

Shifts in human-computer interaction : the internet as a mediation environment

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DISCUSSION FORUM

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SHIFTS IN HUMAN–COMPUTER INTERACTION: THE INTERNET AS A MEDIATION ENVIRONMENT

(POSITION PAPER)

The focus of the research on human-computer interaction (HCI) has shifted from interest in building interfaces for individual use to commitment to adapt technology to contexts of use. The development of computer-mediated communication (CMC) changed the aim of HCI from that of working to improve the cognitive compatibility between individual humans and computers to that of expanding the relationships between humans and their environments. The growth of the Internet has produced three main forms of use: information foraging, communicating and sharing, building virtual communities. In the electronic environments humans face unprecedented conditions; changes in human cognition and agency should be carefully monitored, in order to understand innovation as an ongoing process both technological and social.

Keywords: computer-mediated communication, human-computer interaction, information foraging, Internet, artifacts.

From individuals to contexts

The study of human-computer interaction (HCI) gained momentum in the early 80s, because of the usability problems created by the wide diffusion of the personal computer (PC) among novice users who usually lacked previous technical knowledge of electronic devices and were scarcely versed in technical matters (Mantovani 1994, 1995). The first

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phase of research on HCI — aimed at reducing the wide gap separating the different ways of computers and humans of processing information — gave priority to the goal of achieving better *cognitive* compatibility between computers and their human users (Card et al. 1983; Carroll 1987; Kieras and Polson 1985; Norman 1986). The second phase — which was prompted by the recognition that a perfect cognitive match between humans and computers could hardly be attained, due to the dissimilarities of cognitive resources available to the two parties — was directed at improving *communication* between computers and humans by appealing to pragmatics and conversation analysis (McGregor 1992; McTear 1985). The third phase — which started in the early 90s and has been thriving until now — has been centred on the *context of use* and considers the interaction between humans and computers dependent on the particular task to be achieved, on the cognitive resources available to the participants, on the peculiarities of everyday life situations (Bannon and Schmidt 1991; Lave 1988; Suchman 1987).

The emergence of the concept of *context of use* modified the agenda of HCI research because it encouraged designers of computer systems to cope with the dynamic everyday environments using intellectual tools such as the *scenario-based* design (Carroll 1994), the Scandinavian *participatory approach* (Bodker 1996; Schuler and Namioka 1993), and the *activity theory* perspective (Nardi 1996). Two converging processes favoured this shift from the cognitive to the contextual approach. The first one was the fact that, in the decade going from the mid 80s to the mid 90s, computer use underwent a tremendous change: individual use was quickly and massively replaced, both technologically and socially, by networked use. HCI studies became less concerned with the design of interfaces intended to enhance cognitive compatibility between isolated PCs and equally isolated individual users and began to worry about improving the connectivity among communities of humans and computers: early interest in individual cognitive compatibility with computers has been replaced in HCI research by attention to social and communicational processes (Mantovani 1996a; Sproull and Kiesler 1991). The second process which co-operated in pulling *context* to the forefront of HCI studies occurred within the domain of cognitive science in which focus is shifting from individual cognition and the role of representations (Newell 1990; Simon 1981) to the essentially embodied, socially distributed, and situated character of human cognition (Carassa 2000; Clancey 1997; Clark 1997).

Computer-mediated communication

The shift from the design of friendly cognitive interfaces for individual computer users to the commitment to foster effective connections among networks of humans and computers made HCI researchers sensitive to the central role that culture plays in the everyday life of human communities, in the distribution of knowledge among members of groups, and in the invention and use of artifacts (which stretch from language to hammers, from cognitive studies to computer systems). According to the cultural approach (Cole 1996; Hutchins 1995; Mantovani 2000), *social context* does not consist only of the collection of visible objects and people which surround each individual; it is made of the whole set of both visible and invisible instruments (material tools as well as immaterial ideas and social norms) that bind together the members of a community and give a definite meaning to their relationships with the environment and with themselves, thus making communication, co-operation, and social life possible (Mantovani 1996b). *Social context* is neither only «outside» nor only «inside» the individual mind, but is at the same time both «inside» and «outside» it: on one hand it shapes the minds of the individual members of a given community (by inspiring their intentions and actions and assigning people socially recognisable goals) and on the other it shapes the physical and social environment to make it suitable to the community which inhabits it.

