Evaluating TUIs

Approaches for novel interfaces
Lecture Outline

- Quantitative evaluation of TUIs: Pico [Patten & Ishii, 2007]
- Multiple and heterogeneous interpretations [Sengers & Gaver, 2006]
- Research through design [Zimmerman et al., 2007]
- More examples
Evaluating Tangibility

Studies of TUI in the cellphone tower placement task

[Patten and Ishii, 2007]
PICO

[Patten & Ishii 2007]
**Epistemic Action**

Users change their environment to search for the best solution or strategy to perform a task.

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**Pragmatic Action**

Action taken to actually perform the task.

[Kirsh and Maglio, 1995]
PICO Study  [Patten & Ishii, 2007]

- 15 participants, within-subject study
- Position the towers to reach an optimal coverage under 4.5 minutes
Hypotheses [Patten & Ishii, 2007]

**H1**: Users will shift their control between objects more often in the Pico condition than with the screen based condition.

**H2**: Users will shift their control between objects more often in the Pico condition than in the Pico without actuation condition.

**H3**: Users will constrain the motion of pucks more in the Pico case than the screen case.
Task Completed [Patten & Ishii, 2007]

- 15 participants, within-subject study
- Position the towers to reach an optimal coverage under 4.5 minutes
Tuesday Week 14: Evaluating TUIs

Theory and Practice of Tangible User Interfaces

- Evaluating TUIs

- Objects per second

- Completed task: 0.2 objects per second
- Did not complete: 0.1 objects per second
Any Thoughts?
I/O Brush
[Ryokai, Marti, & Ishii, 2004]
Control Condition?
Staying Open to Interpretation
Engaging Multiple Meanings in Design and Evaluation

[Sengers & Gaver, 2006]
Design as Communication

Design is a conversation between designer and user, even though the designer is no longer present once the user enters the scene.

[Norman, 2004]
Design as Communication

Design is a conversation between designer and user, even though the designer is no longer present once the user enters the scene.

[Norman, 2004]
Levels of Interpretations

**High level**: “What does it mean to me, my social group, my society, my culture?” (social & cultural)

**Mid level**: “What activities is it appropriate for?”
“What role can it play in my everyday life?”

**Low level**: “Is this a button?”
“What does this button do?”
“How do I do this task?”

[Sengers & Gaver, 2007]
Open to Interpretations

“No single one of these perspectives may necessarily be ‘correct;’ instead, all may be useful in highlighting aspects of how systems will be understood, be used, and find roles in individual’s and community’s lives.” [Sengers & Gaver, 2006]
License to Interpret

Let individual users define their own meanings for them, rather than merely accept those imposed by designers.

Let people play a substantial role in determining the meaning of systems. This implies that they will be actively engaged in the process of understanding both the system and its context of use.

[Sengers & Gaver, 2006]
Meaning Making Process

Design shifts from deciding on and communicating an interpretation to supporting and intervening in the processes of designer, system, user, and community meaning-making.

[Sengers & Gaver, 2006]
Open to Interpretations

1. Specifying clearly usability without constraining use.
2. Supporting a space of interpretations around a topic.
3. Stimulating reinterpetations by blocking expected ones.
4. Unfolding new opportunities for interpretation.
5. Making space by downplaying system authority.
6. Thwarting any consistent interpretation.

[Sengers & Gaver, 2006]
Open to Interpretations

1. Specifying clearly usability without constraining use.

[Sengers & Gaver, 2006]
Open to Interpretations

2. Supporting a space of interpretations around a topic.

[Sengers & Gaver, 2006]
Open to Interpretations

3. Stimulating reinterpretations by blocking expected ones.

[Sengers & Gaver, 2006]
Traces [Penny et al., 2001]

**Open to Interpretations**

4. Unfolding new opportunities for interpretation.

[Sengers & Gaver, 2006]
LeafView [White et al., 2007]

**Open to Interpretations**

5. Designs can make space for user re-interpretation by downplaying the system’s authority.  [Sengers & Gaver, 2006]
Open to Interpretations
6. Designs that thwart any consistent interpretation.
[Sengers & Gaver, 2006]
Evaluation Techniques

Instead of asking “Did the preferred interpretation take hold with users?” ask “How many different interpretations does a particular ‘blank canvas’ generate, and why?” or “Do users feel both stimulated and empowered to develop their own interpretations?”

[Sengers & Gaver, 2006]
Evaluation Techniques

Dynamic Feedback [Boehner & Gay, 2005]

When using dynamic feedback, whatever information is collected about or from users is also given back to users to interpret.

Affector [Sengers et al., 2004]
Evaluation Techniques

Multiple, Potentially Inconsistent Assessments

Key Table [Equator IRC]
Research through Design

Method for Interaction Design Research in HCI

[Zimmerman et al., 2007]
Evaluation Techniques

1. Process
2. Invention
3. Relevance
4. Extensibility

[Zimmerman, 2007]
1. Process

“The rigor applied to the methods and the rationale for the selection of specific methods. In documenting their contributions, interaction design researchers must provide enough detail that the process they employed can be reproduced. In addition, they must provide a rationale for their selection of the specific methods they employed.”

