Would You Describe...

Where you live in Taipei?

Where you lived when you were in U.S.?

# My Answer

Where you live in Taipei?

In 南勢角.

Where you lived when you were in U.S.?

In Ithaca, a college town in the middle of New York state if you know where it is. It's where Cornell University is located.

# My Answer

Where you live in Taipei?

In 南勢角.

Where you lived when you were in U.S.?

In Ithaca, a college town in the middle of New York state if you know where it is. It's where Cornell University is located.

**Do you see the general difference? Why?**



# My Answer

Where you live in Taipei?

In 南勢角.

Where you lived when you were in U.S.?

In Ithaca, a college town in the middle of New York state if you know where it is. It's where Cornell University is located.

**Do you see the general difference? Why? The amount of knowledge that we shared.**

# Common Ground

Knowledge, beliefs, attitudes **we share**,  
and **know that we share**,  
and **know that we know that we share**,  
influence how we use language to communicate.

**Grounding:** Interactive process  
by which communicators exchange  
evidence of their understanding to  
arrive at the state of **common ground**.



Herbert Clark  
Stanford University

# Evidence of Common Ground

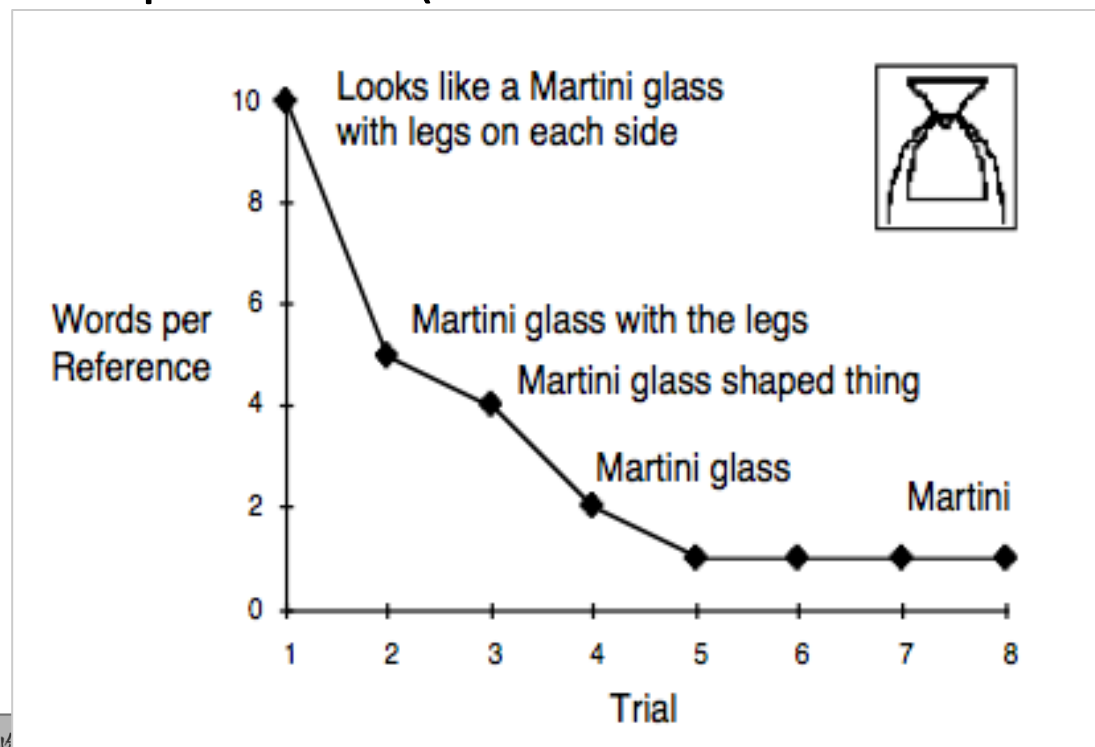
Physical co-presence (being co-located)

- “close **that door**”

Shared community membership

- “Let’s meet at 小七”

Linguistic co-presence (can access same utterances)



“What’s this?”

# The Role of Media: Affordances

An influential HCI-rooted concept, which roughly means “action-permitting properties” of objects that people see

- Chair **affords** sitting
- Door-knob **affords** door-opening
- Virtual keyboard **affords** typing (but is this trivial?)



Don Norman



# Affordances of Communication Media

Affordance	Face-to-Face	Video Conf.	Phone	Email
Copresence	++	?	--	--
Visibility	++	+	--	--
Audibility	++	++	++	--
Cotemporality	++	+	++	--
Simultaneity	++	+	++	--
Sequentiality	++	++	++	--
Reviewability	--	--	--	++
Revisability	--	--	--	++

[Clark & Brennan, 1991]

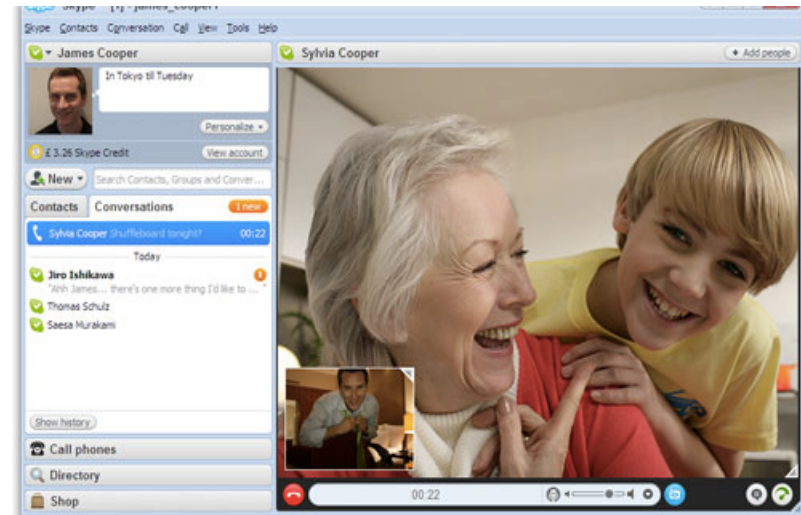
# Technology Changes Grounding

Affordances of media determine how people may interact with one another

- E.g., if no visibility, impossible to use head-nodding as a technique for grounding

People may learn to adapt their grounding behaviors (this happens. E.g., emojis in instant messaging)

Design *non-verbal features* to enable new ways of grounding in communication.





