Representing Passengers, Journeys and Navigation

Lucian Leahu
Computer Science Department
Cornell University
lleahu@cs.cornell.edu

ABSTRACT

Although critiques of computational models and rigid representation schemes have been quite vocal in the past decades, by and large current system design still overwhelmingly relies on straightforward mappings of entities and processes from the outside world. My research draws on and extends existing critiques to address the demands of today's technological trends and the limitations of traditional system design. I am very interested in exploring the underlying assumptions as well as opportunities pertaining to representation afforded by automated journeys technologies.

1. INTRODUCTION

Computational technologies are inherently representational. In order to reason about the world, systems typically have access to relevant aspects of their environment via sensors or input modalities; these aspects are typically represented internally through variables and models associated to objects, entities or processes in the outside world. From these representations outcomes are derived, which must hold in the outside world. As such, representation gives computers the means to participate in their environment.

As expected, any representation is a simplification of the outside world: it highlights certain features which appear to be general or relevant and discards less frequent as well as harder to formalize aspects. Computational models are certainly very useful when all the aspects relevant for the system's success are captured in the model. However, problems arise when the system's focus is on aspects that are less general or the ones that resist formalization. Indeed, this is old news in CSCW as the limitations of modeling users, users' actions and work processes have been thoroughly discussed in the past two decades in the work of, for example, Suchman [10] and Robinson and Bannon in [8].

In spite of these significant contributions, new and old issues related to formalization surface in current HCI practice. On the one hand, the growing interest in experience-focused technology brings out new tensions between the subjective, idiosyncratic aspects of human experience that are the focus of such systems and the objective representations required by the technology. On the other hand, mismatches between internal representations and the outside world are a recurrent source of difficulties in HCI and related fields, as evidenced by the omnipresent call for future work on better, more accurate models. This suggests that the lessons of Suchman and others have been incorporated only superficially in current practice as current systems are still fundamentally constrained by the power, as well as the limitations, of such models. More specifically, although these hard learned lessons have informed the conceptual phase of the design process, they have not made their way into the technical design and implementation level. As such, especially from a technical perspective, systems continue to be built with the implicit assumption that representation is in strict one-to-one correspondence with reality. While corrective measures may be taken through interface and interaction design, often the mismatches are deeply rooted in the technical implementation and frequently little can be done to prevent their impact on the overall experience of the system. Consequently, my research focuses on 1) how to reposition representation to better accommodate both new demands and existing critiques and 2) advancing a holistic approach to system design, in which this reorientation of representation permeates every aspect of system design, including the technical level.

2. EXPECTED CONTRIBUTION

My PhD thesis aims to advance current research in HCI by rethinking the role of representation in system design: moving away from representation as a one-to-one mapping to reality to an understanding of representation as partial, incomplete, subjective (e.g. the mere decision of what gets represented and what is left out is subjective) and always situated in a particular socio-cultural context. Moreover, the limitations of representational devices implemented in systems should not be transparent as is common today; instead, they should be central to every stage of system design, embracing representation as a digital scaffolding of reality and reorienting the entire system design around this understanding. One example of doing so is to use the uncertainty and ambiguity that accompanies any representation as a way to engage the users into meaning making as well as reflection [5], as well as allowing multiple meanings to emerge [9].

My research confronts these issues across the continuum of practices associated with system design: conceptual/philosophical, design, ethnography, algorithm and technical/implementation. As such my work is informed by critiques pertaining to representation and formalization. Moreover, while grounded in subfields of HCI (e.g. affective computing) in which these problems are most evident, my work proposes a methodology for approaching such issues through illustrative case studies demonstrating heuristics for design.

3. CASE STUDIES

Over the years, a number of researchers have tackled the problem of representation. As such my work builds on conceptual critiques such as Winograd and Flores in AI [11], Robinson and Bannon in CSCW [8] and Brooks in robotics [3], Dourish in HCI [4]. Perhaps most influential in HCI has been the work of Lucy Suchman [10] regarding the fundamental mismatch between the models of action underlying planning research in AI in the 1980's and actual, situated human activity in the world. Although concerned with similar issues, the debates within HCI and CSCW around representation have developed in parallel with debates within AI; however there has been little crossover with the

exception of *'Plans and Situated Actions'* [10]. My work attempts to tap these resources outside HCI. One first project for my dissertation discusses the tactics developed within interactionist approaches in AI with respect to representation and discusses their relevance for today's HCI [7]. These tactics were developed to avoid the conceptual and technical pitfalls associated with complete, one-to-one representations. These tactics demonstrate how more can be achieved with less: less in terms effort spent representing and reasoning about the world and more in terms of the delivered experience and utility. For example, one such tactic is to design for engaged audiences, thus making the believability of the system a central feature. This translates into a simplified system design, driven largely by the way the system will be interpreted by friendly users, rather than by its behavior when analyzed either in a vacuum or by a hostile user. That is, system design can become simpler and more effective by making the experience and interpretation of the system by users central to every design decision (including technical), rather than only considering this when it comes to design the user interface. As a continuation, my current research attempts to show how these tactics can be used in today's HCI. As such the focus is on an every day technology such as GPS navigation devices. Currently, I am doing some fieldwork in order to document breakdowns that occur in usage. These finding will then be used to inform the redesign of such devices using more flexible representation techniques and incorporating the above mentioned tactics.

