Human Computer Integration *versus* Powerful Tools

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Abstract

In 1960, JCR Licklider forecast three phases for how humans relate to machines: human-computer interaction, human-computer symbiosis, and ultra-intelligent machines. Have we moved from interaction to symbiosis or integration, should we focus on this or on other aspects of human augmentation via powerful tools, and how will such decisions affect us as designers, researchers, and members of society? This panel will raise uneasy and disruptive HCI notions. For example, we will debate whether integration is a necessary and desirable next phase, or whether it could undermine human self-efficacy and control and lessen the predictability of machine actions.

Author Keywords

Artificial intelligence; human augmentation; symbiosis; creativity; direct manipulation; intelligent agents.

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Introduction

In a recent *Interactions* cover article, the panel organizers claimed the following.

"The era of human-computer interaction is giving way to the era of human-computer integration—integration

Key takeaways from the motivational paper on Human Computer Integration [1]:

- ✓ Interaction can be described as stimulus-response, whereas integration implies partnership between the human and the computer.
- ✓ There is a continuum from interaction to integration.
- ✓ Investigating computer initiative and transparency with respect to human agency is a pressing area for research on integration.

in the broad sense of a partnership or symbiotic[1] relationship in which humans and software act with autonomy, giving rise to patterns of behavior that must be considered holistically." [1]

Is this true and if so, is it a desirable path? Could we build powerful tools to enhance underlying human capabilities that are more directly responsive to us? While higher levels of automation are reasonable and even desirable in routinized repetitive tasks, in situations with incomplete, uncertain, or misleading data could increased human control be more effective perhaps?

Although the panelists agree that the perspectives that served us well in the past are changing, they differ as to how they feel we should respond. For example, undermining human primacy could lead to reduced willingness of experts to work in situations where they could be complicit to dangerous, costly, and destructive outcomes.

The article recommended a shift from observing the world through lenses acquired in the era of human-computer interaction to a new perspective that enables us to more effectively plan, design and evaluate proactive systems. However, engineers and fiction writers have long envisioned aspects of such a future, and not all the visions were utopian. Intriguing possibilities and cautionary challenges confront us (e.g.

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[1] JCR Licklider used the words "symbiosis" and 'partnership.' The article used those words and 'integration' interchangeably. The panel distinguishes between symbiosis, which implies independent entities with their own goals that happen to help and rely on one another, and integration, which implies a potentially more intimate but less symmetrical relationship.

[8]). Different research questions and design options arise when we consciously shift from the familiar perspective of human-computer interaction to views of human-computer integration or augmentation that are still coalescing.

The evolution of HCI
The nature of our interaction with computers and other digital devices has continuously evolved. We progressed from switches, cards, and tape to typing, mice, and styluses, adding speech and gesture. Skin sensors might become routine, or even brainwave interaction if hats make a fashion comeback. We can see these changes. Another dramatic change in human-computer interaction was invisible: what the computer does when we are not interacting with it.

For decades, the relationship could be described as stimulus-response. A computer responded to our last input or command, then waited for the next. Our action could be to load in a program as a deck of cards; the computer then read them, returned a printout, and waited for the next deck of cards. We typed in a command name, the computer processed it, typed back a response, and waited. We clicked on an icon, the computer produced a menu or initiated an action, and then waited. Sometimes the control was reversed: An application issued commands and a human entered information. This was by no means a partnership.

When the personal-computing era arrived, most computers were usually turned off or displayed a screen saver as they waited for a human to initiate an interaction. A few people installed SETI@home to devote unused cycles to exploring radio telescope data for evidence of extraterrestrial life, and some fell victim
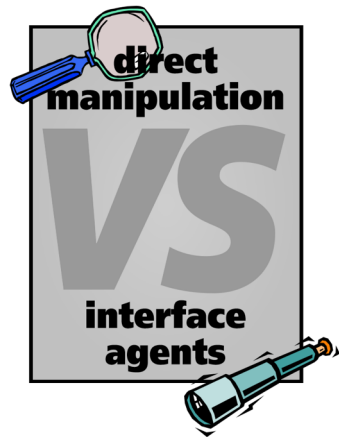
Key takeaways from a key HCI debate [2]:

✓ User interfaces should be predictable, so that users trust them.
✓ Direct manipulation supports rapid performance and low error rates while supporting exploratory usage in positive ways.
✓ There are real limits to what we can do with visualization and direct manipulation…we will have to, to some extent, delegate certain tasks or certain parts of tasks to agents that an act on our behalf or that can at least make suggestions to us.

to a hacker who took over their computers to redirect large quantities of spam. But in general, little activity occurred until an owner returned.