# Sample Projects

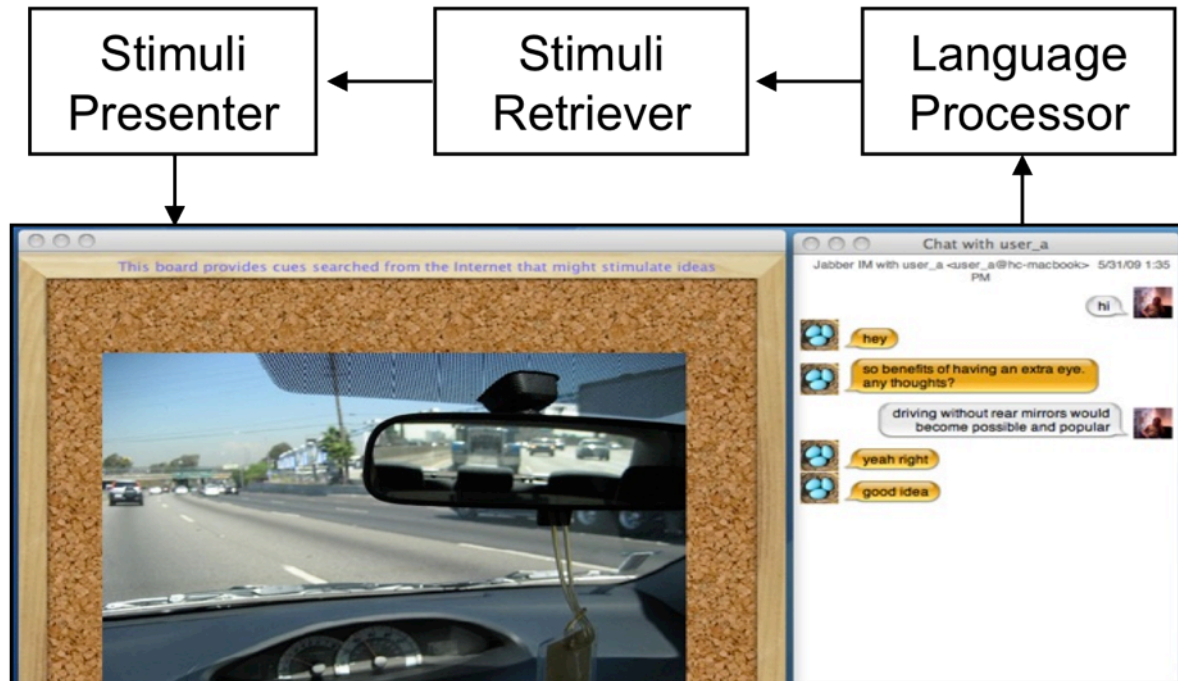




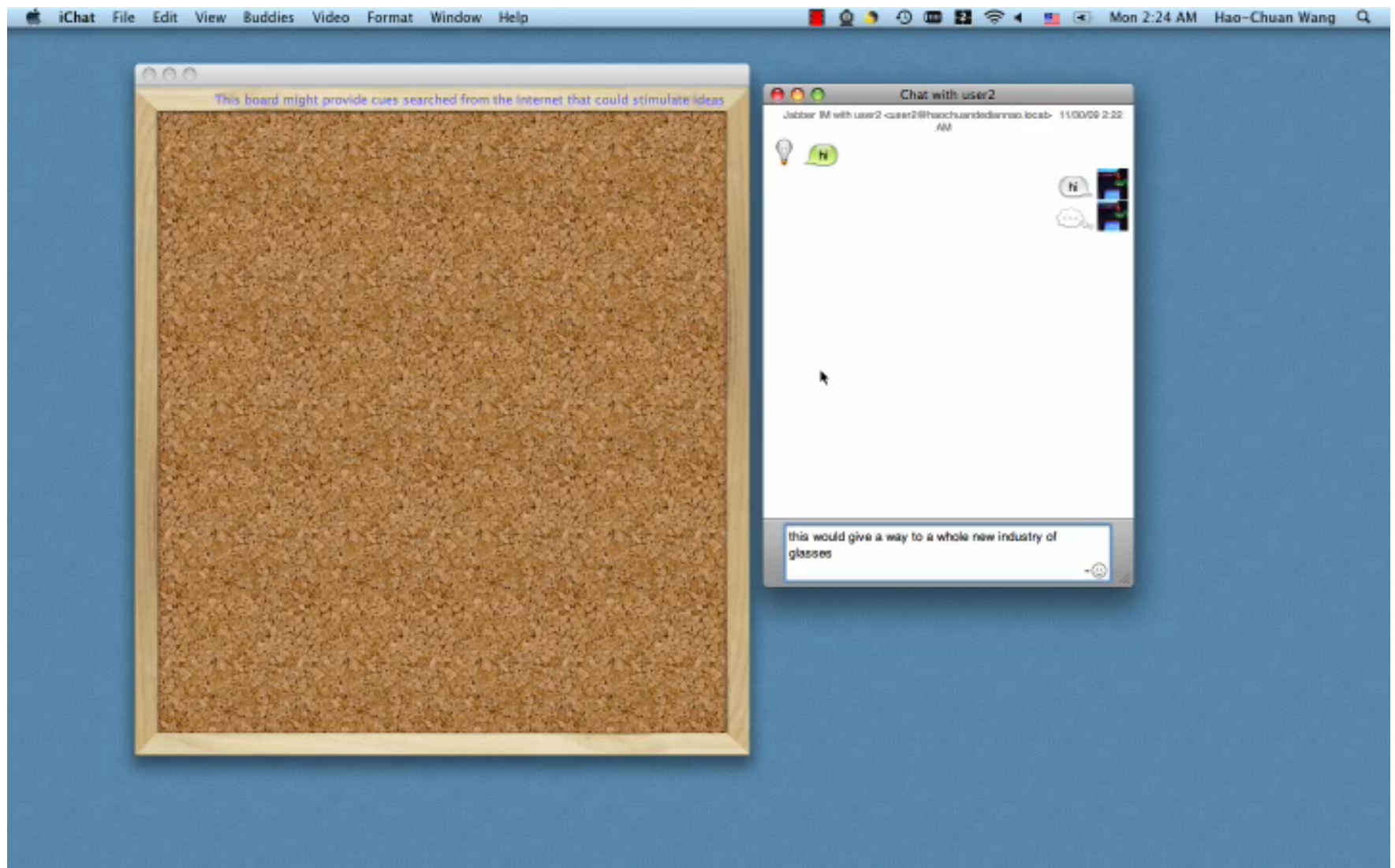
# IdeaExpander

**Augmenting Human Processing:** People can be bad at doing some work (e.g., creativity), and machines can possibly help out.

Ex. IdeaExpander- Supporting idea generation by visualizing ongoing conversations as relevant pictures.



[Wang et al., CSCW 2010, 2011] [http://www.cs.cornell.edu/~haochuan/manuscripts/WangCosleyFussell\\_CSCW\\_10](http://www.cs.cornell.edu/~haochuan/manuscripts/WangCosleyFussell_CSCW_10)



# Prototyping

## Language Processor

SVM classifier,  $f$ : utterance  $\rightarrow$  (idea,  $\neg$ idea).

