Reaching Out

Options for Sustainability Research in Human-Computer Interaction, 2014–

M. Six Silberman

1. Sustainability, HCI, and sustainable HCI

2. What have we learned in sustainable HCI?

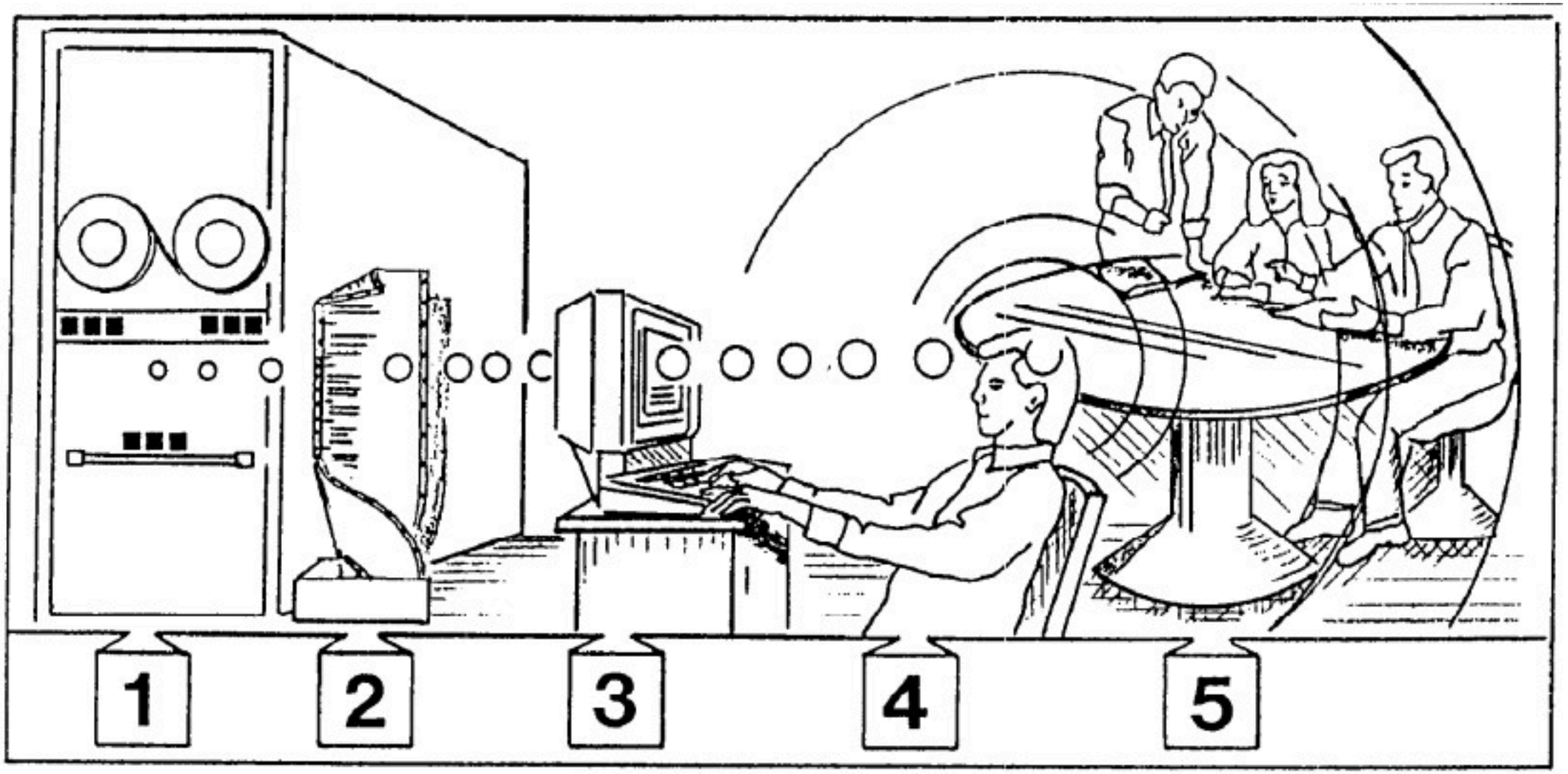
3. Reaching out

1. Sustainability, HCI, and sustainable HCI

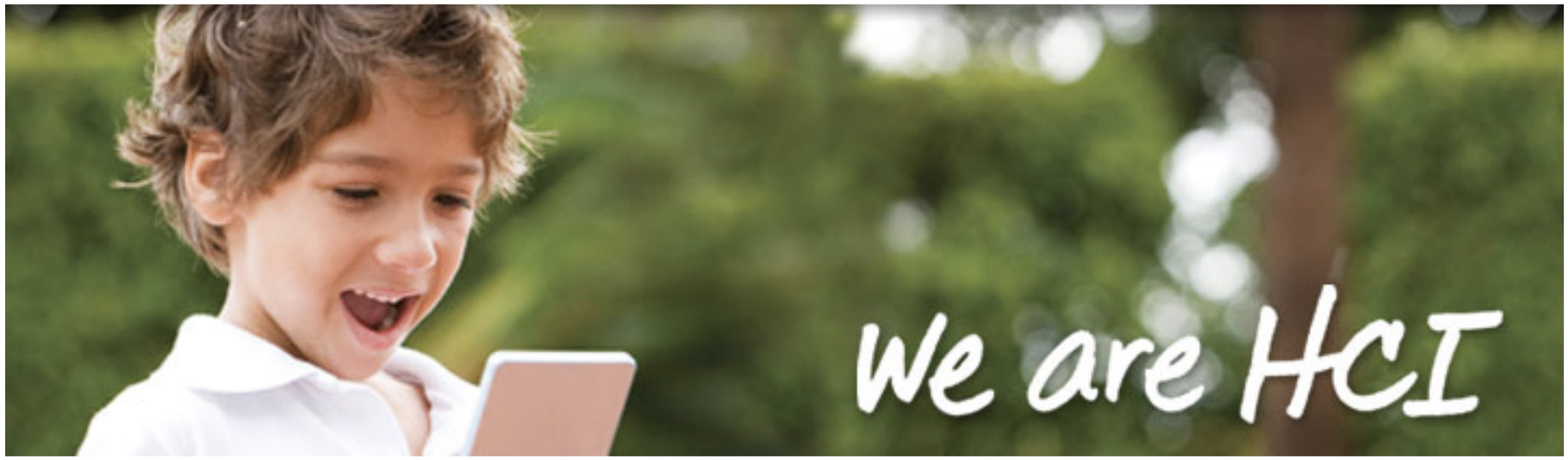
climate change
sea level rise
degradation of ecosystems and their services
biodiversity loss / sixth mass extinction
loss of arable land
freshwater and food scarcity
deforestation
desertification
ocean acidification
peaking oil production
rising energy costs

geography
ecology
