Inhabiting the virtual city:

The design of social environments for electronic communities

Judith Stefania Donath

B.A. History, Yale University, 1983
M.S. Visual Studies, Massachusetts Institute of Technology, 1986

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Author: _____

Program in Media Arts and Sciences
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Certified by: _____

Andrew Lippman
Associate Director, MIT Media Laboratory
Thesis Supervisor

Accepted by: _____

Stephen A. Benton
Departmental Committe on Graduate Students
Program in Media Arts and Sciences

Abstract

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by **Judith Stefania Donath**

Submitted to the Program in Media Arts and Sciences, School of Architecture and Planning, on October 31, 1996 in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

The goal of this work is to develop an approach to the design of on-line social environments. My thesis is that, in order to foster the development of vibrant and viable online communities, the environment – i.e. the technical infrastructure and user interface – must provide the means to communicate social cues and information: the participants must be able to perceive the social patterns of activity and affiliation and the community must be able to evolve a fluid and subtle cultural vocabulary.

The theoretical foundation for the research is drawn from traditional studies of society and culture and from observations of contemporary on-line systems. Starting with an analysis of the fundamental differences between real and virtual societies - most notably, the presence and absence of the body - the first section examines the ways social cues are communicated in the real world, discusses the limits imposed on on-line communities due to their mediated and bodiless nature, and explores directions that virtual societies can take that are impossible for physical ones.

These ideas form the basis for the main part of the thesis, a design platform for creating sociable virtual environments. The focus of the discussion is on the analysis of a set of implemented design experiments that explore three areas of the platform: the visual representations of social phenomena, the role of information spaces as contexts for communication, and the presentation of self in the virtual world.

Thesis Supervisor: Andrew Lippman
Title: Associate Director, MIT Media Laboratory

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Doctoral Committee

Advisor:

Andrew Lippman
Associate Director, Media Laboratory
MIT

Reader:

Lee Sproull
Professor of Management
Chair, Information Systems Department
Boston University

Reader:

William Mitchell
Professor of Architecture and Media Arts and Sciences
Dean, School of Architecture and Planning
MIT

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This dissertation is dedicated to the memory of my father, Stephen Henrik Donath (1914-1993). His lifelong quest to formulate the basis of a just society has been the inspiration for this work.

1 Introduction

William Whyte, describing what makes for a successful urban environment, said: "What attracts people most, in sum, is other people. If I labor the point, it is because many urban spaces are designed as though the opposite were true and as though what people liked best are the places they stay away from" (Whyte 1988).

Whyte went on to describe a number of places that attract people to them: they are places in which there are other people – sometimes familiar, often not. The key is an environment that is vigorous and populated, one that has a constant flow of human activity. Whyte's book is an argument against the design of spaces that do not draw people to them, against the bland corporate landscapes and sterile plazas, against places that may perform their stated function efficiently, but that fail in their community role.

The same principle – that the presence of other people is the key to a vital urban environment – is likely to hold true for electronic communities as well.

> People on the net should be thought of not only as solitary information processors but also as social beings. People are not only looking for information; they are also looking for affiliation, support and affirmation... If we view people as social actors, then we should view the net as a social technology. A social technology is one that makes it possible to find people with common interests, to talk with them and listen to them, and to sustain connections with them over time. (Sproull and Faraj 1993)

To a large extent, the future success of virtual communities depends on how well the tools for social interaction are designed. If they are poorly designed, the on-line world may feel like a vast concrete corporate plaza, with a few sterile benches: a place people hurry through on their way to work or home. If the tools are well designed, the on-line world will not only be inhabited, but will be able to support a wide range of interactions and relationships, from close collaboration to casual people watching.

This thesis is about the design of public space in the on-line world: it is about the design of the tools that allow people to interact with each other and that enable them to establish their identity in the on-line community.

1.1 The problem: designs for data, not people

Networked communities are quickly growing in size and importance.[1] Email is becoming a standard means of communication among friends as well as colleagues, telecommuting and virtual offices are changing the structure of corporation, and on-line discussion groups – on topics ranging from the care of cats to the revival of Islam – are growing in size and influence.