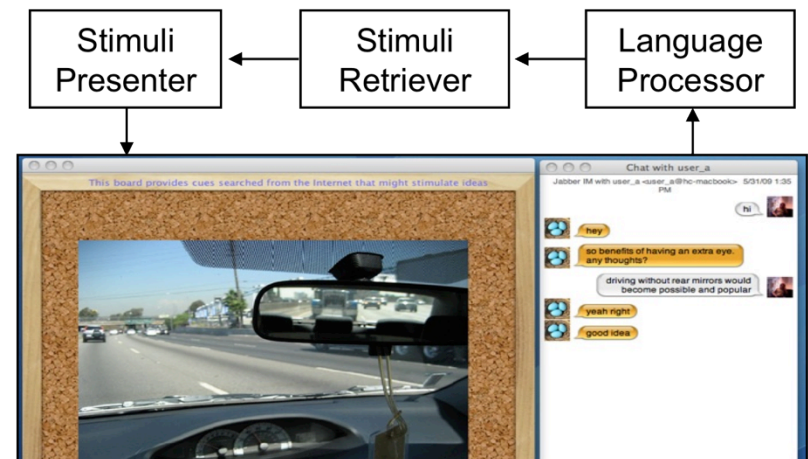
Feature sets: unigrams,

bigrams (markers of non-ideas, “I agreed”),  
sentence length (ideas can have more words)

10 fold CV: 80% accuracy (.6 Kappa).

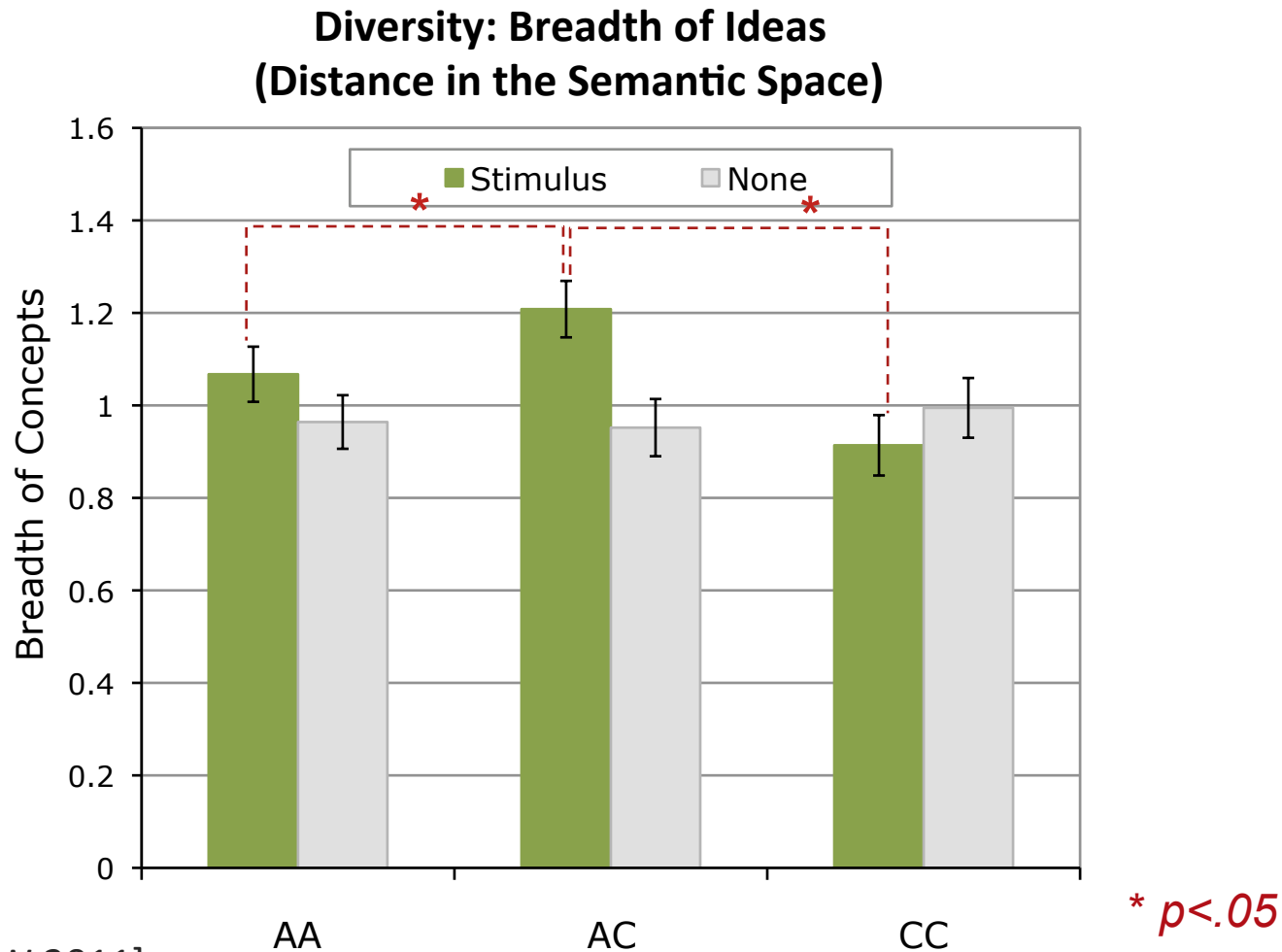
## Stimuli Retriever

Using cosine similarity between  
input sentence and picture  
tags to rank candidate pictures.



# Impact on Group Brainstorming

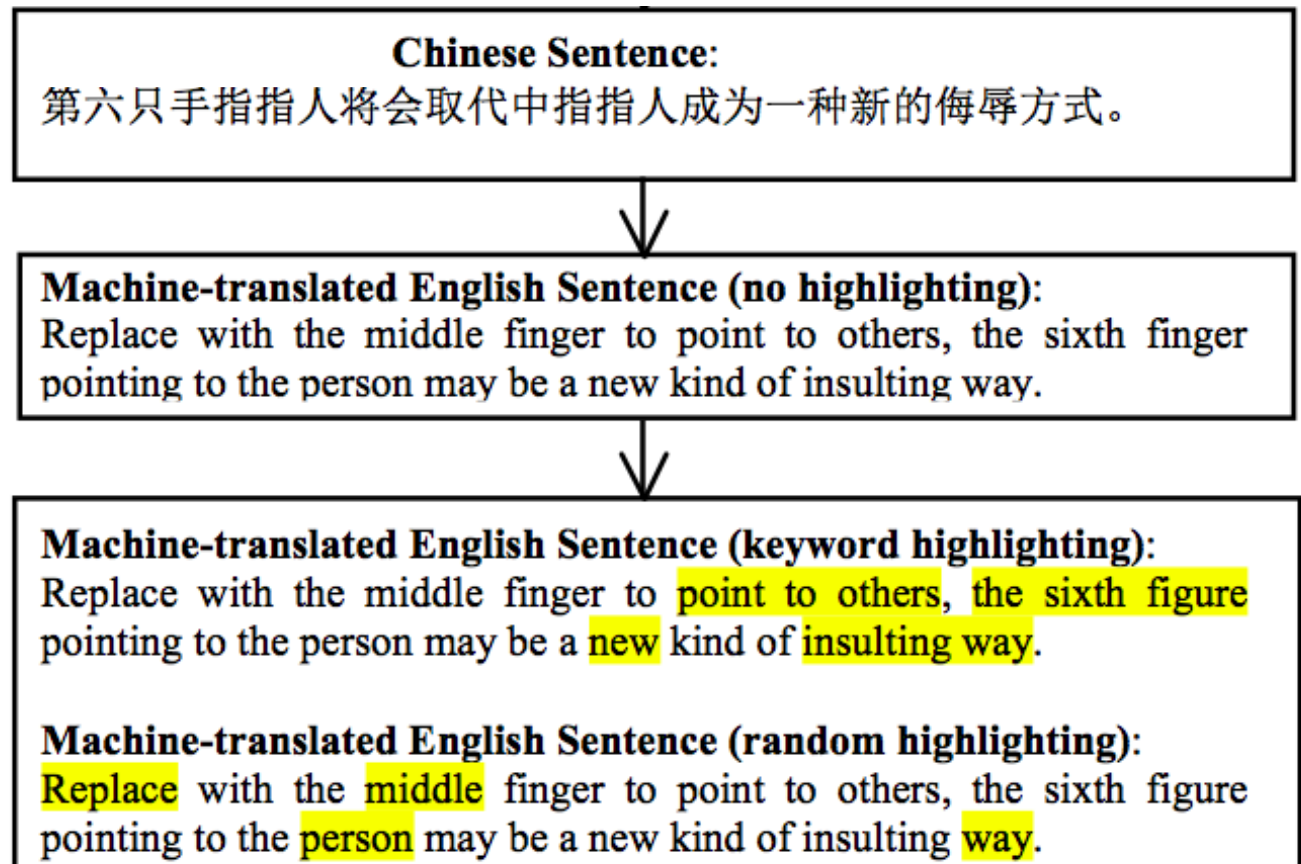
With IdeaExpander, inter-cultural groups (AC) generated more ideas, and ideas with the greatest breadth.



