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Mediated Interaction: Social Informatics in the Era of Ubiquitous Computing

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Abstract
Social Informatics (SI), as originally envisioned by Rob Kling and his collaborators, is a body of research that examines "the social aspects of computerization." Based on this definition and a particular notion of the "social," great emphasis is put in SI on the interaction of information technologies with their institutional and cultural contexts. This focus has for several decades directed research in SI largely towards organizational and social contexts, providing valuable insights into computing practices in organizations, communities, and societies – for instance, in the notion of "computerization movement." The shift in the last decade towards more pervasive and ubiquitous use of computers, however, seems to call for complementary approaches that adopt a micro-level perspective, focusing on the individual as a key actor in the computerization of society. For this to happen, research in SI needs to be informed by ideas, findings, and theories in such areas as cognitive science, social psychology, human-computer interaction, and Artificial Intelligence. This shift of focus is in accord with a parallel trend in social science that puts cognition at the heart of human interaction and sociality, allowing accounts of social processes that breach the traditional social-psychological divide. While heedful of the role of technologies in these processes, these accounts do not typically give enough weight to technological artifacts as integrated extensions of the human mind. SI can contribute to this trend by focusing on computer-mediated interactions that are on the rise in terms of both frequency and intensity. This paper is a preliminary examination of the theoretical issues involved in this shift.

1. Introduction: An Original Vision

Social Informatics (SI), as an area of research, developed from an original vision of *computing as social action* (Kling and Scacchi 1980). Computing technologies, according to this *interactionist* view, are "objects that can take on rich social meaning for people who deal with them," and a proper understanding of these technologies should, therefore, concern itself with "the ways in which people define their social situations, and the ways in which they create strategies of action in line with their perceptions and intentions"(p.254). This perspective provided a fresh, radical, and effective understanding of computing that has retained its vitality to this date, as witnessed by the growing body of literature, academic activity, and institutional support for SI approaches around the world (Robbin and Day 2006). Accordingly, great emphasis was put in SI on the interaction of information technologies with their institutional and cultural contexts.

This focus has for several decades directed research in SI largely towards computing practices in organizations. However, "[m]any important reasons for this focus on computing in organizations [were] pragmatic" (Kling 1980: 63, footnote 1). Otherwise, There is no *a priori* analytic advantage in taking organizations as the unit of analysis in SI research. In fact, the shift in the last decade towards more pervasive and ubiquitous use of computers seems to suggest otherwise. If anything, this shift calls for complementary approaches that adopt a micro-level perspective, focusing on the individual user as a key actor in the computerization of society. Some recent work in SI (e.g., Lamb and Kling 2003) seeks to connect the micro- and macro-levels of analysis, but it still focuses on the "organizational individual" as the key social actor. We also need to pay attention to non-organizational individuals who constitute another major category of social actors. Even a rough comparison between the computing worlds of the 1970's–1980's and the present reinforces this idea.

2. The Computing World: Now and Then

In a seminal paper that sought to detail the major lines of segmentation in the computing world, Kling and Gerson (1978) identified three broad structural interests, which they called, respectively, "vendors," "users," and "consumers" – roughly, those who produce and develop computer technologies, those who use them in furthering their work and interests, and those recipients or end-consumers "whose relationship to the computing world is primarily passive." (p.24). Kling and Gerson broke down the computing world along four dimensions, each one giving rise to distinct sub-worlds – namely, those generated: (i) by kinds of problem solved (scientific, commercial, industrial, and academic); (ii) by kinds of technology used (hardware, software, firmware, and communications); (iii) by varieties of application (e.g., manufacturing, freight handling, weather prediction); and (iv) by relationship to IBM. The authors then provided a lucid analysis of how these sub-worlds interact and intersect, giving rise to a complex ecology of flexible, fluid, and shifting interests and interactions. Understandably, the key players in this ecology were vendors and users (as defined above), with the end-consumers playing the passive role of recipients. That situation has drastically changed, as a short anecdotal account might illustrate.

I have a twelve-year daughter who acquired her first desktop Personal Computer when she was ten years old. Typing at a speed of about 140 words per minute, and as an avid user of Skype™, she chats, confers, and discusses schoolwork with her friends on a regular basis. She exchanges email with her cousins overseas almost everyday, downloads her favorite music on Limewire, and watches comic video clips about Persian parents on YouTube, which she can download, at her will, into her PC or her iPod. Following our recent move from California to Indiana, she spends hours talking with her distant friends on her Razr™ cell phone, which, under irresistible peer pressure, she literally *made us* buy for her back in California (and, with an ironic reversal of the pressure in Indiana, she has stopped taking it to school here). The same cell phone allows her to download her favorite rings, take photos, and share them with her friends, with whom she also exchanges on the average of 30 instant messages a day. Computers and the Internet are also an integrative component of her schoolwork. Doing "research" on her school project on World War II, she recently obtained a great deal of material — stories, statistics, maps, images of battleships and commanders, etc. — on the Internet, and so on and so forth.