Yet, many of these communities have grown up haphazardly, evolving in environments that were designed for other purposes. The Usenet newsgroups, for example, were originally planned for the exchange of technical information. Although they are flourishing, their flaws as a social technology cause a number of problems: it is difficult to grasp how many people are involved in a forum; it is hard to develop a sense of who the participants in a discussion are; and there are increasing conflicts over anonymity and responsibility. The Web was designed as a way to manage information, a tool for scientists and researchers (Berners-Lee 1989). It has quickly evolved into mass publishing phenomenon, with sites created for everything from obscure rock bands and religious cults to global corporations; it has ushered in an era in which everyone, from great-grandparent to unborn child, is portrayed on a home page. Yet here too, an infrastructure designed for linking information is an imperfect solution when viewed as a social technology; for instance, visitors to a site are likely to share common interests, yet they cannot communicate with each other, nor are they aware of each other's presence.

In many organizations, groups of people are linked electronically, but the interface for communication is quite rudimentary. The Media Lab is a typical example of the situation in many institutions. We have a very large number of computers, a community that is global in extent (both frequent-flying faculty and far-flung alumni), and a computer-savvy populace. Many people work at home. Yet the primary electronic support for this community is the mail alias file and some Unix utilities such as *who* and *finger*. We are very far from the day when logging in from home or from Japan feels like joining the presence of one's colleagues.

Until recently, low bandwidth and slow processors restricted the form that on-line social environments could take. Today, advances in technology are removing many of the constraints and the black and white ASCII text world is yielding to graphics, sounds, new input devices, and rapid interaction. Yet more bandwidth and brighter colors do not alone create a better social environment – some of the most successful on-line communities, such as the WELL (Rheingold 1993), are among the most technically primitive. Having the technology is only the start: a

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1. August 1995 estimates put the number of Internet users - people who can browse the Web, send email, participate in on-line discussions - at 20-30 million. (Quarterman 1996). Access increased an estimated 50% between August 1995 and March 1996, along with changing demographics. The newer users come from a broader socio-economic background and are more likely to use the net for personal reasons (CommerceNet/Nielsen 1996).

deeper understanding of both interface design and of the sociology of on-line communities is needed in order to create truly viable on-line societies.

1.2 The structure of this thesis

This thesis develops an approach to the design of on-line social environments.

A social environment is anywhere that people interact with each other - anything from a city street to a business meeting, from a cocktail party to a line at the bank. In such environments people are constantly exchanging cues and social information, observing the appearance and behavior of others. These observations may be conscious, as when one tries to form an impression of a new acquaintance or size up how colleagues are reacting to a new idea. Or they may be subconscious, as in the way one picks up on changes in fashion – and in the cultural messages encoded in it. These observations and exchanges help us to make sense of the surrounding social world; they are fundamental to our ability to get to know each other.

In order for on-line systems to function well as social environments it is essential that the participants be able to communicate this sort of social information: they need to have a fluid and subtle cultural vocabulary for conveying social information and they must be able to perceive the patterns of activity and affiliation that reveal the structure of a community.

In the on-line world, the system design shapes and constrains how people communicate and how their cultural vocabulary, i.e. the means by which they express their identity, affiliation, etc., evolves. Thus, the designer's goal in creating an interface is not simply to make one that is attractive and easy to use, but to build a good infrastructure for social interaction: one that allows people to see (in what may be a very abstract sense) each other and that provides a rich environment for the development of a cultural meaning. The problem I am addressing in my dissertation is the design of this infrastructure.

The first part of my thesis ("The Virtual Society") develops the sociological and theoretical basis for this hypothesis. The research here draw upon traditional studies of society and culture and upon observations of contemporary on-line systems. The section begins with a discussion of how our knowledge of the real world, particularly of the built environment and of the social role of the body, can be applied to the design of the virtual world. The section continues with an overview of practices in existing on-line environments, focused on the establishment and perception of identity.