[Wang et al., CSCW 2011]

# Interfacing Machine Translation

**Enhanced machine translation** with  
keyword highlighting for cross-  
language communication (e.g.,  
Chinese-English  
chat)



[Gao, Wang, Cosley, Fussell, CHI 2013]

# Wizard-of-Oz Study: Interface for the Confederate

**Admin Panel**

[Message Archive](#)

No timer was set.

**The sentence pool from which machine translated ideas were chosen**

CONVENTION	ORIGINAL	TRANSLATION
38	more elaborate fingerprinting artwork	
53	Rich han i-painted works of art	
63	4 thumbs up can do thumbs up and thumbs down at the same time	
121	Erected in four fingers can do the finger erect to lay down and fingers	
43	we might need to regenerate sign language -	
67	We may need to re-invent the Sign Language	
33	6 12-base system would be popular	
86	6 or 12-based system will be popular	
17	Double thumb wars	
40	Two thumb fight	
51	Different method of typing might need to be created	
69	Not the way of typing will need to be invented	
79	Use of scissors i e use both righty and left scissors difficulty using them	
158	The use of scissors, for example: the left hand and right-handed scissors are used to use their difficulties	

**The chat box for doing brainstorming with participants**

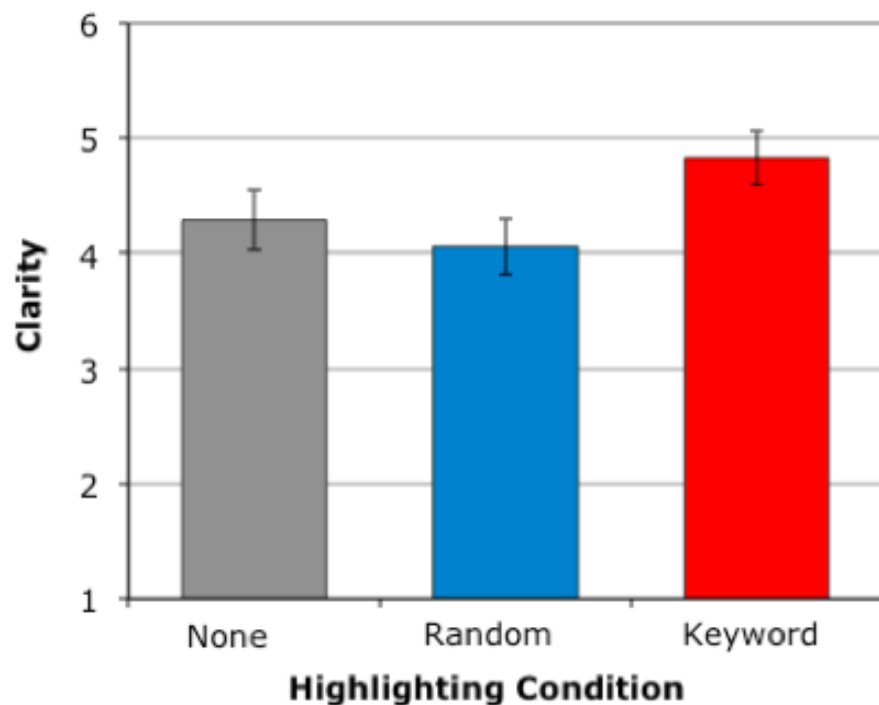
**The chat box for sending out the selected idea**

Send

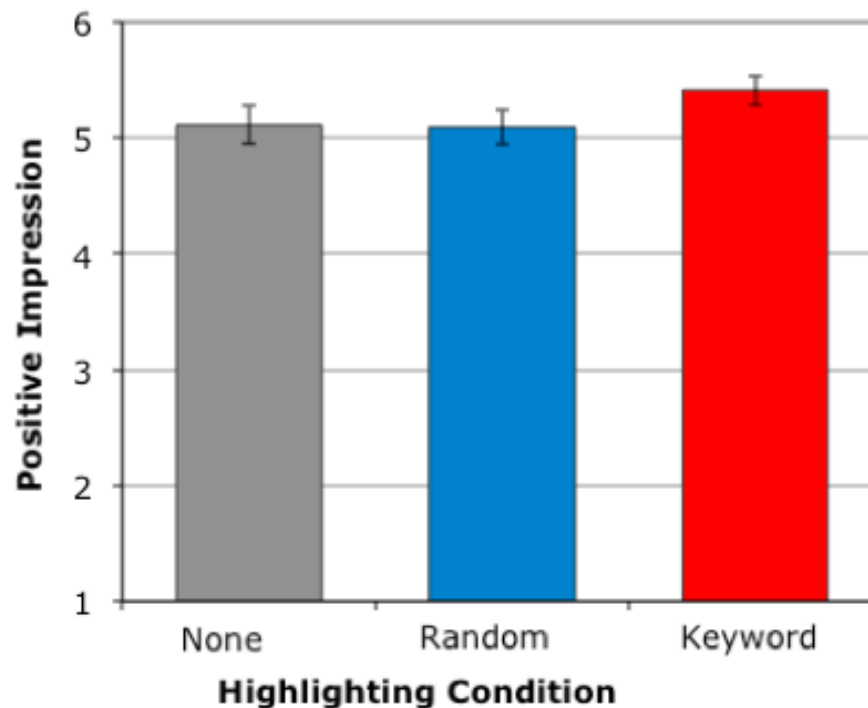
[Gao, Wang, Cosley, Fussell, CHI 2013]