The cultural approach considers HCI as a peculiar case of *mediation*. Artifacts, such as computers, are tools which mediate — i.e., guide and at the same time constrain — the interaction taking place between the members of a community and their environment. While early HCI research was centred on the problem of making it possible for individual users to achieve their previous usual goals by using the newly introduced computer systems without too much strain and effort, the cultural approach to HCI is more interested in the ways in which traditional practices are transformed by the introduction of computer systems, the ways in which communication changes with the advent of computer-mediated communication (CMC), and the ways in which technology itself undergoes deep transformations to be adapted to specific contexts of use. Research on CMC has been too often prone to «technological determinism», which maintains that technology has a generally positive effect on society. CMC was said (Sproull and Kiesler 1991) to encourage low-status people to express themselves in private and public spaces, thus favour-

ing personal openness and organisational democracy, thanks to a supposed absence (or temporary weakening) of social contexts in CMC. This position was challenged by researchers (Lea 1992; Spears and Lea 1992) who showed that social context is not lacking in CMC; on the contrary, it can even be present more strongly in CMC than in face-to-face communication.

CMC is now generally regarded as a mediation environment whose social «effects» depend not so much on the peculiar technology used (Kraut et al. 1994) but rather on the characteristics and purposes of the «communities of practice» (Wenger 1998) which adopt it: a democratic organisation will use CMC to help de-centre its decision-making processes while an autocratic one will use the network to increase surveillance and central control over the employees. The extraordinary success of the Internet ignited a hot debate which had wide national media coverage in the U.S. about the «impact» of the new communication technologies: field research carried out by eminent psychologists of the Carnegie Mellon University among individuals and families living in the area of Pittsburgh, Pennsylvania, (Kraut et al. 1998) found that intense use of the Internet reduced social involvement and increased loneliness and depression; McKenna and Bargh (2000) on the contrary maintain that the Internet does not induce *per se* a special kind of experience, neither pro-social nor anti-social, and that — as happens with other media such as TV or telephone — its alleged social «effects» depend mainly on individual interests and cultural context. This conclusion is in accord with the tenets of the cultural approach but arouses further questions about the ways in which the Internet mediates human cognition, communication, and society.

Information foraging in the Internet

How does the Internet mediate the human cognitive activity? The huge amount of information available on the Internet has changed the way in which we treat and consider information. While before the spread of the Internet information was generally a scarce resource to be carefully searched, in the Internet era information is superabundant and the problem is that of filtering relevant cues in a sea of useless information. What is scarce is no longer information but attention. Information itself is not knowledge — we are beginning to understand this — unless some social actor selects it, interprets it, and uses it to clarify ambiguous situations.

Acknowledging this point may give a jolt to the current model of cognition, which considers cognition simply a processing of information. In the web people adapt to an environment extremely rich of information in much the same way in which living organisms move in a natural habitat: they have to detect the opportunities present in their environments and they do this by communicating with each other, making coalitions, planning subtle and flexible strategies. Strategic action, neglected by canonical cognitive theory, is central in the *Information Foraging Theory* (Pirolli and Card 1999) which has been built just to account for the cognitive use of the information stored within the Internet.

New artifacts like the Net create unprecedented conditions for human experience; this in turn stimulates the invention of other novel artifacts to deal with the new conditions. To manage dense sets of information which would be practically intractable to human minds — think of huge databases such as the gigabytes of data on the functional imaging of human brain activity supplied by nuclear magnetic resonance machines — special software programs for *data mining* (Muggleton 1999; Mitchell 1999) have been developed. Even when information is not so deeply buried to require *data mining* it may be difficult for humans to find it: the metaphors of *navigating* or *surfing* the web give an idea of the problems that users meet in doing a search. Search engines (like AltaVista) provide a lot of information about what can be found in the Internet but they do it in a poorly organised way, mixing relevant with irrelevant information; directories (like Yahoo) supply more selected collections of data but cannot avoid giving lists of sites which are often too large for the time resources of people who are carrying out the search. Although a new generation of tools (like Google) seems more effective, the conflict between the mass of information available and the time required for exploring it persists.