Over time, slowly, background tasks began utilizing client or server cycles on a user's behalf. They range from programmed interactions to adaptive processing that monitors context and proactively does tasks for us. Consider browser page predictions, where pages are pre-rendered in expectation that one might navigate there next. Such unseen software activity can shape subsequent interactions.

Computers aren't like people in most respects. They will not be our equal partners. (Equality is sometimes seen as a state that might briefly precede ultra-intelligence.) But in the meantime, there are times autonomous activity of devices affects how we interact with them. Our timelines are partly independent, yet they frequently intersect. Devices are busy on our behalf. We don't often know what they are up to when we are asleep. Sound creepy? Not necessarily, and it is happening. But to design software that does it well will require an intense effort to understand what humans expect and need in partnerships.

Is that how we should invest our resources? As designers, developers, researchers, product managers, entrepreneurs, and users, we might improve human-computer interaction by focusing on this larger context of integration, but we might choose other ways to enhance human capabilities, for example through more powerful tools.

We may disagree as to whether or not a machine should in some way try to understand the goals and

intentions (or interests) of a user and then act proactively to help. The devil may be in the details of "in some way." To what extent should a machine try to understand a person in real time versus simply embodying the understanding of its human designers? Maybe a key design goal should be to ensure that humans are made fully aware of what the internal state of the computer is, so that humans can comprehend, predict, and control the computer's actions. If that is too complex to do, then maybe the design should be simplified. On the other hand, the lens of integration can enhance human potential and unleash creative aspirations.

Panel goals & outcomes

This panel will raise uneasy and disruptive HCI notions. For example, we will ask whether integration could undermine human self-efficacy and control and lessen the predictability of machine actions. Could integration undermine users' responsibility for their actions if they can claim that "the computer did it," or "I was just going along with what the computer did." Integration may be seen as an attractive strategy for some consumer applications, but could be dangerous and ethically questionable in life-critical applications.

Is artificial intelligence about building a mind or about improving tools to solve problems [5]? This panel will consider tool-like designs, which users want to reflect their moral values, ethical principles, and socio-cultural conventions [6, 7]. Furthermore, the discussion will identify tradeoffs in value sensitive design in today's era of social media.

Panel organization

The first and second authors will organize and moderate the panel. The panel will comprise three distinguished members of the CHI community who have accepted our invitation. The panelists have a unique position on Human Computer *Integration* versus *Augmentation* that will lead to a constructive debate. For example, the panelists have previously been participants in debates [2] and have published their positions [3, 4]. Our panel seeks to bring these different perspectives on one stage for the CHI community.

The panel will be organized as follows:

- Introduction: Moderator 1 (first author) will introduce the topic of *Integration* versus *Augmentation*. (5 minutes)
- Statements: Each of the three panelists will state their position. (30 minutes total)
- Discussion: We expect considerable discourse between the panelists and the audience. Therefore, the majority of time will be allocated to this section. (40 minutes)
- Summary: Moderator 2 (second author) will summarize the discussion. (5 minutes)

During the position statements, audience members can live tweet their comments and questions that will be projected in real time. During the discussion, the moderators will solicit questions from the audience that can be addressed to a specific panelist or the entire panel.

Panel moderators

The panel moderators will ensure an equal and constructive discussion while engaging with the CHI audience. Below are succinct profiles of the moderators in alphabetical order.

JONATHAN GRUDIN
Jonathan Grudin is a principal researcher in the Natural Interaction research group and affiliate professor at the University of Washington Information School. He has participated in CHI and Computer Supported Cooperative Work since they coalesced in the 1980s, is an ACM Fellow and member of the CHI Academy, and served as Editor-In-Chief of ACM Transactions on Computer-Human Interaction for six years and Associate Editor for Computing Surveys for ten. His book on the history of HCI will be published in early 2017.

UMER FAROOQ
Umer Farooq is a user research manager at Facebook on the Messenger team. Prior to Facebook, he was a principal user research manager at Microsoft. In 2008, he joined Microsoft's Cloud & Enterprise team as a user researcher and advanced API usability methodologies for Visual Studio and Azure. In 2013, he helped to launch Xbox One globally, working on key entertainment scenarios such as media integration. He is now writing a book on the evolution of user research practice based on the CHI 2015 case study "Industry is changing, and so should we".