climate science
earth systems science
global environmental change research
environmental psychology
ecological economics
social ecology
environmental policy
ecosystem management
social-ecological systems
coupled human-natural systems

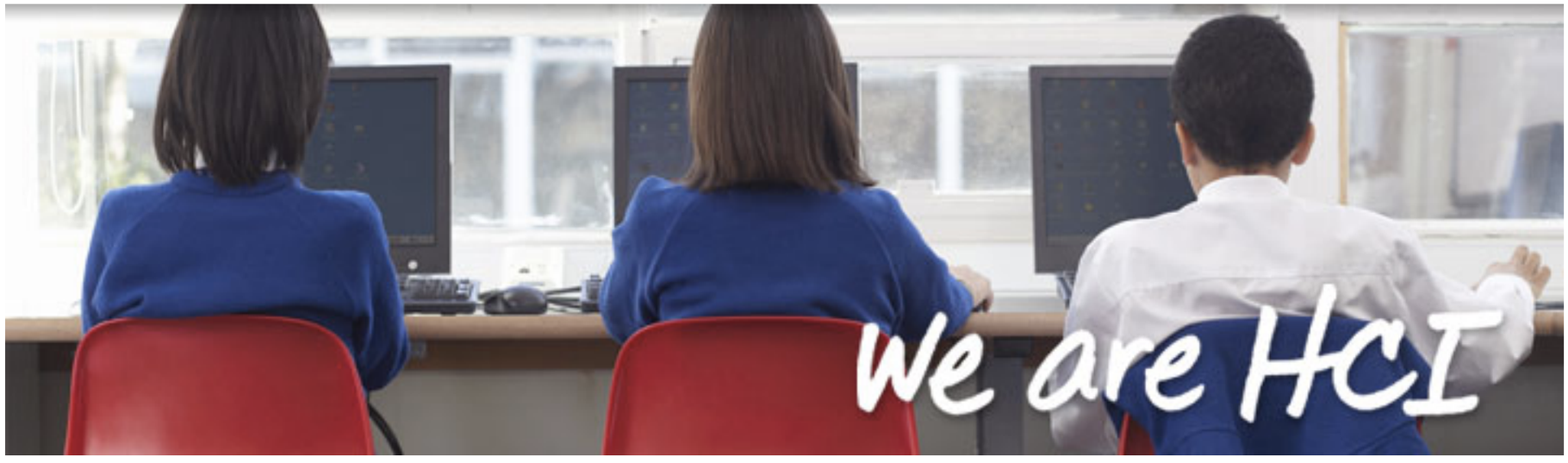
stabilize population numbers
improve health
provide water and sanitation
intensify agriculture and food security
modify consumption
create sustainable cities
maintain biodiversity
clean air and water
restore marine resources
increase resilience to disaster
reduce poverty in Africa
slow climate change
limit war, conflict, crime, and corruption

