Design Methods to Investigate User Experiences of Artificial Intelligence

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Abstract

This paper engages with the challenges of designing 'implicit interaction', systems (or system features) in which actions are not actively guided or chosen by users but instead come from inference driven system activity. We discuss the difficulty of designing for such systems and outline three Research through Design approaches we have engaged with - first, creating a design workbook for implicit interaction, second, a workshop on designing with data that subverted the usual relationship with data, and lastly, an exploration of how a computer science notion, "leaky abstraction", could be in turn misinterpreted to imagine new system uses and activities. Together these design activities outline some inventive new ways of designing User Experiences of Artificial Intelligence.

Introduction

There has been a growing interest in technology pre-empting our needs, with at least the potential of systems that are contextual, anticipatory and personalized, drawing on objects and bodies embedded with sensors and actuators. While progress has been at times halting, we are no longer surprised at the idea of cars that automatically park themselves, toilet paper that preemptively replenishes stock, or virtual assistants that sensitively diagnose diseases. These smart technologies potentially offer the possibility to transform our everyday lives, catalyzing a shift from explicit interactions towards implicit interactions.

One way of characterizing these possibilities is in a change from *explicit* to *implicit* interactions (Ju and Leifer 2008). While explicit interactions demand our immediate attention for direct engagement or manipulation, implicit interactions rely on peripheral information to seamlessly behave in the background until appropriately shifted into attention. Systems like the Google Nest automatically change household temperature based on the predicted presence of household inhabitants, offering a tantalizing sense of systems that pre-empt our needs.

Yet, in reality the inevitable choreography between implicit and explicit interactions and the resulting user experiences are far from seamless, secure and sure. Automatic doors jerk and stutter, digital products and services uncannily act upon our behalf, manipulating our emotions, or curating filtered experiences without an ability to inquire or intervene. Content is hidden from us without our permission, and in extreme cases, systems take pre-emptive actions – resetting for system upgrades just before a talk, or suspending activity until impossible conditions are satisfied.

In our own recent work, we have focused on how AI and Machine Learning techniques can be used to support the choreography between these implicit and explicit user and system actions. Working in this area is challenging because while a system might pre-empt a user action, error rates - as well as unforeseen actions - can hinder utility. It is not clear that focusing simply on automating existing applications and system actions is as useful as expected – the track record of pre-emptive system actions is mixed at best.

What is perhaps needed is a design perspective on implicit systems, deploying design methods to understand and conceptualize how the developing form of AI systems might be deployed in actual systems. In our research, we are focusing on exploring new application areas for implicit systems. That is, exploring what new actions and activities systems might engage in rather than simply automating existing ones. One major resource in this work has been design research, an area that has pioneered thinking about and approaching what systems can do in new ways. As Kelley, one of the founders of IDEO puts it, "enlightened trial and error outperforms the planning of flawless intellect (Winograd 2006)." So rather than set out with clear sense of what our systems will do, we are attempting to instead test and explore how implicit systems might work in a design led way. More broadly, our research goals can be broken down into three potential contributions:

1. Surveying and challenging existing user interactions with ubiquitous and smart technology to expose design opportunities.
2. Understanding Machine Learning as an actual limited part of systems that can be approached and shaped by designers and users.
3. Unpacking the social implications of implicit interactions across information, interfaces, and infrastructures.

While both our overarching project and this design research are at early stages, we are approaching our developing design process and artifacts themselves as ways to acquire new knowledge (Zimmerman, Forlizzi, and Evenson 2007). In this position paper, we outline and detail the progress of three such methods that correspond to each of the potential contributions, and share resulting reflections and questions that contribute to the design of meaningful and appropriate user experiences of Artificial Intelligence. In the first method, we have explored the creation of a design workbook to map varied conceptual approaches and definitions of implicit interaction. In the second method, a workshop on designing with data was employed to explore and understand how data can be used in novel ways. Lastly, in the third method we have developed a simple system that rethinks a technical notion ("leaky abstractions") to explore new types of system behavior.

A Design Workbook on Implicit Interaction

Our first approach has been the creation of a *design workbook* to collaboratively unpack definitions and implications of implicit interaction while exploring opportunities for intelligent system action. A design workbook is a collection of design concepts, proposals and related material that creates a design space in which participants can engage with or expand upon design ideas, issues, and investigations (Gaver 2011). While design workbooks can be beneficial for designers working alone or in teams, its recognition that complex designs emerge slowly and often through the synthesis of tacit relationships between an array of concepts, affords its position as a boundary object for multidisciplinary teams and in particular communicating the intellectual rigor of design (Gaver 2011; Wolf et al. 2006).