[Zimmerman et al., 2007]
2. Invention

“Interaction design researchers must demonstrate that they have produced a novel integration of various subject matters to address a specific situation. An extensive literature review must be performed that situates the work and details the aspects that demonstrate how their contribution advances the current state of the art in the research community.”

[Zimmerman et al., 2007]
Vision of the Future Project [Philips, 1995]

Process • Invention • Relevance • Extensibility
3. Relevance

“The work must be documented in such a way that peers can reproduce the results. Also articulate the preferred state their design attempts to achieve and provide support for why the community should consider this state to be preferred. Without this critical component, a research through design approach appears to be a self-indulgent, personal exploration that informs the researcher but makes no promise to impact the world.”

[Zimmerman et al., 2007]
4. Extensibility

The design research should be described and documented in a way that the community can leverage the knowledge derived from the work.

[Zimmerman et al., 2007]
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- Process
- Invention
- Relevance
- Extensibility
Tuesday Week 14: Evaluating TUIs

Theory and Practice of Tangible User Interfaces
Invention?
Tools for both Picking up and Painting

- **Fine control**
  - Painter™
  - Photoshop™ / Illustrator™
  - ImageSprayer™ (Corel™)

- **Coarse control**
  - KidPix™
  - Pixter™ (Fisher Price)
  - "Easel"
    (Rozin, 1999)

- **N/A**
  - “Preset inks”
  - Syaraku™ (Fuji Xerox™)
  - Colortron™
    Digital Cameras
  - “Personalized inks”
Tools for both Picking up and Painting

Fine control

Coarse control

N/A

Painting

"Preset inks"

"Personalized inks"

I/O Brush

"Easel"

(Frozen, 1999)

"Preset inks"

"Personalized inks"

Tools for both Picking up and Painting

Painter™

Photoshop™ / Illustrator™

ImageSprayer™ (Corel™)

KidPix™

Pixter™

(Fisher Price)

Syaraku™

(Fujixerox™)

Colortron™

Digital Cameras

(Covered™)

I/O Brush

Picking Up
Design Process?
Design Evolution of the I/O Brush system

fall 2003 | summer 2004 | current
I/O Brush Modes

Texture

Color

Movement
I/O Brush Modes

Texture     Color     Movement
I/O Brush Modes

Texture

Color

Movement
I/O Brush Modes

Texture

Color

Movement
1st I/O Brush at Kindergarten
1st I/O Brush at Kindergarten

2003

2004

current
1st I/O Brush at Kindergarten

2003
2004
current
1st I/O Brush at Kindergarten
2nd I/O Brush at Ars Electronica
2nd I/O Brush at Ars Electronica
2\textsuperscript{nd} I/O Brush at Ars Electronica
Final Design
I/O Brush System

I/O Brush

Canvas
with history

Palette

2003

2004

current
Final Design
I/O Brush System

2003
2004
current

I/O Brush System
Canvas with history
Palette
Final Design
I/O Brush System

I/O Brush

Canvas with history

Palette
Final Design
I/O Brush System

Canvas with history

5 sec of video and audio
Final Design
I/O Brush System

5 sec of video and audio
5-week study in kindergarten classroom

• How do children use the tool for their creations?
• How do children’s expressions change over time?
• How does the tool influence the way they interact with the world?
Mastery of Tool?
Mastery of Tool
Mastery of Tool
Mastery of Tool
Open to Multiple Interpretations?
Multiple Interpretations
Multiple Interpretations

Supporting different styles – “Visualizers” [Gardener, 1982]
Tuesday Week 14: Evaluating TUIs

Theory and Practice of Tangible User Interfaces
Multiple Interpretations
Supporting different styles – “Dramatizers” [Gardener, 1982]
Multiple Interpretations
Supporting different styles – “Dramatizers” [Gardener, 1982]
Multiple Interpretations
Supporting different styles – “Dramatizers” [Gardener, 1982]
Exploring the Environment
Evaluation with Kindergarteners

- Mastery of tools
- Sharing and explaining their work with peers
- Supporting various styles of expressions (e.g. “visualizer,” “dramatizer”)
Summary

• Consideration of multiple heterogeneous interpretations, as opposed to a single authoritative interpretation.

• Evaluations sensitive to people’s interpretations could take a long time. It is an iterative process of observing, designing, testing, and redesigning.

• Use these criteria as lenses that guide you in evaluating the success of your design.
Your Final Project

- Your final project write up (4-6 pages) in ACM SIGCHI Extended Abstract format: http://www.chi2008.org/chi2008extendedabstracts.doc

- Your final project presentations on Thursday December 6th and Tuesday December 11th.

- We are available during our office hour and by appointment.

- Please ask early about resources.
Thanks!