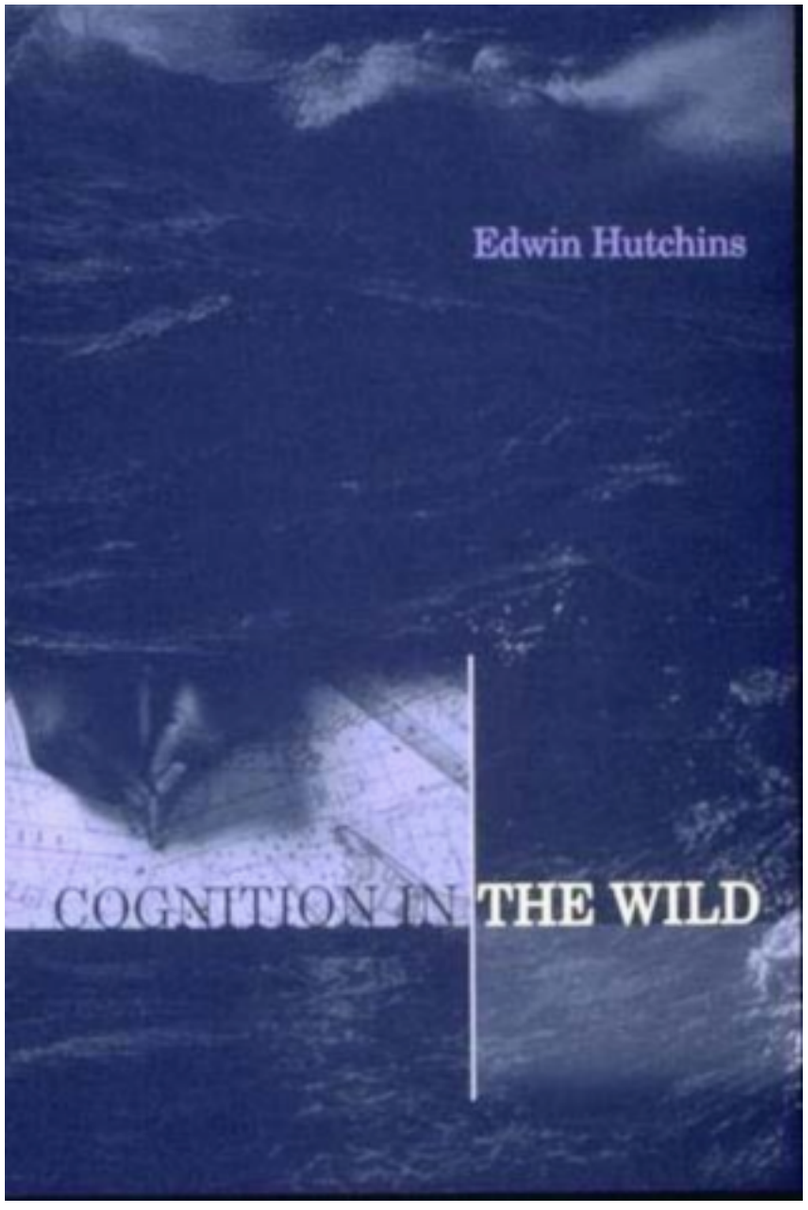


From Grudin, J., The computer reaches out: the historical continuity of interface design. *Proc. CHI 1990*: 261-268.