As our project work is comprised of multiple academic disciplines from differing philosophical and methodological backgrounds (i.e. Artificial Intelligence, Social Sciences, and Interaction Design), our design workbook serves as a design space in which intentions, objectives and aspirations can be communicated and aligned. Ultimately, as Interaction Design strives to unpack and overcome barriers of designing novel and consequential products and services with and for Artificial Intelligence, we are equally interested in exposing the black box of design for participation and collaboration.

Our design workbook is composed of five sections. The first section *Implicit: Meanings, Definitions, Terms* is a collection of words from meetings, workshops and emails that have been used to describe or define implicit interaction. The content of this section has been particularly important in challenging prior definitions of implicit while revealing disciplinary assumptions and mental models through subsequent card sorting exercises. The second section *Examples: Interactions, Services, Systems* is a visual collection of projects that both inspire and provoke while more importantly affording concrete examples for colleagues to reference during project activities. The third section *Domains: Situations, Contexts, Opportunities* is another visual collection, yet of problem spaces, complex challenges and interesting areas that prompt ideation and foreground an alignment in meaningful real-world applications. The fourth section *Technology: Data, Activations, Inferences* is a list of existing and aspirational data streams and sources that has been a key starting point in latter engagements with data as a design material. The fifth and final section is *Projects: Concepts, Abstracts, Briefs* and serves as a working portfolio of completed and potential projects from speculative academic abstracts to utilitarian ideas to disturbing provocations.

One example of such a provocation is the project brief written for *Designing and Prototyping a Pee-ometer to Investigate Training in Machine Learning*:

> Machine Learning is increasingly prevalent in everyday interactions with technology, affording personalization and prediction in the design of user experiences. This ability contributes to ongoing discussions of Machine Learning as a design material, in particular to the explicit and implicit training of system decisions. This project investigates interactions to initiate, influence, and correct machine learning while reflecting upon the user experience of engaging in machine training. How could and should we enable users to train and re-train Machine Learning algorithms? And how might user training of algorithms in turn intentionally or unintentionally train users?
>
> This project explores these questions through the design and prototyping of a *pee-ometer*, a connected wearable that predicts when a user has to pee based on body movements. Following foundational research, design workshops and cultural probes that investigate the training of non-technological objects, people and animals, a *pee-ometer* with a tangible user interface will be designed and prototyped to predict pee habits, suggest user actions and respond to user training.

While this project brief is obviously not advocating that there should be *pee-ometers*, by conceptually surfacing and

potentially prototyping the possibility of such a device, working on the brief simultaneously reveals social tensions, relational frictions and interactional loops with smart technology while inviting those working on it to extend technical practices, such as training, into the design space. Thus, as the project navigates multi-disciplinary collaborations and investigates novel intelligent systems such as *semantic avatars* (Nilsson, Sahlgren, and Karlgren 2016), our design workbook serves as an arena for participation, critique and discourse.

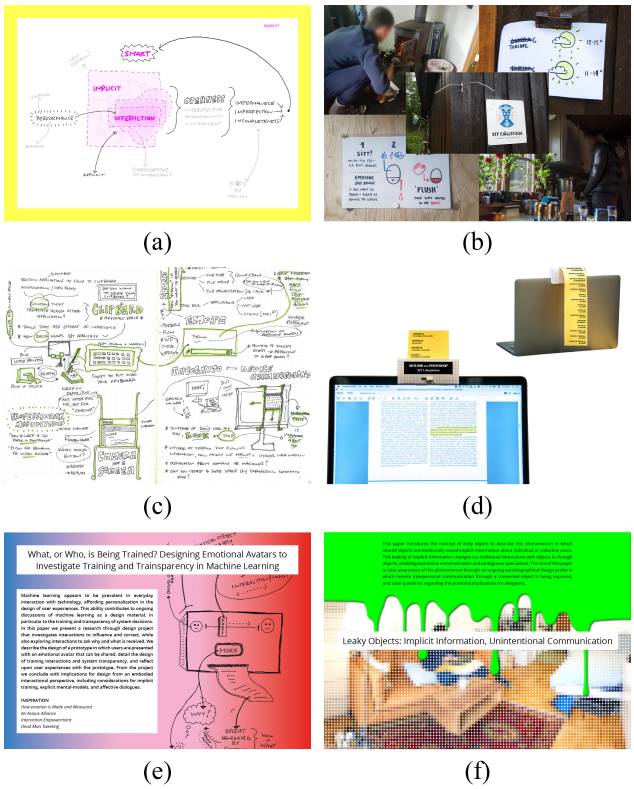

Figure 1: Example pages from design workbook, including a) sketch diagram of smart implicit interactions, b) photos of outdoor domain opportunities, c) annotated sketches following multidisciplinary workshop, d) concept investigating screenshots as a data source e) fictional abstract of emotional avatars, and f) abstract of in-progress project Leaky Objects