An elegant approach to the problem of the information overload is that of using narrative forms of presentation of the answers to the queries: in this line Card et al. (1996) invented two software tools, *Web-Book* and *WebForager*, to connect collections of web pages; in a similar vein Terveen et al. (1999) designed an *Auditorium Visualization* to present clearly complex collections of sites. If the main characteristic of the Internet as a cognitive medium is abundance of information, then the major problem for the Internet surfers is that of getting lost at sea. As a consequence in the evaluation of the cognitive use of the web priority has to be given to clarity (and honesty) of presentation, memorability of the content, traceability of the route.

Communicating through the Net

How does the Internet mediate interpersonal communication? People look not only for information but also for support, affiliation, and recognition. A large part of the time that people spend in the web is devoted to activities like chatting, discussing, arguing, confiding — in one word, *sharing*. Kling (1999) estimates that 30 % of the domestic use of the Net is passed in *chat rooms*, *BBS* (*Bulletin Board Systems*), *MUDs* or *MOOs* (which are forms of basically textual virtual reality, sometimes endowed also with 3D graphic animation).

The cognitive use of the Net suffered from information overload; the communicative use of the Net suffers from a similar illness. The speed, easiness, and reliability in transferring great amounts of information from one place to the other in the world is not a problem; what can be a problem is the attention that the receiver of the message chooses to give it. Considering that the cost of sending a message through the web is often less than the cost of reading it — *junk mail* is just one effect of this imbalance — why should the receiver of an email message give its precious time to it? The standard model of communication as *information transfer* did not concern itself much with the co-operation among the participants — but we see that co-operation is necessary for the success of communication as a social process. The *information transfer* model is adequate for the engineers' side of communication but is defective for its social side: communication as a social process requires co-operation among participants and aims at building a (at least partly) shared meaning for the situations that individuals, groups, and organisations meet in their ordinary lives (Clark and Schaefer 1989).

In the Net people can share common interests, talk to one another, and establish significant relationships. But cyberspace is an environment different from the one in which face-to-face communication occurs. «In cyberspace, everything is in the dark», says Rheingold (1993: 61). Sincere self-disclosure and vile deception may mix in the Net, as appeared in the famous and widely discussed case of «Julie» (van Gelder 1991), a seriously disabled older woman, worthy member of an all-female electronic community, who used to send warm messages filled with optimism, beating on the keyboard with a stick fixed to her head. Many women became friends of «Julie» and felt indebted to her for the encouragements they received. Years later, thanks to the perseverance of a friend of Julie who insisted in trying to meet her face-to-face, it was discovered that «Julie» was in fact a

middle-aged male psychiatrist, not at all disabled. Many women felt themselves violated as their confidence had been gained through deception while others continued to appreciate «Julie» for the support she had offered them: two completely different ways to enter electronic parlours.

Just as the cognitive use of the Internet led us to discover the importance of attention, the communicative use of the web stresses the central role of social processes such as co-operation and sense-making. The darkness inherent in the communicative use of the Net can be reduced not only by use of «netiquette» but also by allowing participants to build shared cultural norms in order to keep the interaction on the «right» tracks with respect to the interests of the participants. As a consequence, a criterion to evaluate the quality of a communication site will be its capability to provide effective frameworks to support significant social interactions, such as the narrative structures present in MUDs and MOOs.

Communities in cyberspace

How does the Internet mediate the construction of virtual communities? It is not possible to give a simple answer to this question because the present use of the Web is highly diversified, ranging from e-commerce to gambling, from pornography to online psychotherapy. We have to take into account also the fact that the Net is moving toward a less U.S.-centric condition (Cohen 1999), with India, China, and developing countries finding their way in the Internet. We will consider here only two problems.