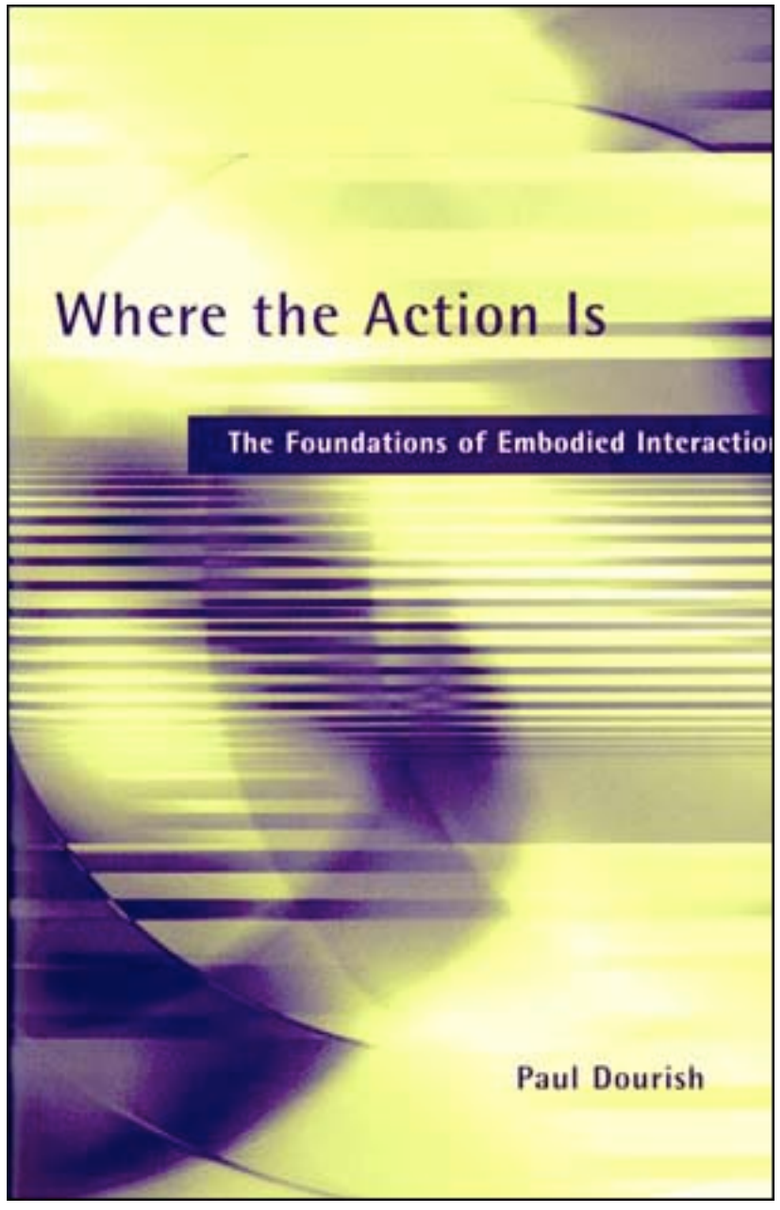

We are HCI


We are HCI


We are HCI



1995
distributed cognition
“second wave”



2001
phenomenology,
embodied interaction

2006
a “third wave” view on
activity theory

WHERE ARE U.S. ADULTS USING SMARTPHONES?

9% During sex

35% In a movie theater

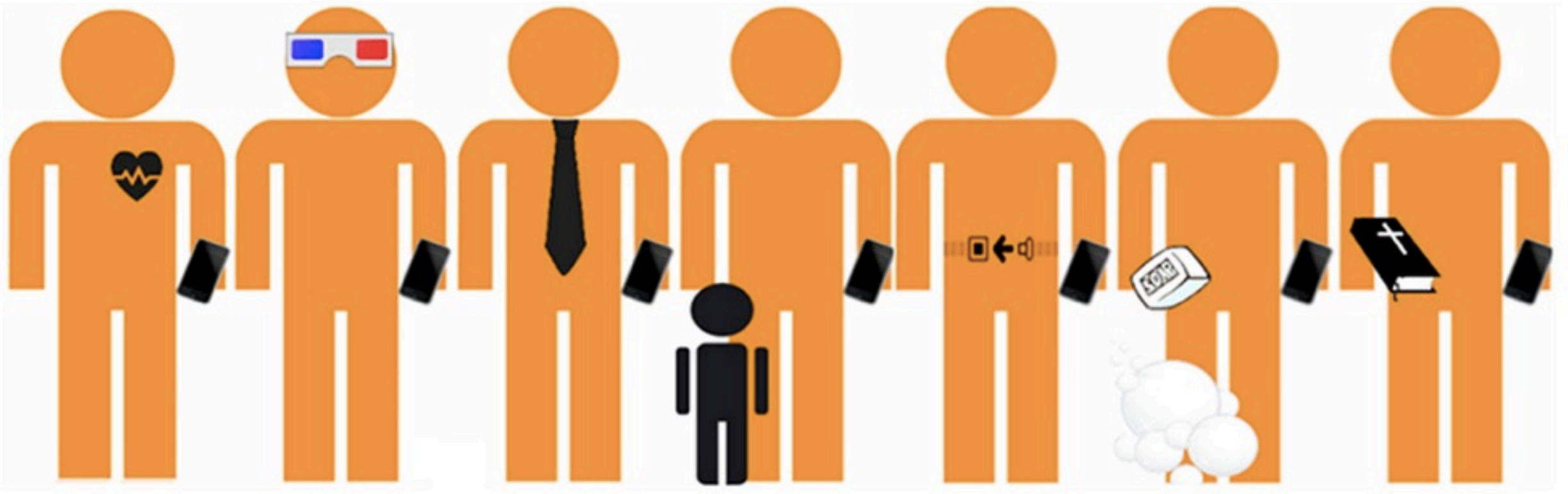
33% On a dinner date

32% At a child's/ school function

55% While driving

12% In the shower

19% In church/place of worship




We are HCI

[more attention to] disposal
salvage
recycling
remanufacturing for reuse
reuse as is
achieving longevity of use
sharing for maximal use
achieving heirloom status
finding wholesome alternatives to use
active repair of misuse
linking invention and disposal
promoting renewal and reuse
promoting quality and equality
de-coupling ownership and identity
using natural models and reflection