A Workshop on Designing with Data

Our second approach has been to investigate through design workshops what diverse data sources might mean and how they can be used to think about implicit system action. A growing body of research in the HCI Design Research community has been investigating data as a design material (Brown, Bødker, and Höök, 2017; Dalton et al. 2017; Boucher and Gaver 2017), i.e. a material that is approachable and shapeable by designers and possibly end users. Within our current work on implicit systems, data as a design material can be more specifically expressed as something that enables system action without that action being necessarily well defined. Indeed, from the perspective of building AI (or a Machine Learning model), data is an absolute requirement. We cannot learn anything if there is no learning material available. Data for a Machine Learning model is typically connected to a task the model is supposed to perform. If we want to categorize images, then we need labelled images to learn from. If we want to classify sentiment in text, then we need text examples of how the various sentiments are expressed. Thus, more traditional approaches to designing with data often focus on clear applications of what a system needs to do. For example, in some cases training data is collected and used to train systems which can then engage in the task unguided. We, instead, opted for what might be perceived as a backwards approach, starting with data as a material from which to ideate potential use cases, application domains, and system activities.

Our design process began with self-data collection in which screenshots from the authors' computers were taken every minute over a six-week period of time. While we wrote a program that utilized Google's image recognition API to convert these screenshots to text, we decided in parallel to inquire into the conceptual properties and arrangements of the gathered data by using a framework of *materials experiences* to investigate the practices, or situated 'ways of doing', between people and data (Giaccardi and Karana 2015). For our first workshop on designing with data, a script was used to randomly generate 'booklets' of data from the screenshot database of the first author for each of the other five workshop participants. Each booklet of data consisted of 20 screenshots from varying time intervals, i.e. across the entire six weeks, a week, a day, an hour and 20 consecutive minutes. The screenshots were then indiscriminately 'shaped' by the designer, or workshop leader and data owner, in which a series of predetermined filters, distortions, zoom lenses and effects were applied. At the beginning of the workshop, the data booklets were handed out to each participant to first familiarize with before handing out a series of five prompt cards to extract and map inferences, reflections and discussions from the data. The cards included questions regarding ownership, contexts, emotions, aspirations, and ecosystems. The workshop concluded with a speculative exercise in which participants were asked to imagine how different actors, from specific colleagues and technologies to more general personas and services, might misuse mapped inferences. Structured to design disruptions, the concluding step situated the experienced properties and performances of the data in external and consequential contexts.

Figure 2: Screenshot 'booklets' with inferences, reflections, and discussion points from workshop participants

Prior to the workshop, our application ideas and directions for the captured data centered on actions such as advertising and recommendations that could be based on text extracted from the screenshots. Through the materialization of data and by taking an unconventional approach relative to the development of Machine Learning models, we were able to open a design space regarding how this data could be used to present more complex representations and aspects of users in new and different ways. For example, our subsequent conceptual directions that are driving current ideation included activity and inactivity hierarchies, behavioral adjustments in response to data tracking, enhancing rather than obscuring, social traces of data sharing, and the pacing of rhythms and routines. Therefore, investigating data as a material to understand the strange and perhaps even hidden aspects of online and computer based activity has enabled us to reimagine new possibilities of how systems might approach data through activities centered on how humans make sense of data.

A Prototype on Asymmetrical Interactions

Our third approach has been the prototyping of a simple informational infrastructure, or a custom Internet of Things application, to understand and design counter-strategies for asymmetrical interactions of data-driven systems in use. Prototyping is an established, interdisciplinary method employed by design researchers and interaction design practitioners for multiple purposes including but not limited to understanding an intended experience (Buchenau, Francisco, and Suri 2000). While prototypes can also reveal potential implications of proposed products, services and systems, it is less clear how designers might engage with the underlying informational infrastructures of data-driven devices and applications, such as those supported by Artificial Intelligence, to not only expose but also transform their functioning. This engagement by designers to materialize or open up an infrastructure for either design or local user intervention (Davoli and Redström 2014), is of particular interest to our work regarding conflicts of agency and concerns regarding privacy. Therefore, in addition to design explorations into new application areas, an ongoing prototype in which we are investigating the materialization of an everyday data-driven infrastructures is the autobiographical design probe Leaky Objects (Helms 2017).

