What kind of ‘partnership’?

Take a taxi

Driver in control
What kind of ‘partnership’?

Take a taxi
  Driver in control

Drive a motorcycle
  User in control
What kind of ‘partnership’?

Take a taxi
  Driver in control

Drive a motorcycle
  User in control

Ride a horse
  Shared control
Towards generative theory

Define principles of a unified theory of interaction

Instrumental Interaction
Reification
Polymorphism
Reuse
Substrates

Reciprocal Co-Adaptation

* with Michel Beaudouin-Lafon
Natural Sciences: deduction

Theory → model → new model → revised model

Empirical studies → observation → evaluation → re-evaluation

HCI, Natural Science and Design: A Framework for Triangulation Across Disciplines
Natural Sciences: induction

Theory

Model

New model

Revised model

Empirical studies

Observation

Evaluation

Re-evaluation


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All natural sciences are cyclic

Theory → model → new model → revised model

Empirical studies → observation → evaluation → re-evaluation


HCI, Natural Science and Design: A Framework for Triangulation Across Disciplines
What about engineering and design? We study what we create.


HCI, Natural Science and Design: A Framework for Triangulation Across Disciplines
Multi-disciplinary research

Theory → model → new model → revised model

Engineering and design → prototype → system

Empirical studies → observation → evaluation → re-evaluation

HCI, Natural Science and Design: A Framework for Triangulation Across Disciplines
Levels of theoretical power

Describe → Predict → Control → Generate
Theory, Empirical studies and Design

Natural Sciences: Study a natural, existing phenomenon
  Deductive: Theoretical predictions to empirical verification
  Inductive: Empirical findings to theoretical implications

Design: Create a novel artifact
  Top-down: Create architecture then build system
  Bottom-up: Design artifacts then derive architecture

HCl research: Natural phenomena – and – designed artifacts
Methodology trade-offs

Types of settings:
I. Settings in natural systems
II. Contrived or created settings
III. Contrived or created settings
IV. No behavior observation needed

Major concern is:
A. Generality over actors
B. Precise measure of behavior
C. System character of context

Runkel & McGrath, 1972
Perspectives on understanding users

**Scientific perspective**
- Collect data about users
- ‘Objective’ analysis
- Inform designers

**Engineering perspective**
- Address a given problem
- Make trade-offs
- Ensure it works *in situ*

**Design perspective**
- Inspire ideas
- Redefine problem
- Generate innovations
HCI Design Trade-offs

Simple things should be simple, complex things should be possible.

powerful expression versus simple interaction

power

simplicity
Research challenge: how to shift the curve?
Towards generative theory

Define principles of a *unified theory of interaction*

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Generative power: Three design principles

Reification
extends the notion of what constitutes an object

Polymorphism
extends the power of commands with respect to these objects

Reuse
provides a way of capturing and reusing interaction patterns
Physical tools have affordances
Physical tools have affordances we can improvise ...
Physical tools have affordances
we can improvise ...
Physical affordances

any object can become an instrument
any instrument can solve multiple problems

Why isn’t software like this?
Our relationships with tools

Physical tools: follow the laws of physics
users can easily learn them
users can appropriate them

Computer tools: follow the whims of programmers
users must learn and relearn them
users easily break them

Goal: make interaction a first-class computational object
Software tools

Example: Powerpoint
Alignment and distribution
= Cumbersome buttons and pull-down menus
StickyLines: Use key principles to

Reify:
  alignment
distribution
‘tweaks’
creating a StickyLine and snapping objects to it
Towards generative theory

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* with Michel Beaudouin-Lafon
Webstrates

Any web document (HTML) served by the Webstrates server is shared by everyone who looks at it in a regular web browser. Any changes are immediately visible to everyone. Unlike Google Docs:

- Create your own editor (just a doc) with own tools (ditto)
- Edit the same doc with your personal editor and tool
Webstrates

Shareable dynamic media:
- **malleable** by users, who appropriate them
- **shareable** among users, who collaborate on them
- **distributable** across diverse devices and platforms

Users interacts with one document, with personal editors
Towards generative theory

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Reciprocal Co-Adaptation

* with Michel Beaudouin-Lafon
How we interact with computers

Computer as *tool*
Empower users

Computer as *servant*
Delegate tasks

Computer as *medium*
Communicate

Human-Computer Interaction

Artificial Intelligence

Mediated Communication
Human-Computer Partnerships

Combine:
  computer as a tool
to augment human capabilities
and
  computer as a servant
to take over certain tasks

Keep the user in control
Competing perspectives

Human-in-the-loop

Machine learning perspective:
Human is *input to the algorithm*
‘human-in-the-loop’?
Competing perspectives

Human-in-the-loop

Machine learning perspective:
Human is *input to the* **algorithm**

Computer-in-the-loop

HCl perspective:
Algorithm is input to *inform the* **user**
Human-Computer Partnerships

Instead of just creating models of users to inform the system!