What makes this example significant is not its uniqueness, rather its typicality. Computer-mediated interactions are becoming increasingly commonplace among people — more specifically, among those that Kling and Gerson called "consumers" in their account of the computing world. And not only is this representative of a particular social group (a young female second-generation middle-class immigrant in North America), but increasingly of diverse groups around the globe, particularly in the developed world. Those of us who grew up in the 1960's–70's could easily see the sharp contrast between this state of affairs and our own: social interactions have become increasingly mediated in character, punctuating a shift that Gerson (in press) has dubbed as hyper-distribution, hyper-accessibility, or simply "reach," for sake of a convenient term. This, I believe, is the major shift that has taken place in the computing world and in the ecology that was described in early studies such as Kling and Gerson (1980)'s. While some of the features of the original ecology have remained analogous, others have changed dramatically because of the active role that the end-consumers play in the world of computing. The business community has noticed this, as witnessed by marketing campaigns and fierce competition among leading companies to redraw the lines between hardware, software, communication, and entertainment industries: Microsoft against Nintendo, Apple against Nokia, and Sony against all of them. Business is leading the way in shaping the future of our technologies and, through that, the future of our societies. How should SI respond to this?

3. Questions: Old and New

These shifts introduce new dilemmas and controversies, evoking new questions or recasting the old ones. The key question now, as in the past, is the significance of all of this: What difference does the ubiquitous presence of computers make in the life of individuals? Broken down into its relevant components, however, this calls to mind questions such as the following:

Cognitive
How are our cognitive capabilities modulated (enhanced or frustrated) by modern computer technologies? How do we make sense of the overwhelming, mixed, and spurious flow of information that impinges on our cognitive apparatus in a non-interrupted fashion? What strategies are most effective in dealing with issues of information reliability, undersupply, or overload?

Psychological
How do real-life and virtual worlds spill over to each other? What elements of each world constitute our psyche most powerfully and durably? What socio-technical arrangements are most conducive to the psychological wellbeing of different groups, populations, and communities?

Social
How do people participate in the social process of meaning-creation through computer artifacts? How are identities shaped through online interactions? And how does this affect the social relationships that they forge in their lives?

Cultural
How vulnerable is our private life to the interruptions or interferences of the above spillovers or of their spurious inputs? Or to surveillance capabilities that they provide? How exposed are we to strangers' gaze? What are the best technologies, policies, and institutional arrangements for encouraging cultural diversity, tolerance, and understanding among local and global communities?

Political
What types of social and political participation are enabled/inhibited by computer technologies? How does social status benefit or detriment our access to modern computer technologies and information resources?

These questions, admittedly, cross the line between the descriptive and normative, but critical engagement is a built-in component of SI that needs to be retained (more on this later). We currently have adequately satisfactory answers to few of these questions, the ingredients of possible answers to others, and barely any understanding of the rest. Even to the extent that we have answers they hardly fit together in a coherent system of conceptual and theoretical understanding. How should SI respond to this state of affairs? What is to be done?

4. On Theory: A Non-Reductionist Research Strategy

To be sure, the project that would address the above questions (and many others that belong here) constitutes an immense undertaking that does not fall within the purview of any single approach, discipline, or methodology. Social Informatics, however, is relatively well-positioned to take on a good chunk of this project. To this end, SI researchers have to first overcome a psychological barrier that tends to separate the social sciences from psychology. Historically, there is skepticism among social scientists towards the value of psychological theories and in particular about the possibility of building bridges between cognitive psychology and sociology (Woolgar 1999). This partly derives from the early dominance of mentalistic views in cognitive science and its neighboring disciplines. In the last decade or so, however, the situation in cognitive science has changed in favor of situated views of cognition that take the social and cultural context of cognitive processes seriously. This change of perspective has been noticed by some social scientists but neglected by others, including most researchers in SI. The concern over privileging the psychological over the social, while understandable, is misplaced because sociology is "in effect a kind of inter-psychology" (Latour 2005: 13). SI researchers can pioneer the effort to overcome this barrier by developing theories and methodologies that draw upon ideas and findings in cognitive science, developmental and social psychology, and human-computer interaction as well as sociology and anthropology. Such an approach should seek to integrate analyses at different levels — from micro to macro — without risking the reduction of the social to the psychological, or vice versa. The aforementioned work by Lamb and Kling (2003) provides an elaborate model of social actors within the framework of institutionalist theory of Scott (1995) and others. Their model identifies four interdependent dimensions of ICT-related actions by social actors: affiliations, environments, interactions, and identities. However, as mentioned earlier, these authors focused their research on "the organizational contexts of situated use" (p. 202–203). Therefore, their analysis might not directly apply to the study of non-organizational actors. Some of these dimensions might be more usefully relevant than others in understanding the behaviors of such actors. It is too early to outline the similarities and differences, but here I want to provide examples of alternative ideas that might provide useful examples for this purpose.