A central tenet of my research is the belief that the world is not completely available to us or to a computational system. Consequently, it is crucial for the design of real world applications that representations inside the system are understood to be partial and not always in direct correspondence to the outside world. This is particularly obvious in today's HCI with the move towards experience and also in light of the paradigmatic shifts experienced by the field [2]. One such area is affective computing. Here the central challenge is how to address the subjective, idiosyncratic, personal nature of emotions within the rigid framework offered by technology. One difficulty lies in mapping sensor readings to their meaning. Indeed this is not a problem specific to this area, but here it is quite obvious – e.g. how to get from one's heart rate to the felt emotion? My previous work shows how this objective measures do not directly map to affective meaning that needs to be decoded by way of technology (as often assumed in the literature). Through a participative study, my work uncovers a complex relationship between sensor readings and their significance and suggests methodologies based on user interpretation to recover such complexity [6]. Another difficulty in this area relates to statistical models of emotions – emotion recognition by way of sensor readings. Concerned with scenarios where user interpretation is not feasible due to cognitive constraints placed on the user, my current work analyses the ways such models are obtained and raises epistemological questions with respect to said models ability to generalize. My current work in this area, suggests a reflective incorporation of such models in system design, one that must carefully account for the models uncertainty and inaccuracy, with respect to emotion recognition, as this models can offer at best an educated guess regarding the emotions felt by the user, rather than an oracle that transparently accesses the user's affect. These findings can be generalized beyond affective computing to other areas that fundamentally rely on the accuracy of the models developed.

4. CONCLUSION

Focusing on issues of representation, my research contributes to an ongoing discussion in HCI, in particular, and computer science more generally on the role and limitations of computational models. My dissertation will serve researchers and practitioners with two key contributions. First, it will provide a framework to better understand the consequences of representational choices and to demonstrate feasible alternatives based on a holistic approach taking into consideration every aspect of system design. Second, it will include several example studies demonstrating a methodology to address the inherent limitations encountered when addressing subjective, idiosyncratic experiences that characterize recent developments in HCI.

5. AUTHOR'S BIO

Lucian Leahu is a Ph.D. Candidate in Computer Science at Cornell University under Phoebe Sengers' supervision. His work consists of developing critical and reflective technologies at the intersection of human-computer interaction (HCI) and artificial intelligence (AI). His thesis focuses on limitations of formal representational schemes and practical alternatives to reposition representation in system design in order to encourage examination and reflection.

In what now feels like a previous research life, Lucian has contributed to the field of constraints satisfaction and constraint programming. Combining methods from AI and Operations Research, his work consisted of developing heuristics based on linear programming and semidefinete programming techniques in order to solve hard combinatorial problems. Lucian has co-chaired the 2007 North East Student Colloquium on AI.

Lucian has earned an Engineering Degree in Computer Science from Technical University of Cluj Napoca (Romania) in 2003 and a Master of Science from the Computer Science Department at Cornell University in 2007. He is expecting to complete his PhD degree by the end of 2009.

6. REFERENCES

[1] Agre, P. *Computation and human experience*. Cambridge University Press. 1997.

[2] Bødker, S. When second wave hci meets third wave challenges. In *Proc. NordiCHI '06*, 1-8, (2006).

[3] Brooks, R. Intelligence without representation. *Artif. Intell. 47(1-3)*, 139-159, (1991).

[4] Dourish, P. What we talk about when we talk about context. *Personal Ubiquitous Comput. 8*, 1 (Feb. 2004), 19-30.

[5] Gaver, B., Beaver, J. and Benford, S. Ambiguity as a resource for design. in Bellotti, V., Erickson, T., et al. eds. In *Proc. CHI '03*, 233-240.

[6] Leahu, L., Schwenk, S., and Sengers, P. Subjective Objectivity: Negotiating Emotional Meaning. In *Proc. DIS'08*.

[7] Leahu, L., Sengers, S. and Mateas, M. Interactionist AI and the promise of ubicomp. In *Proc. Ubicomp'08*, (to appear), available at: www.cs.cornell.edu/~lleahu

[8] Robinson, M., and Bannon, L. Questioning Representations. In *Proc. ECSCW'91*. 219-233.

[9] Sengers, P. and Gaver, B. Staying open to interpretation: engaging multiple meanings in design and evaluation. In *Proc. DIS '06*, 99-108.

[10] Suchman, L. *Plans and situated actions*. 1987.

[11] Winograd T. and Flores, F. *Understanding Computers and Cognition*. Ablex Publishing Corp, 1985.