Shouldn’t we create models of the system to inform the user?

Together, they can create effective human-computer partnerships
Reciprocal Co-adaptation

People adapt their behavior to technology
  ... they learn it
People adapt the technology for their own purposes
  ... they appropriate it

Computers adapt their behavior to people
  ... machine learning
Computers modify human behavior
  ... training (or persuasion)
Human-Computer Partnerships

People *adapt to* technology they *learn* it
*adapt* the technology they *appropriate* it

Discoverability

Appropriability

Expressivity
Smart phones are easy to use

... but interaction is more limited
Why can’t users learn to ‘play’ phones?

Users should be able to progress from novice to virtuoso.
Towards generative theory*

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Reciprocal Co-Adaptation

* with Michel Beaudouin-Lafon
Discoverability

How can I learn which gesture executes which command?
Octopocus

Experts just perform the gesture

Bau & Mackay, UIST’09
Octopocus

Experts just perform the gesture
Novices **pause** . . .
and the Octopocus guide appears

Bau & Mackay, UIST’09
Octopocus

Progressive feedforward

What gestures are available?

Progressive feedback

What did the system recognize?

Bau & Mackay, UIST’09
Inking the 'Help' command
How can I create my own gesture commands?
Fieldward

To create your own gesture commands, they must be:

- easy for you to remember

Malloch, Griggio, McGrenere & Mackay CHI’17
Fieldward

To create your own gesture commands, they must be:
- easy for you to remember
- easy for the system to recognize

Malloch, Griggio, McGrenere & Mackay CHI’17
Fieldward

Draw a gesture

If it ends in a red zone
the gesture already exists

If it ends in a blue zone
you have a new gesture!

Malloch, Griggio, McGrenere & Mackay CHI’17
Fieldward

(set timer)
How can I access the phone’s power... simply?
CommandBoard

Transform the space above a soft keyboard into a command input space

Offers the power of a command-line interface on a mobile phone

Alvina, Griggio, Bi & Mackay UIST’17
CommandBoard

Type ‘doodle’
then ‘execute’ gesture ^
Launches ‘doodle’
CommandBoard

Type ‘doodle’
    then ‘execute’ gesture ^
Launches ‘doodle’

Type ‘color’
    then select a color

Alvina, Griggio, Bi & Mackay UIST’17
Commandboard

Use progressive feedforward to **discover** strike-through command

Alvina, Griggio, Bi & Mackay UIST’17
Commandboard

Use progressive feedforward to

discover strike-through command

When you know the gesture
you just draw it

I slept through—loved the lecture

Alvina, Griggio, Bi & Mackay UIST’17
Expressivity

How can I generate expressive output?
Human expression vs. Machine classification

Machine learning algorithms:
  Goal is to classify the correct word
  Human variation is treated as noise
Gesture typing algorithms are great . . .

Four ways to input the word “great”

All produce the identical result: great
Expressive Keyboard vs. Machine classification

Machine learning approach
Classify the correct word
Remove human variation

Our approach
Transform human variation into expressive output
color, emojis, typography ...

Alvina, Malloch & Mackay CHI’16
Expressive Keyboard
Expressive Keyboard – measure variation

great great

normal, curvy, constant speed

Expressive Keyboard

mapping

recognizer: what word?

feature analysis

color

“great”

rich gesture

speed: 2x
Expressive Typography

Vary fonts for different audiences, goals and contexts

Dynamic typography plain style
Dynamic typography plain style
Dynamic typography informal style
Dynamic typography kids style
Dynamic typography spread style
Dynamic typography elegant style
Dynamic typography scripte style
Human-Computer Partnerships

Discoverability

Appropriability

Expressivity
Human-computer partnerships like these?

Discover  Appropriate  Express
Thank you!

Wendy E. Mackay

Inria, Université Paris-Saclay
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