# Effects of Highlighting on MT Comprehension



**Figure 4. Mean clarity ratings by highlighting condition (error bars represent standard errors of the mean).**



**Figure 6. Mean impressions of partner by highlighting condition (error bars represent standard errors of the mean).**

[Gao, Wang, Cosley, Fussell, CHI 2013]

# Effects of Interface Interactivity on Collecting Language Data to Power Dialogue Agents

Hao-Chuan Wang, Tau-Heng Yeo, Hsin-Hui Lee, Ai-Ju Huang

**National Tsing Hua University, Hsinchu, Taiwan**

Jia-Jang Tu, Sen-Chia Chang

**Industrial Technology Research Institute, Hsinchu, Taiwan**



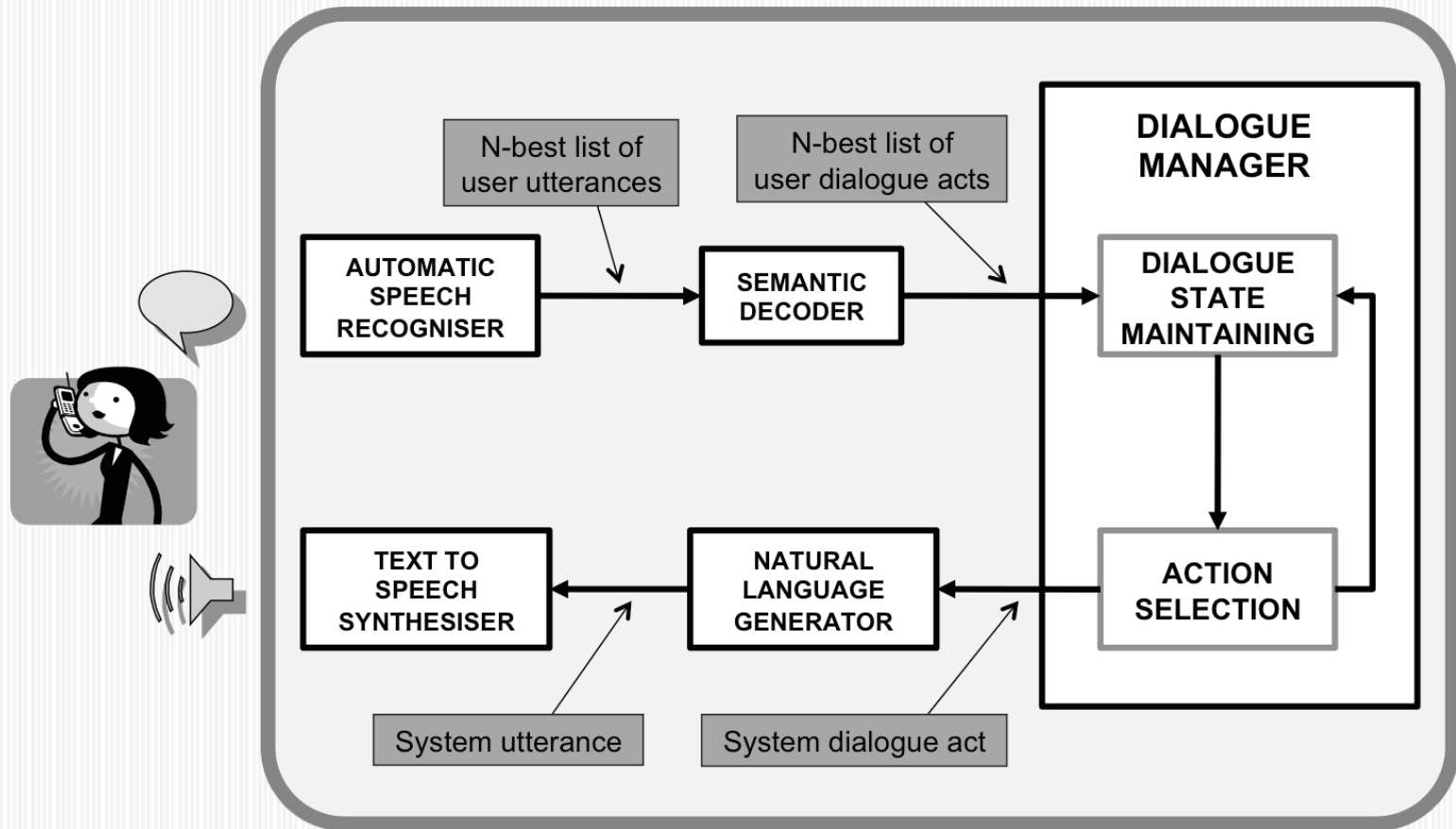
A man with short brown hair, wearing a dark blue or black button-down shirt, is seated at a table. He is holding a white mug with both hands. The background is slightly blurred, showing other people and what appears to be a restaurant or cafe setting. Overlaid on the image is a semi-transparent dark brown rectangular box containing three lines of white text.

“What’s the top-grossing movie in  
2012?”

“Let me see... The Avengers.”

“The top-grossing movie in 2012  
is The Avengers”