4.1. Scaffolded Thinking

The philosopher Andy Clark provides a fascinating theory of humans as (disguised) *natural-born* cyborgs. "[W]hat is special about human brains, and what best explains the distinctive features of human intelligence," he argues, "is precisely their ability to enter into deep and complex relationships with nonbiological constructs, props, and aids" (2003: 5). These constructs take different shapes — from language to computers and silicon implants — but they all share the property that they are extensions of the human mind, or *part* of the human mind if we take a radical reading of Clark.

To understand the thinking behind this idea, let us look at a familiar technology: the wristwatch. David Landes (2000) has chronicled the history of the development of timekeeping technologies in modern times and how they have enabled us to factor time constantly into our social and individual activities; how we have become time-disciplined and time-conscious, in other words. As Clark (2003: 41) notes, however, "what counts here is not always *consciously knowing* the time… Rather, the crucial factor is the constant and easy availability of the time, *should we desire to know it*" (original emphasis). The poise for easy use and deployment is the characteristic of what are called "transparent technologies," of which the wristwatch is a homely example. It is this transparency that makes us unhesitatingly reply "yes," even before consulting our wristwatches, when somebody asks us about the time on the street. What this suggests, according to Clark, is that "the line between that which is *easily and readily accessible* and that which should be counted as *part of the knowledge base* of an active intelligent system is slim and unstable indeed" (ibid: 42; emphasis is Clark's). In other words, your "yes" answer to the question "Do you know the time" amounts to the literal truth, for you do know the time. "It is just that the 'you' that knows the time is no longer the bare biological organism but the hybrid biotechnological system that now includes wristwatch as a proper part" (ibid).

Clark compares this with the case of an Oxford dictionary, an equally ubiquitous technology available in most households. The difference here is that, unlike the case of the wristwatch, if someone asks the meaning of a word which we do not know, we won't say "Yes, I know what that word means" and then proceed to consult the dictionary. How can we explain this difference? The difference is in the distinct histories of wristwatches and dictionaries, which has turned the former, but not the latter, into a transparent technology. The passage to transparency involves a process of *co-evolution*, in which the technology becomes increasingly easy to use and access while humans learn to use technology through social, cultural, and educational change — a process that, according to Landes, took over a hundred years in the case of wristwatches. Both sides of the co-evolution are fascinating in their own right but, as Clark points out, the technological story pales beside the human-centered story.

The example of timing technologies is but one example in a series of old and new technologies — pen, paper, written words, numerical notations, etc. — that allow what Clark, calls "scaffolded thinking." The unusual degree of cortical plasticity together with the unusually extended period of learning and development allows us to assimilate a whole range of nonbiological props, scaffoldings, tools, and resources, making humans (but not dogs, cats, or dolphins) natural-born cyborgs. The idea of scaffolded thinking provides a useful lens to examine some of the questions that we asked earlier. Similar ideas are also explored under the rubric of distributed cognition and activity theory in CSCW and HC literature (for example, Nardi 1998).

4.2. Interaction Engine

The anthropologist Stephen Levinson has introduced the concept of "interaction engine" as "a set of cognitive abilities and behavioral dispositions that synergistically work together to endow human face-to-face interaction with certain special qualities" (Enfield and Levinson 2006: 44). Levinson traces the origin of human sociality in our ability to attribute motivations and intentions to others, to simulate another actor's reading of one's own behavior, to have the motivating intentions recognized, and so forth. By embedding these individual-level capacities in, respectively, an "interpersonal matrix" and a "socio-cultural framework," this view seeks to understand universal constraints on social organization (Enfield and Levinson 2006: Introduction).