persuasive technology
ambient awareness [of resource consumption]
sustainable interaction design
formative user studies
pervasive and participatory sensing

“everyday practice” and practice theory
“the implication not to design”
“undesigning”
non-use
new energy systems (e.g., smart grid)
design fictions
calls to activism
design for large-scale social collapse
poverty and other economic constraints
rebound effects
more user and non-user studies
(e.g., farmers, “simple living” families)

2. What have we learned in sustainable HCI?

grapple seriously with the community's unresolved differences

find concrete ways to support work that builds on existing sustainability knowledge within and beyond HCI

find concrete ways for HCI to contribute to achieving sustainability

1. What is sustainability?
2. What do we know, from within and beyond HCI, about how sustainability might be achieved?
3. What crucial open questions remain?
4. How can HCI research help achieve sustainability?

5. How should HCI & Sustainability research be evaluated (e.g., is it possible or desirable to review papers in different genres with one coherent framework)?
6. How can the community use critiques of past work to develop new, more productive approaches?
7. How can we make better use of sustainability knowledge from outside HCI?
8. How can we encourage work that contributes substantively to practical efforts to achieve sustainability?

In this forum we highlight innovative thought, design, and research in the area of interaction design and sustainability, illustrating the diversity of approaches across HCI communities. — **Lisa Nathan and Samuel Mann, Editors**

Next Steps for Sustainable HCI

M. Six Silberman, University of California, Irvine, **Lisa Nathan,** University of British Columbia,
Bran Knowles, Lancaster University, **Roy Bendor,** University of British Columbia,
Adrian Clear, Lancaster University, **Maria Håkansson,** Chalmers University,
Tawanna Dillahunt, University of Michigan, **Jennifer Mankoff,** Carnegie Mellon University.

We want to change things for real, not just write papers.
—E. Eriksson, workshop participant

Six years after the workshop on "defining the role of HCI in the challenges of sustainability" [1], that role remains unclear. In 2010, DiSalvo, Sengers, and Brynjarsdóttir identified five distinct genres in sustainable HCI (SHCI). Between the genres, they found striking unintentional redundancy; significant but unexamined differences in assumptions, methods, and outputs; and little connection to sustainability work outside HCI [2]. Since 2010, SHCI has continued to grow, through, for example, accounts of everyday practices, rich connections to practice theory, discussion of "undesigning," design fictions, calls to activism, and speculations on large-scale social collapse. But we have done little so far to explicitly address the conceptual inconsistences in the field.

Motivated by this state of affairs, the SIGCHI HCI & Sustainability Community (HCI&S) held a workshop at CHI 2014 to "grapple seriously with the community's unresolved differences; find concrete ways to support work that builds on existing sustainability knowledge within and beyond HCI; and find concrete ways for HCI to contribute to achieving sustainability" [3]. The overarching question orienting discussion was: What have we learned in sustainable HCI? Organizers asked participants to consider eight questions:

- What is sustainability?
- What do we know, from within and beyond HCI, about how sustainability might be achieved?
- What crucial open questions remain?
- How can HCI research help achieve sustainability?
- How should HCI and sustainability research be evaluated (e.g., is it possible or desirable to review papers in different genres with one coherent framework)?
- How can the community use critiques of past work to develop new, more productive approaches?
- How can we make better use of sustainability knowledge from outside HCI?
- How can we encourage work that contributes substantively to practical efforts to achieve sustainability?

Drawing from insights revealed by the workshop discussion around these questions, here we focus on lessons and next steps.

Insights

→ Sustainability issues pose severe challenges for HCI business as usual.

→ In future work, we aim to: specify sustainability goals; consider longer time scales; draw from relevant work outside HCI; build, support, and shape systems in everyday use; and move beyond simple models to address the full complexity of sustainability problems.

WHAT HAVE WE LEARNED FROM SUSTAINABLE HCI?