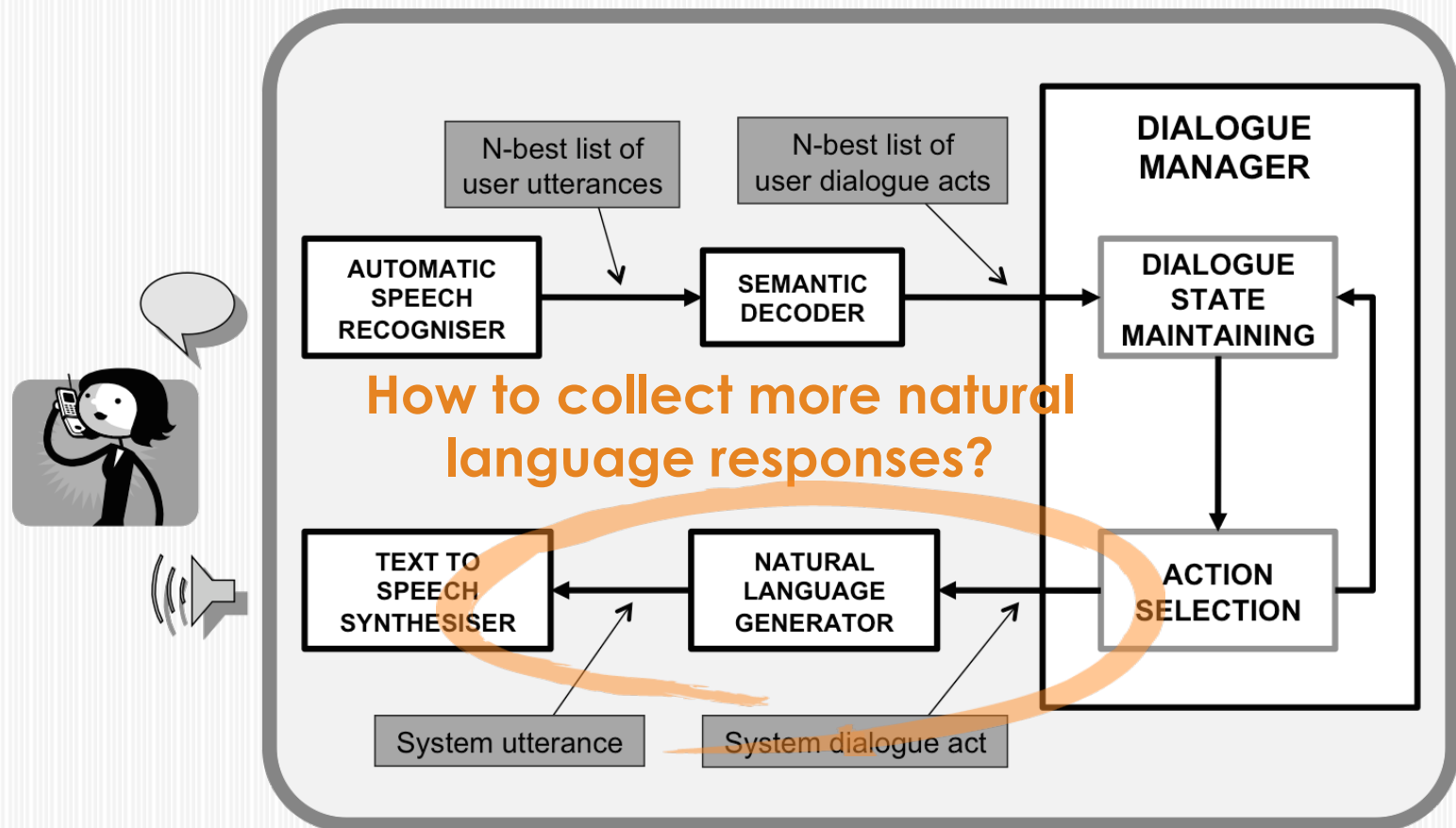
# Spoken Dialogue Systems



Young, S., Keiser, S. & Gašić, M. Spoken Dialogue Management using Partially Observable Markov Decision Processes

- ChiCHI 2014 | Effects of Interface Interactivity on Collecting Language Data to Power Dialogue Agents

# Language Generation Task



Young, S., Keiser, S. & Gašić, M. Spoken Dialogue Management using Partially Observable Markov Decision Processes


- ChiCHI 2014 | Effects of Interface Interactivity on Collecting Language Data to Power Dialogue Agents

# Some Existing Methods

- One-on-one interviews to get the responses from people
  - Manual data collection.
  - Expensive.
- Using surveys with specific instructions, *“Imagine that you’re answering people’s questions ...”*
  - Less expensive.
  - Non-interactive, “imagined interaction”.

# Idea: Using an Interactive Chat Bot to Elicit Natural Responses


You might need this



**Pacific Rim**

When legions of monstrous creatures, known as Kaiju, started rising from the sea, a war began that would take millions of lives and consume humanity's resources for years on end. To combat the giant Kaiju, ... more »


STARRING: Charlie Hunnam, Charlie Day, Idris Elba, Rinko Kikuchi



**World War Z**

On an ordinary day, Gerry Lane and his family find their quiet drive interrupted by urban gridlock. An ex-United Nations investigator, Lane senses that this is no ordinary traffic jam. As police helicopters buzz the ... more »

STARRING: Brad Pitt, Mireille Enos, James Badge Dale, Anthony Mackie



**Monsters University**

Mike Wazowski and James P. Sullivan are an inseparable pair, but that wasn't always the case. When these two mismatched monsters met they couldn't stand each other. This is the story of how Mike and ... more »

STARRING: Billy Crystal, John Goodman

This study is very simple. I'll ask you several questions.

At the same time, some information related to the question will show on the screen.

You can answer the question in your own way according to the information.

It's like you are chatting with your friends.

ok

Let's do some simple exercises.

What animal is showing on the screen?

kitten

If there isn't any problem, let's start!

ok

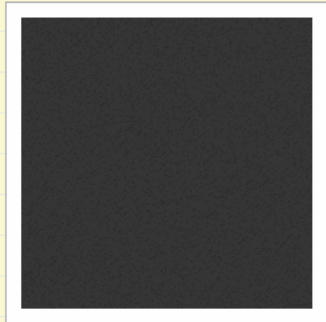
I want to find the latest movie starring Brad Pitt. Can you tell me which is it?

Cindy is typing .

|

- ChiCHI 2014 | Effects of Interface Interactivity on Collecting Language Data to Power Dialogue Agents
-

You might need this



### Anthropomorphic features:

- ✓ Greet workers
- ✓ Simulate human typing delays
- ✓ Wait for response

Hello! :)

Thanks for joining this study.

hello

This study is very simple. I'll ask you several questions.

At the same time, some information related to the question will show on the screen.

You can answer the question in your own way according to the information.

It's like you are chatting with your friends.

ok|

# Static Interface

Hello! Thanks for answering this questionnaire. This questionnaire is very simple. I'll ask you several questions. At the same time, some information related to the question will show on the right of the screen. You can answer the questions in your own way according to the information.

What animal is showing on the right of the screen?



I kind of want to watch "Transformer". How are the reviews of this movie?

## Transformers (2007) - User Reviews

YAHOO! USERS:

★★★★☆ 99,574 ratings

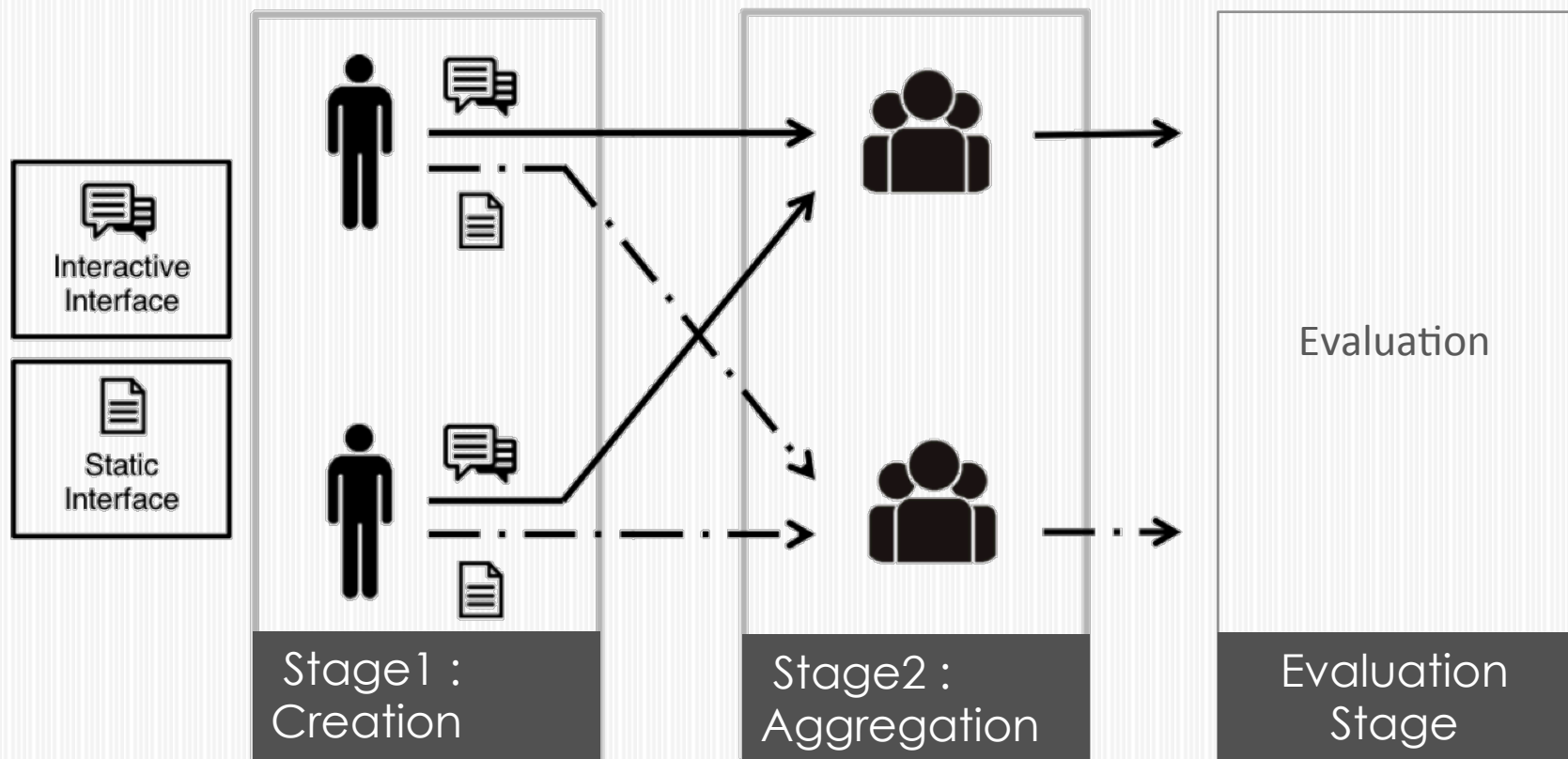
10520 USER REVIEWS

[Transformers....A must see](#)

RATING: ★★★★★



# Crowdsourcing Answer Generation



Compare  
interactive and  
static interface

Crowdsourcing  
to select quality  
responses

Evaluate the  
results with end  
users



# Multilingual Crowdsourcing Study

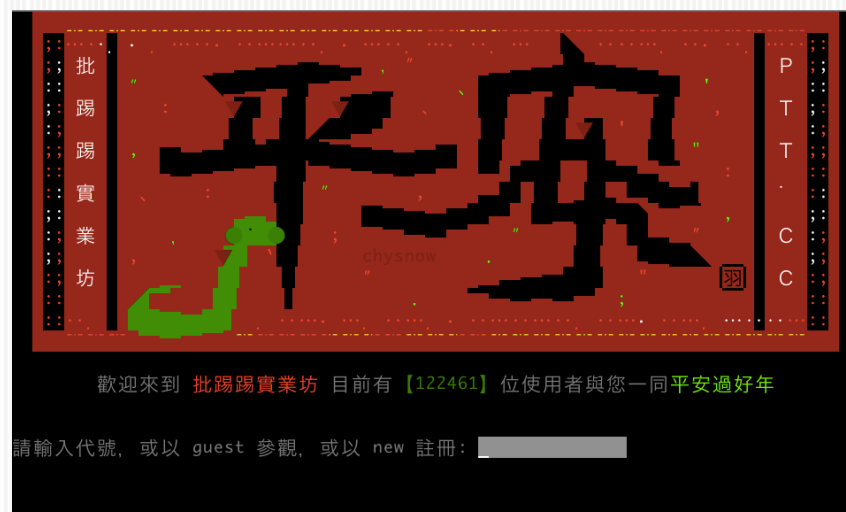
Chinese and English versions of ads and task instructions are prepared for crowdsourcing

MTurk



PTT

A BBS System and Online Community in Taiwan



## **Stage 1 : Answer Creation**

- 223 workers
  - 122 from MTurk
  - 101 from PTT

## **Stage 2 : Answer Aggregation**

- 222 workers

## **Evaluation**

- 165 workers
  - 98 from Mturk
  - 67 from PTT

# Key Results

...

- ChiCHI 2014 | Effects of Interface Interactivity on Collecting Language Data to Power Dialogue Agents

Hua Univ

# Interactive vs. Static Interface

- 73.6% of comments show preference for working with the interactive chat bot.
- Increasing the satisfaction of workers (Kittur, A., et al. 2013)

# Interactive vs. Static Interface

“Chat is much fun and more likely to make me think, while questionnaire is more standardized, like an exam.”

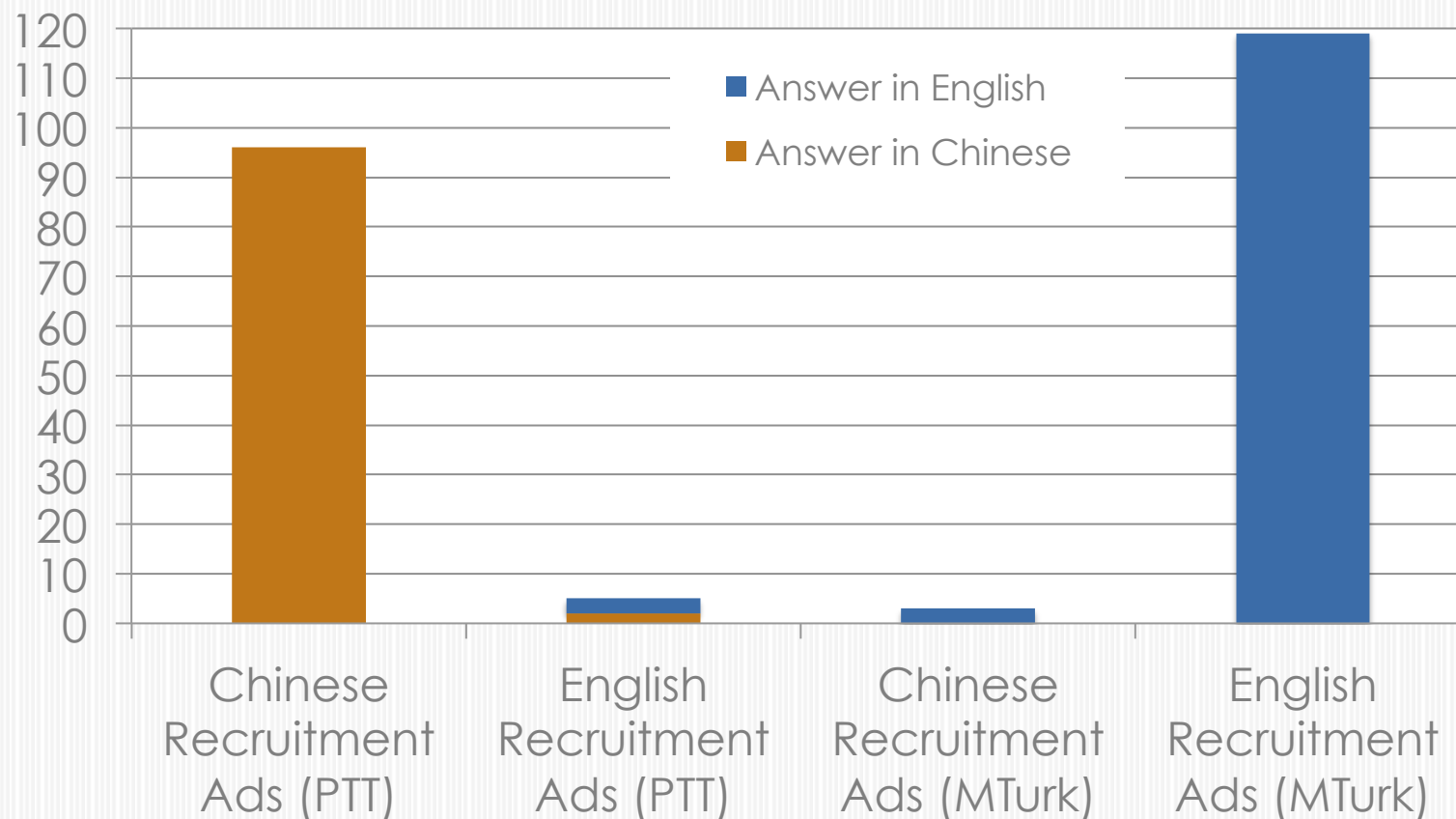
“the chat interface is much better. it recognizes the text entered in real time and responds accordingly with artificial intelligence and recognition. very nice”