The first one regards the ways in which «presence» and «co-presence» can be experienced in electronic environments. This is a critical point for the development of virtual communities because the possibility of building fully working «communities of practices» in cyberspace depends on our capability of extending to the people connected by strong social ties the opportunities of sharing expertise that the Net already offers to people connected by weak social ties (Orr 1996). While most of the current research on immersive Virtual Environments assumes that a good computer simulation has to deal essentially with the perceptive aspects of the environment, we maintain that simulating a «real» working environment — such as a shared virtual office — requires more than the faithful reproduction of the physical features of the «external» reality (Mantovani and Riva 1999). What is necessary to simulate a social environment is making place for the web of artifacts (social rules, habits, hierarchies, rites) which

makes meaningful — and therefore socially visible — every normal working or living environment.

The second problem regards the «democratic» nature of the Net. There is growing evidence of the fact that search engines «systematically exclude (in some case by design, and in some accidentally) certain sites and certain types of sites in favor of others, systematically giving prominence to some at the expense of others» (Introna and Nissenbaum 2000: 169). Users seeking information on the Net are guided by browsers to sites whose owners pay to be indexed quickly and to be ranked high (Hansell 1999). The software agents — softbots, crawlers, spiders — which run the Web to retrieve documents to be indexed are biased in favour of the more powerful site owners: «of the 100 top sites, based on traffic, just 6 are not .com commercial sites. If we exclude universities, NASA, and U.S. government, this number drops to two» (Introna and Nissenbaum 2000: 177). If we consider that, according to Lawrence and Giles (1999), none of the major search engines was able to index (individually) more than 16 % of the total information indexable, we realise how little coverage of the Net is granted by current search engines and how little visibility is given in the Net to social actors who are not rich and mighty.

The present situation contrasts with the original values of the community of scientists and technologists who created the Internet intending it as a public space, a space accessible to everyone (King et al. 1997). These values, which were important in order to gain moral and political support for the spread of the Net, are now challenged — this is no wonder, as *artifacts are embedded social projects* and their growth requires investment of moral, political, and imaginative resources (Mantovani and Spagnolli 2000). Building friendly interfaces for individual use was the first move required to grant people access to the new electronic environments; engaging in the political debate about the future of the Net is the next move in the game of developing the human-computer interaction.

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PETER GLOTZ AND GÜNTER HACK*

(RESPONSE, 1)

When it comes to the topic of human-computer interaction, it always pays off to take a look back to the days when the foundations were being laid for our contemporary computer and communication systems. Thus, let us take a closer look at J.C.R. Licklider's famous article on Man-Computer Symbiosis (1960). Written in the still-optimistic climate of the USA in the early 1960s, the article calls not only for better interaction between humans and computers, but rather, as the term «symbiosis» already suggests, for a close *integration* of human and electronic information-processing processes. This was not unusual at the time when, sparked by Norbert Wiener's epoch-making book *Cybernetics* (1948), scientists pondered implanting people with cybernetic components (Clynes and Kline 1960) in order to enhance their performance in mission-critical situations.

Licklider's article on human-computer symbiosis focuses on how the overall workload in, e. g., a scientific project should be distributed among man and machine. By mentioning time-sharing options and even a network of so-called «thinking centers» (client/server computing environments), his thoughts already venture into the realm of computer-mediated communication, a field that he would be exploring eight years later in *The Computer as a Communication Device* (1968), wherein he describes an early prototype of a collaborative computing and conferencing environment set up by Douglas Engelbart, who used terminals connected to a time-sharing computer and even mice as pointing devices.

Licklider's articles neatly illustrate the conceptual movement mentioned in Prof. Mantovani's article from individual computer use towards a networked computer-mediated communication environment. Mantovani asks: «How does the Internet mediate the human cognitive activity?» Licklider answers: «Creative, interactive communication requires a plastic or moldable medium that can be modeled, a dynamic medium in which premises will flow into consequences, and above all a common medium that can be contributed to and experimented with by all» (Licklider 1968: 22). Form follows function — function follows form. One could ask what material Licklider's moldable medium is made out of, to what

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extent it could be stretched without losing its structural integrity.