Our six core lessons derived from the first seven years of SHCI research can be summarized briefly: *The issues indexed by the term* sustainability *pose severe challenges to existing HCI theories, methods, and institutional processes.* HCI "business as usual" is not well positioned to contribute substantively to efforts to address the challenges of sustainability. Specifically:

Refraining from articulating clear sustainability aims and metrics impedes assessment of our efficacy in contributing to sustainability. In response to the first four questions, most of the 23 participants rejected the idea that we could devise a single interpretation of sustainability to orient and evaluate all future SHCI research. The salience of diverse sustainability issues (related, for example, to energy, pollution, poverty, employment, water, climate, and ecosystem health) varies widely among the communities SHCI researchers work in and with. But we cannot assess our effectiveness at contributing to sustainability if we do not make clear what we mean by the term. Participants agreed that SHCI research should articulate clear study- or design-specific sustainability goals and metrics on a project-by-project basis, not restricted to HCI criteria such as usability, efficiency, or user satisfaction. SHCI researchers should also evaluate their work with sustainability criteria derived from relevant natural and social scientific research and the communities within which they work. Most, but not all, participants agreed that

We want to change things for *real*, not just write papers.

—Elina Eriksson, workshop participant

The issues indexed by the term “sustainability” pose severe challenges to existing HCI theories, methods, and institutional processes.

HCI “business as usual” is not well positioned the contribute substantively to efforts to address the challenges of sustainability.

1. Refraining from articulating clear sustainability aims and metrics impedes assessment of our efficacy in contributing to sustainability.

2. The processes that give rise to the issues indexed by the term "sustainability" are larger in time, space, organizational scale, ontological diversity, and complexity than the scales and scopes addressed by traditional HCI design, evaluation, and fieldwork methods.

3. Most sustainability-oriented work takes place outside HCI.

4. There is a great deal of research and practice outside and within HCI that does not explicitly address sustainability, but is relevant to sustainable HCI.

5. There is a tension between the historical focus on technological novelty in HCI and sustainability goals.

6. Thus far, sustainable HCI research has had little impact outside HCI.

Have clear goals and use them to evaluate

Consider longer time scales

Read outside HCI

Build systems people actually use

Move beyond consumer resource use to address larger scales and more topics

Get beyond simple models and face complexity

Collaboration is hard, especially across fields

The one-year publication cycle in computing rewards short-term projects

The blind, one-step review process in the CHI conference limits dialogue and learning and disincentivizes risk-taking

Getting support for socially engaged research from gadget-focused institutions, which are common in computing, is hard

The tension between sustainability and the aim of economic growth that supports and orients, if implicitly, the industry of which HCI is part.

The tension between the need to read broadly, think deeply, and collaborate widely and the need to act quickly.

The tension between respecting the values of users and preventing users from acting on values whose enactment harms others.

The relationship between technology and sustainable social change.

1. What is sustainability?
2. What do we know, from within and beyond HCI, about how sustainability might be achieved?
3. What crucial open questions remain?
4. How can HCI research help achieve sustainability?

In response to the first four questions, most of the 23 participants rejected the idea that we could devise a single interpretation of sustainability or orient and evaluate all future sustainable HCI research.

What is sustainability?

How might it be achieved?

How can HCI research contribute?

3. Reaching out

What is sustainability?

A sustainable system is one which survives or persists.

From Costanza, R. and B. C. Patten, Defining and predicting sustainability. *Ecological Economics* **15**(3): 193–196, 1995, p. 193.

But there are three complicating questions:

(1) **What system** or subsystems or characteristics of systems persist?

(2) For **how long**?

(3) **When** do we assess whether the system or subsystem or characteristic has persisted?

Sustainability can only be assessed after the fact [or predicted imperfectly beforehand]. One must look at systems and subsystems as hierarchically interconnected over a range of time and space scales. And each of these systems and subsystems has a necessarily finite life span.

From Costanza and Patten, Defining and predicting sustainability, p. 193.

The primary goals of a transition toward sustainability over the next two generations should be to meet the needs of a much larger but stabilizing [global] human population, to sustain the life support systems of the planet, and to substantially reduce hunger and poverty.

From National Research Council Board on Sustainable Development 1999, *Our Common Journey: A Transition Toward Sustainability*, p. 31.

meet human needs

provide food and nutrition
nurture children
find shelter
provide education
find employment

sustain the life support systems of the planet

ensure the quality and supply of fresh water
control emissions into the atmosphere
protect the oceans
maintain species and ecosystems

substantially reduce hunger and poverty

ensure income growth
provide employment opportunities
maintain essential safety net services

How might sustainability be achieved?

By changing institutions and infrastructures.

How do institutions and infrastructures change?

What are institutions and infrastructures?

Institutions are the prescriptions that humans use to organize all forms of repetitive and structured interactions including those within families, neighborhoods, markets, firms, sports leagues, churches, private associations, and governments at all scales.