Prompted by a change in communication patterns observed by the first author of this paper, the design probe initially intended to investigate how people might indirectly communicate with shared things about each other. Following the deployment of simple sensors within a domestic context and the development of a custom web application in which the status of these sensors could be requested from an Arduino, the prototype next sought to overcome obvious asymmetries in agency by incorporating a mechanism to reveal when sensor information is accessed. For example, as one sensor is a photocell attached to a floor lamp that checks the status of the light, a custom power-switch was appropriated into an awareness indicator, causing the light to flicker when its status is remotely requested. While the prototype introduced the concept of *leaky objects*, a playful reimagining of the computer science notion *leaky abstraction*, to describe the phenomenon in which shared objects leak implicit information that results in unintentional communication, it additionally surfaces the potential for further investigations into counter-strategies of obfuscation as the inherently unfinished and messy nature of a prototype creates an opening for the design of further interactions, appropriations, and hacking.

While we have used the prototyping of a simple informational infrastructure as a design method to investigate the potential social implications of implicit interactions in data-driven systems, we also hope to engage interaction designers in discussions on potential strategies of approaching the complex challenges of asymmetry in concerns of agency and privacy. As we continue to engage with more complex and layered data streams that afford Artificial Intelligence and Machine Learning techniques to support implicit interactions, we plan to continue an increased engagement in prototyping as a method for the design of meaningful and responsible user and system interactions.

Symposium

We will share our work in a 20-minute presentation format.

Author Biographies

Karey Helms is a PhD student at KTH. **Barry Brown** and **Airi Lampinen** are faculty members at Stockholm University. **Magnus Sahlgren** is a Senior Scientist at RISE SICS and at the Swedish Defense Research Agency.

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References

Boucher, A. and Gaver, W. 2017. Designing and Making the Datacatchers: Batch Producing Location-Aware Mobile Devices. In *Proceedings of Tangible, Embedded, and Embodied Interaction*, 243–51.

Brown, B.; Bødker, S.; and Höök, K. 2017. Does HCI Scale? Scale Hacking and the Relevance of HCI. *Interactions*, 24(5), 28–33.

Buchenau, M.; Francisco, I.S.; and Suri, J.F. 2000. Experience Prototyping. In *Proceedings of the Conference on Designing Interactive Systemss*, 424–33.

Schnädelback, H.; Jäger, N.; Nabil, S.; Dalton, N.; Kirk, D.; and Churchill, E. 2017. People , Personal Data and the Built Environment. In *Proceedings of the Conference on Designing Interactive Systems*, 360-363.

Davoli, L. and Redström, J. 2014. "Materializing Infrastructures for Participatory Hacking. In *Proceedings of the Conference on Designing Interactive Systems*, 121–30.

Gaver, W. 2011. Making Spaces: How Design Workbooks Work. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems,* 1551–60.

Giaccardi, E. and Karana, E. 2015. Foundations of Materials Experience: An Approach for HCI. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 2447–56.

Helms, K. 2017. Leaky Objects : Implicit Information, Unintentional Communication. In *Proceedings of the Conference on Designing Interactive Systems,* 182–86.

Ju, W. and Leifer, L. 2008. The Design of Implicit Interactions: Making Interactive Systems Less Obnoxious. *Design Issues* 24 (3): 72–84.

Nilsson, D.; Sahlgren M.; and Karlgren, J. 2016. Dead Man Tweeting. In RE-WOCHAT Workshop on Collecting and Generating Resources for Chatbots and Conversational Agents: Development and Evaluation.

Winograd, T. 2006. Shifting Viewpoints: Artificial Intelligence and Human-Computer Interaction. In *Artificial Intelligence* 170 (18): 1256–58.

Wolf, T.; Rode, J.; Sussman, J.; and Kellogg, W. 2006. Dispelling 'design' as the Black Art of CHI. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 521.

Zimmerman, J.; Forlizzi, J.; and Evenson, S. 2007. Research Through Design as a Method for Interaction Design Research in HCI Design Research in HCI. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 493–502.