# Interactive vs. Static Interface

- 73.6% of comments show preference for working with the interactive chat bot.
- Increasing the satisfaction of workers (Kittur, A., et al. 2013)

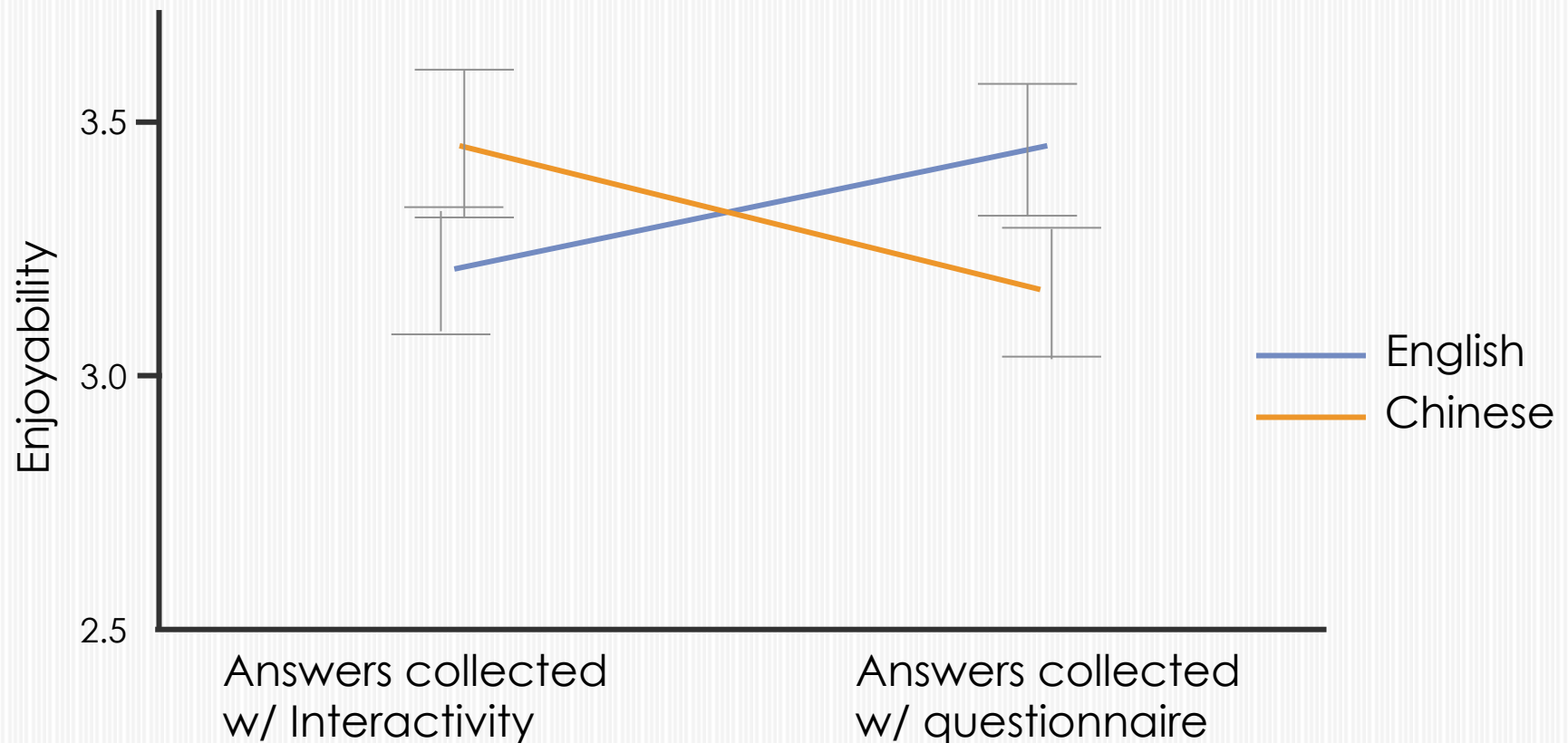
# Mturk vs. PTT : Language

- Two platforms are highly language-specific.





# Evaluation: Ultimate User Experience



- Cultural Differences.  
(Nisbett, R., 2003 & Hall, E. T., 1977).

# Conclusion

- Present an interactive chat bot-based interface for crowdsourcing language generation tasks for building natural dialogue agents.
- Interactivity leads to higher worker satisfaction, and better perceived enjoyability by Chinese-speaking users.
- Also, identified language specificity of crowdsourcing platforms. Helps to inform crowdsourcing practices.

# Ultimate Goal? Mind-Connecting!



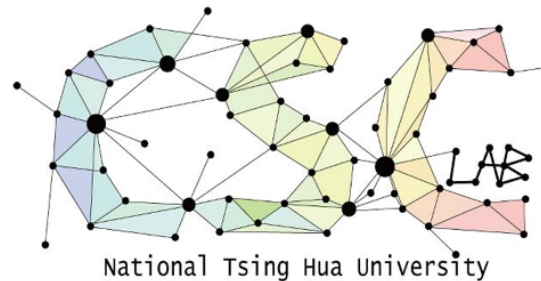
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清華大學人機合作與社群運算實驗室

NTHU Collaborative and Social Computing Lab (CSC Lab)