The integrated cultural approach suggested by Mantovani provides a solid background for further studies in CMC and HCI. The bio/social environment provides the problems to be solved and the techno-economic background from which CMC technologies are emerging and to which they have to be adapted continuously. Despite Licklider's vision, the communication technology available cannot be morphed into any desired form so that it «guide[s] and at the same time constrain[s]» (Mantovani). What remains to be taken into account is the impact of those constraints on the communicating individuals who are using the system. This shows that it makes no sense to restrict research to either macro- or micro-sociological phenomena or technological details. Research on the effects of CMC and HCI should incorporate methods that can deal with the scaling effects that show up every time that an individual person and its computer connects themselves to the Net.

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GUSTAVO ROSSI*

(*RESPONSE, 2*)

I agree with most of the argument in Mantovani's paper. He indicates from an interesting perspective many of the problems that Internet users are suffering today. What is valuable from his point of view is the idea of the Internet as a mediation environment in which interfaces must encourage interactions among human beings. One could be skeptical about this possibility regarding some of the problems Mantovani mentions, such as the non-democratic nature of the Web and other well-known drawbacks of current tools such as the lost-in-hyperspace syndrome, among others.

However, I think that the Internet community has enough tools and concepts to build good solutions to these problems and to provide users with a powerful workbench for cooperation. And my position here is to stress the value of good design practices in the process of building Internet applications and infrastructures and the need to record these practices in order to re-use them in different contexts. What we need are Design Patterns for the Internet as a Mediation Environment.

Though the idea of patterns itself originated in urban architecture (Alexander et al. 1977), design patterns are being increasingly used in software systems (Gamma et al. 1995). Patterns record design experience by explaining and evaluating recurrent problems and proven solutions. They describe those problems in an abstract way and the core of the solution in such a way that it can be used with different instantiations of the same problem.

It is interesting to compare the original Alexandrian approach to patterns with our current needs in the Internet environment. Alexander aimed at describing regular structures in buildings and urban projects that made life better. Quality of life in his work is related to those (architectural) design decisions that help human beings to move, co-exist and interact in their environment. It is not surprising that these objectives are similar to the ones in Mantovani's paper. We need Internet-based systems and applications that facilitate collaboration among individuals.

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The impact of patterns in the process of building usable Internet applications may be important if we are able to gather a sufficient number of them and articulate existing design methods and strategies with the underlying idea behind those patterns. In this sense, mining successful design solutions (for example those appearing in effective, usable Internet applications) and recording them as patterns is a rewarding activity and our community should attempt to do this. The benefits that other communities (as for example the object-oriented one) have got from building good pattern catalogues show us that this is a good approach.

Patterns complement design methods as they show solutions that go beyond the use of primitives of a method. For example, a naive object-oriented designer will tend to follow closely the main concepts of the object paradigm, encapsulating structure and algorithms in the same object. However, complex problems require more «advanced» solutions, like the ones appearing in patterns such as Bridge, Strategy or State (Gamma et al. 1995). In those cases either the representation, the algorithms or the state of the object are further «objectified» and defined outside the object in the context of a separate hierarchy. In the same way, a novice Web designer will tend to link nodes in his application only with links with strong semantics. For example, in a library application books will have links to their authors. However, when browsing the set of books of a particular author, the user will have to go to the index to reach each book. A better solution would be to use Sets as first-class citizen and define links connecting each book to the following one by the same author. This example shows the ideas behind the Pattern Set-based Navigation (Rossi et al. 1999). This and other patterns have been recorded by the hypermedia community and gathered in a Catalogue (<http://www.designpattern.lu.unisi.ch>).

When we document a pattern, we describe which kinds of problems originate this micro-architecture, when it should be used, and what is the trade-off when using it. As explained in (Gamma et al. 1995), patterns are neither original nor new solutions to software problems; instead they are well proven and used strategies employed in successful developments. As such, patterns are not invented but discovered or «mined». Consequently, to expert designers these patterns may appear to be obvious, since they will reflect design choices they usually employ. But, for less experienced designers, these patterns will constitute a valuable source of design expertise, to be tapped when creating a new design.