From Ostrom, E., *Understanding Institutional Diversity*. Princeton University Press, 2005, p. 3.

Individuals interacting within rule-structured situations face choices regarding the actions and strategies they take, leading to consequences for themselves and for others.

The opportunities and constraints individuals face in any particular situation, the information they obtain, the benefits they obtain or are excluded from, and how they reason about the situation are all affected by the rules or absence of rules that structure the situation.

Further, the rules affecting one situation are themselves crafted by individuals interacting in deeper-level situations. For example, the rules we use when driving to work every day were themselves crafted by officials acting within the collective-choice rules used to structure their deliberations and decisions.

From Ostrom, *Understanding Institutional Diversity*, p. 3.

People commonly envision infrastructure as a system of substrates—railroad lines, pipes and plumbing, electrical power plants, and wires. It is by definition invisible, part of the background for other kinds of work.

From Star, S. L., The ethnography of infrastructure. *Am. Beh. Sci.* **43**(3): 377–391, 1999, p. 380.

"Infrastructure" generally conjures up the notion of a large-scale physical resource made by humans for public consumption. Standard definitions of infrastructure refer to the "underlying framework or foundation of a system." Familiar examples include (1) *transportation systems*, such as highway systems, railway systems, airline systems, and ports; (2) *communication systems*, such as telephone networks and postal services; (3) *governance systems*, such as court systems; and (4) *basic public services and facilities*, such as schools, sewers, and water systems.

From Frischmann, B. M., *Infrastructure: The Social Value of Shared Resources*. Oxford University Press, 2012, Ch. 1 (orig. emph.).

Infrastructure resources are shared means to many ends.

Infrastructure resources may be used as inputs into a wide range of productive processes.

Infrastructures generate significant positive spillovers (externalities) that result in large social gains.

From Frischmann, B. M., *Infrastructure*, Ch. 1 *and* Frischmann, B. M., An economic theory of infrastructure and commons management, 89 *Minn. L. Rev.* 917, 2005, p. 956.

For a railroad engineer, the rails are not infrastructure but topic. For the person in a wheelchair, the stairs and doorjamb in front of a building are not seamless subtenders of use [i.e., infrastructure], but barriers. One person's infrastructure is another's topic, or difficulty. Infrastructure is a fundamentally relational concept. Systems become real infrastructure in relation to organized practices. The cook considers the water system as working infrastructure integral to making dinner. For the city planner or the plumber, it is a variable in a complex planning process or a target for repair.

From Star, The ethnography of infrastructure, p. 380.

What are institutions and infrastructures?

How do institutions and infrastructures change?

Operational situations

Individuals' actions taken that directly affect state variables in the world
(Provision, production, distribution, appropriation, assignment, consumption)

Biophysical world

Community

Collective-choice situations

Individuals' actions taken that affect rules that affect operational situations
(Prescribing, invoking, monitoring, applying, enforcing)

Constitutional situations

Individuals' actions taken that affect rules that affect collective-choice situations
(Prescribing, invoking, monitoring, applying, enforcing)

Meta-constitutional situations

From Ostrom, *Understanding Institutional Diversity*, p. 59.

What is the role of HCI in achieving sustainability?

What is the role of HCI in

enabling and supporting changes in institution-infrastructure systems

to allocate more resources toward

meeting human needs, sustaining the life support systems of the planet, and reducing hunger and poverty?

Sustainability is
meeting human needs,
sustaining the life support systems of the planet, and
reducing hunger and poverty

Sustainability will be achieved by
changing institution-infrastructure systems
to allocate resources away from non-
sustainability-oriented goals
and toward the goals of meeting human needs,
sustaining the life support systems of the
planet, and reducing hunger and poverty

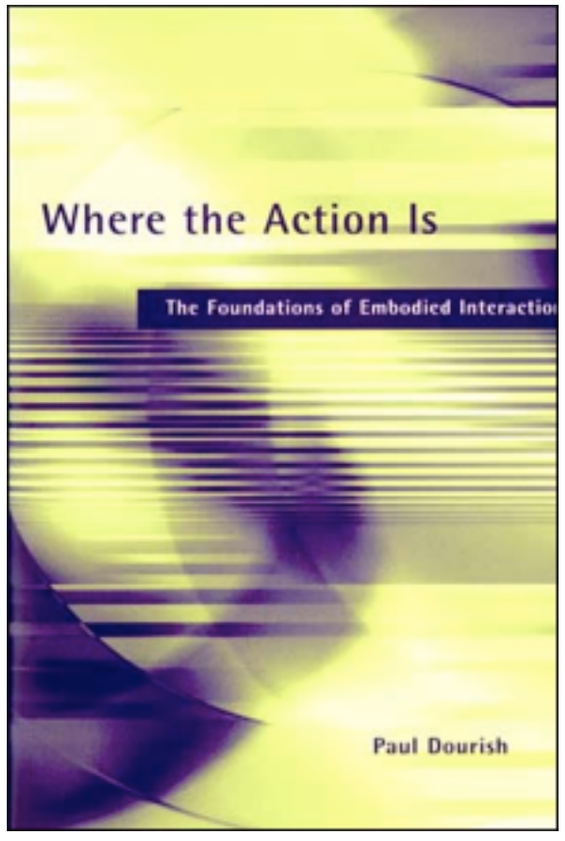
Institution-infrastructure systems are changed mainly by authorized actors in collective-choice or constitutional situations