This approach raises an apparent tension between different levels of analysis – that is, between those who emphasize individual psychological capacities, those who focus on the emergent properties of the interaction matrix, and those who are interested in how social interaction is adapted to local sociocultural organization. This tension cannot be easily resolved, because reduction to any one level is not going to work and because the levels are mutually interdependent. The interaction matrix would not be possible without the interaction engine, but it is not "generated" by it either. It has higher-order emergent properties, reflected in the local and contingent actions and responses of individuals. In the same fashion, social institutions manifest historically contingent properties, although they too are realized through interaction. In short, as Enfield and Levinson conclude, "this will remain an interdisciplinary domain of inquiry, requiring input from disciplines with insights special to the different levels that make it up" (2006: 31).

Social Informatics can be informed by this interdisciplinary inquiry into the character of human interaction. But it can also contribute to it by focusing on computer-mediated interactions, which, as we saw, are the hallmark of contemporary life.

4.3 Social Simulation

The above ideas are being experimented by those social scientists who use computers for simulation. The social sciences seek to understand how the interaction of many individuals leads to large-scale outcomes. To explain macroscopic regularities such as social norms, institutions, and political systems they try to figure out how the autonomous local interactions of heterogeneous agents generate the given regularity (Epstein 2005: 1). Traditionally, social scientists approached this question by gathering qualitative data from interviews, observations, and surveys or by conducting studies that use quantitative data. While these methods can illustrate effectively the emergence of regularities, they are rather limited by the static nature of their data and by the inevitably impressionistic character of their analyses.

Computer simulations provide a useful way to overcome these limitations and to develop models of high clarity and precision. By making it necessary to think through one's basic assumptions, simulations force the analyst to specify every parameter and every relationship in an exact manner, also allowing others to inspect the model in great detail (ibid). One approach to implementing computer simulations is called "Agent-Based Modeling." This approach conceives complex systems as a set of agents that interact and adapt to changing environments. Starting with a description or theory of individual agents, it seeks to formulate rules of behavior that can be captured in computer programs. Based on these rules, the simulation can then be used to study the behavior of a system as a whole – that is, of how the system could evolve in time.[i]

In this fashion, agent-based models play a similar role in the social sciences to that of mathematics in the physical sciences (Gilbert and Troitzsch 2005: 5). Rather than providing mathematical models, however, what it does is to provide "generative explanations" of phenomena. To explain a pattern, it shows "how a population of cognitively plausible agents, interacting under plausible rules, could actually arrive at the pattern on time scales of interest" (Epstein 2005: 1). The motto, in other words, is: *If you didn't grow it, you didn't explain it* (ibid).

5. The Critical Gaze

A distinctive feature of SI, which separates it from popular and professional accounts, is its critical stance towards technology (Robbin and Day 2006). However, even in this respect the critical gaze of SI should take a more diffuse shape, going beyond the large-scale social and organizational implications of technology. The ubiquitous, but invisible, presence of computer technologies in our daily lives demands a subtle and critical examination of their consequences. Ironically, as new technologies become incorporated into our daily practice, we tend to notice them less, not more. Soon, we cease thinking of them as technologies at all. Some HCI experts advocate a vision of ubiquitous computing as benignly hidden – out of sight, out of mind, and out of the way (Weiser 1991). As Rogers (2006) has argued, this utopian vision portrays the average user as passive recipient of technology, leaving them at the mercy of machines and their designers. SI research cannot remain indifferent to these social and ethical questions.

Day (2007: 575) argues that, "social informatics was founded upon the notion of the *critical*, as the analysis of disjunctions between popular and professional claims about the social values and uses of information and communication technologies and the empirical reality of such." The importance of critical analysis, according to Day, is to bring into question established social assumptions and values regarding ICTs. Given the historical and cultural specificity of these assumptions and values, the challenge facing SI now is how to bring them into question so as to do justice to their contextual character but to also make a difference in social life.

6. Conclusion

In analyzing computing as social action SI has traditionally taken its lead from the symbolic interactionist school in sociology. This tradition should still be celebrated by SI researchers today. In fact, I believe that the suggestions made here are closely aligned with this school of thought. Howard Becker outlines three key assumptions of the interactionist view as follows:

- Human beings are active, not passive;

- Human conduct is never automatic, but always involves the possibility of a pause;
- During such pauses, the actor thinks about how others will respond to what he is thinking of doing, and adjusts what he was going to do to take account of that imagined response.

The notion of "pause," broadly understood, implies that human interactions are always *mediated*, mentally but also physically, symbolically, artifactually, etc. In an era of ubiquitous computer use, a good part of the mediation happens through computers, to the extent that, in developed countries, the computing world is almost coextensive with the human world. Under these circumstances, a discipline that studies computer-mediated interactions would be able to make a significant contribution to the key question of interactionism — namely, "What, in realistic detail, is the process by which people arrive at a common perspective that allows them to engage in effective collective action?" (Becker 2004). Social Informatics might well be one such discipline.

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