In my opinion, the systematic recording and use of patterns will lead

us to a better set of tools for improving mediation and interaction through the Internet

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(RESPONSE, 3)

The paper addresses an very interesting theme: what is (or what should be) the focus of the Human Computer Interaction discipline. It raises a number of interesting questions and provides stimulating observations. In this respect the paper, globally, can be considered a good platform for a discussion. The weak points, however, are not few: the answers to the questions are often too quick and simplistic; there is a very strong bias toward one approach to HCI (the socio-psychological observation), basically ignoring all the others; it oscillates between, correctly, considering Internet a «medium», used in several different environments, and, wrongly, considering Internet a social environment on its own, about which general statements can be formulated.

Let us examine now, more in detail, what the paper says: one very interesting observation is that interaction between humans and computers can't be analyzed in general, but should be investigated in the context of

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specific situations and tasks to be accomplished. The weakness is twofold: first of all the paper seems to assume that this (probably correct) point of view is accepted by everybody in the HCI community, while it isn't true. Secondly the paper itself, in later sections, seems to ignore the observation.

Another interesting observation is that HCI should investigate the interaction between human beings, mediated by computers (should we call it HHCMI, human-to-human computer-mediated interaction?), rather than the interaction between a human being and a computer. The weak point, again, is an ambiguity in what paper actually says: is this point of view a recommendation of the author (and I would agree with the recommendation) or is it an observation about what the field of HCI actually is today (in this case I would strongly disagree with the author).

The whole section about «computer-mediated communication» is strongly biased toward a sociological perspective, neglecting a number of possible other perspectives. In some cases, in order to make a point, it oversimplifies reality. It is said, for example, that «... computers are tools which mediate, i.e., guide and at the same time constrain the interaction...». Consideration is not given to the fact that computers, beside guiding and constraining, also may, in some cases, enhance interaction among human beings, offering possibilities not available otherwise (think, as a trivial example, of the interaction offered by synchronous instant messaging, which has no obvious counterpart in the so-called «real world»).

Some «opinions» (possibly correct or possibly incorrect) are given as «granted», that the unwary user may take as «truths»: «... Internet reduced social involvement and increased loneliness and depression...», is an example. This statement, like many similar ones, is taken out of the context (see our initial comments) of the corresponding scientific investigation and may seriously mislead the reader.

The section «Information foraging in the Internet» is the weakest: it is not up-to-date in a technical sense, and it is very partial (incomplete) in the description of the current situation.

An interesting observation is that «What is scarce is no longer information but attention.» After this observation, however, the distinction about «information» and «knowledge» is very weak (it can't be reduced to the interpretation of an actor). «Strategic Action» not well elaborated, is considered as a kind of general solution or interpretation (it is not clear of what or to what). The discussion about «data mining» and «search engines» is very weak for two reasons: the tools are not well understood (for

what they «promise» and what they do), nor is their role in the overall organization and access to information in the computer age. This is the typical position of the «non professional» who does not sufficiently understand how the bulk of information is actually managed and accessed: information systems, Data Bases, Digital Libraries, etc..

What is contradictory in the section «Communicating through the Net» is the fact that it apparently ignores what was observed in the first section, i.e., the relevance of the social context. Statements such as «a large part of the time that people spend in the web is devoted to activities like chatting, discussing, arguing,...» fail to make a proper distinction between the professional context (users) of internet and the amateur context (users). It is like putting in the same pot professional interaction and everyday interaction: does it make sense?

It is also observed, properly and interestingly, that raising the attention of the receiver is more important than the amount of information transferred. Then, sentences such as «the *information transfer* model is adequate for the engineers' side of the communication [my note: what does it mean, and who said this?] but is defective for its social side...» leave the reader disoriented.

The section «community in the cyber space» is technically quite incorrect. It still presents the old belief (never shared by professionals) that immersive VR (Virtual Reality) is the best (or the most natural) way to interact with other human beings with a computer, or that «simulating a *real* working environment...» is a desirable goal. It is «known» that VR in general, and immersive VR in particular, has a very limited range of usage: almost negligible in professional situations, and a progressively reduced role even in areas such as entertainment. Games are an obvious exception, but that is a specialized «context», not adequately representing Internet as a whole.

The conclusion is that the paper is very stimulating and interesting, but, overall, needs to be «balanced» in a number of senses.