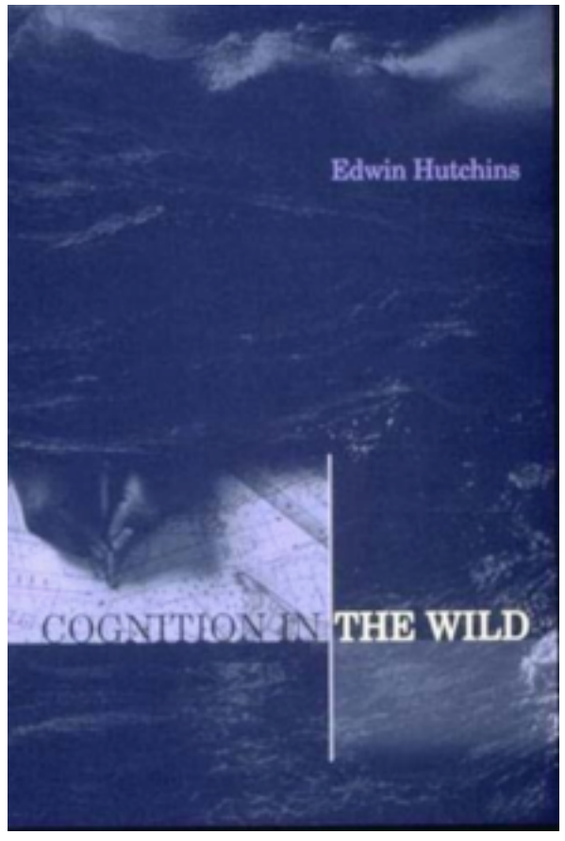
HCI can support institutional change by
collaborating with specifically institutionally located actors
in efforts to change institutional practices

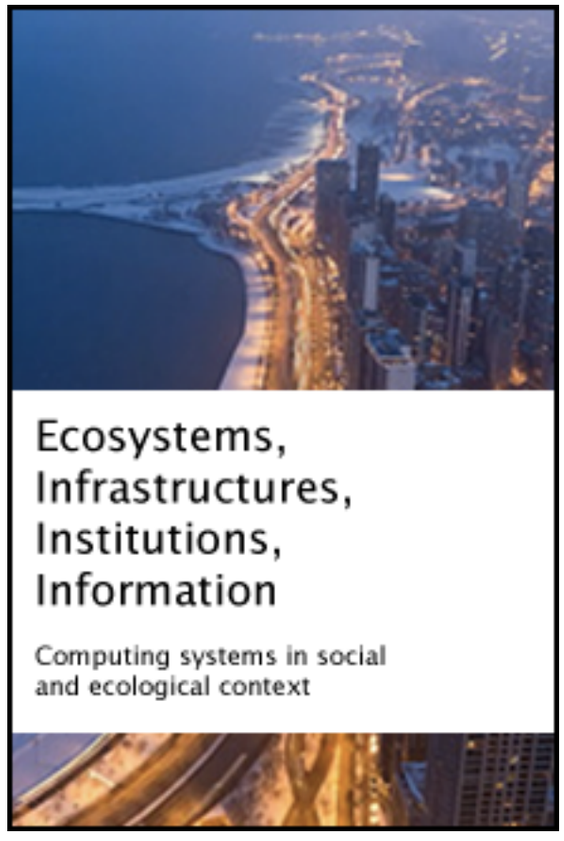
HCI can support institutional change by
collaborating with specifically institutionally
located actors
in efforts to change institutional practices

and by
creating new institutions through software


Victor Kaptelinin and Bonnie A. Nardi
ACTING WITH TECHNOLOGY
Activity Theory and Interaction Design


Where the Action Is
The Foundations of Embodied Interactio
Paul Dourish


Edwin Hutchins
COGNITION IN THE WILD


Ecosystems,
Infrastructures,
Institutions,
Information
Computing systems in social
and ecological context