Panel members

Below are biographical sketches in alphabetical order.

BEN SHNEIDERMAN

Ben Shneiderman is a Distinguished University Professor in the Department of Computer Science, Founding Director (1983-2000) of the Human-Computer Interaction Laboratory, and a member of the Institute for Advanced Computer Studies at the University of Maryland, College Park. He was elected as a Fellow of the Association for Computing (ACM) in 1997 and a Fellow of the American Association for the Advancement of Science (AAAS) in 2001. He received the ACM SIGCHI Lifetime Achievement Award in 2001. He is a member of the National Academy of Engineering.

He pioneered the highlighted textual link in 1983, and it became part of Hyperties, a precursor to the web. His move into information visualization spawned Spotfire, known for pharmaceutical drug discovery and genomic data analysis. He is a technical advisor for the treemap visualization producer, Visual Action.

Ben is the author of Software Psychology: Human Factors in Computer and Information Systems (1980). In 1986, the first edition of Designing the User Interface: Strategies for Effective Human-Computer Interaction was published (5th ed., 2010, with C. Plaisant). This book is popular for his list of "Eight Golden Rules of Interface Design " which is frequently taught in Human-Computer Interaction courses. He co-authored Readings in Information Visualization: Using Vision to Think (1999) with S. Card and J. Mackinlay. His book, Leonardo's Laptop: Human Needs and the New Computing Technologies (MIT Press), won the IEEE Award for Distinguished Literary Contribution in 2004. He coauthored Analyzing Social Media Networks with NodeXL: Insights from a Connected World (2011),

with D. Hansen and M. A. Smith. His latest book is The New ABCs of Research: Achieving Breakthrough Collaborations (2016).

PATTIE MAES

Pattie Maes is a Professor in MIT's Media Lab and head of its Program in Media Arts and Sciences. She founded and directs the Media Lab's Fluid Interfaces research group and previously founded and ran the Software Agents group. While Maes started her research career in Artificial Intelligence, her research for the last 25 years has focused on "intelligence augmentation", or the close integration of human and machine that extends and enhances people's natural intelligence. Maes holds bachelor's and PhD degrees in computer science from the Vrije Universiteit Brussel in Belgium.

Maes is the editor of three books, and is an editorial board member and reviewer for numerous professional journals and conferences. She has received several awards: Fast Company named her one of 50 most influential designers (2011). Newsweek magazine named her one of the "100 Americans to watch for" in the year 2000; TIME Digital selected her as a member of the Cyber-Elite, the top 50 technological pioneers of the high-tech world; the World Economic Forum honored her with the title "Global Leader for Tomorrow"; Ars Electronica awarded her the 1995 World Wide Web category prize; and in 2000 she was recognized with the "Lifetime Achievement Award" by the Massachusetts Interactive Media Council. She also received an honorary doctorate from the Vrije Universiteit Brussel in Belgium. Maes' 2009 TED talk is among the most watched TED talks ever.

XIANGSHI REN

Xiangshi Ren is a professor in the School of Information and founding director of the Center for Human-Engaged Computing (CHEC) at Kochi University of Technology. He is founding president and honorary life-time president of the International Chinese Association of Computer Human Interaction (ICACHI). ACM CHI 2015 Local hero. He was a visiting professor at the University of Toronto, visiting faculty researcher at IBM Research (Almaden), and visiting/guest/chair professor at several universities in China. He currently is adjunct professor, PhD student supervisor of University of Science & Technology Beijing. He is a Senior Member of the ACM, a Senior Member of the IEEE, a member of the IPSJ, the IEICE, and the Human Interface Society.

Prof. Ren has been working on fundamental studies in the field of human-computer Interaction (HCI) for over twenty-five years. His research interests include all aspects of human-computer interaction, particularly modeling human performance models, pen-based interaction, multi-touch interaction, eye-based interaction, haptic interaction, gesture input, game interaction, user interfaces for older users and for blind users. He and his colleagues have established a unique research framework based on information technology, incorporating methodologies such as human performance modeling, developing new algorithms, conducting user studies, and systematically testing and applying HCI theory to applications.

Prof. Ren has presented talks at various institutions and international conferences. He often serves as a reviewer, associate editor, guest editor, conference/program chair or program/steering

committee member. He was recently the general co-chairs of International Symposium on Interactive Technology and Ageing Populations 2016 (IxAP 2016).

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