The second part of the thesis ("Design for the Virtual City") proposes a design platform for creating sociable virtual environments. Three areas are emphasized: the creation of visual representations of social phenomena, the role of information spaces as contexts for communication, and the portrayal of individuals in the virtual world. The series of projects that I have undertaken as part of my doctoral studies are discussed in-depth, providing examples of these design principles in action.

Part I: The virtual society

The virtual world is in many ways quite different from the physical. It is a mediated environment: all interactions pass through and are transformed by a communication channel. It is wholly man-made: explicit decisions by the system designers ultimately determine what can be seen, heard, and done within it. And it is immaterial: the on-line world and its inhabitants are without solid physical presence. Such an environment brings very different freedoms – and limitations – to the on-line social world.

Yet the two worlds also share many essential qualities. Real-world and virtual communities are, after all, inhabited by the same people whose underlying interests, needs and motivations are common to both environments (Wellman and Gulia 1996).

In order to design virtual environments that function well and that make use of the possibilities presented by the electronic world's novel capabilities, it is useful to consider the underlying theoretical issues. What are the differences – and the similarities – between a virtual society and a real one? What qualities of the real world do we want to replicate on-line – and can we? What are the potentials of a virtual society, possibilities unrealizable in the physical domain? These are complex and controversial questions. My purpose in addressing them in this section of the thesis is not to attempt a definitive answer, but to provide a basis for the design ideas set forth in the second section.

CHAPTER 2 begins with an introduction to the metaphor of the city. Because the virtual world is abstract and the directions in which it will develop still highly speculative, it is very useful to have a more concrete way of thinking about it. The city metaphor is pertinent both for thinking about the design of the virtual environments themselves and for understanding the role of the designer/architect.

Real world cities are inhabited by physical beings; virtual cities are not. Arguably, the major difference between real and virtual worlds is the body: it is the lack of physical presence that allows the on-line communities to transcend space – and it is the same lack that can make on-line communication sporadic and affectless. I next discuss the social role of body, looking specifically at expression, presence, recognition and social control. These are fundamental to communication and the formation of a coherent society. For the designer of

environments for the disembodied, it is important to be cognizant of these missing features – whether the goal of the design is to replicate their functions or to explore the culture that develops in their absence.

CHAPTER 3 turns to the contemporary on-line world. Today's systems provide the foundations of what will be built in the future. Not only is there an existing infrastructure, used by millions world-wide, that future systems will be built upon, but there is already a nascent culture on the net, with a growing vocabulary, mythology, and established (though often disputed) social mores. In this chapter I look at three environments – MUDs, Usenet newgroups, and the Web. My focus is on how identity is established in each of these areas.

Identity, both in the guise of personal identity (who you are) and of social identity (whom you are like), is basic to the formation of a society. We need to know each others identity in order to form affiliations, interpret communications, and establish responsibility and reputation. Yet identity on-line is problematic. Cues are missing, it is malleable and ephemeral. The body, which anchors identity in the real world, is absent.

This problem of identity in the on-line world is a theme that runs through the entire thesis. The discussion of the body (CHAPTER 2) is in essence a discussion of aspects of identity; the review of contemporary environments (CHAPTER 3) focuses on it; and the designs in the second section of the paper all address the establishment and communication of identity. Yet, as the metaphor of the city and the architect highlights, the construction of identity is not something the designer addresses directly. Rather, the goal is to create an environment in which the inhabitants can develop ways of establishing and expressing identity that are well suited to their evolving society.

2 The city and the body

2.1 The metaphorical city

Designing the virtual environment is a challenging problem. In its newness and abstraction, it presents a nearly blank canvas to the designer. There is neither an inherent form nor much history and shared culture on which to base a design. Its features are unprecedented: millions of people worldwide are able to communicate with each other and share information, transcending the accustomed limitations of time and space. Its infrastructure is in constant flux: these people are communicating through channels that were non-existent five years ago and which are likely to be superseded in the next five.

The metaphor of the city is a very useful tool for thinking about the virtual world. The virtual world is abstract and unknown; the city is physical and, though very complex, better known. Here I will look at some of the key parallels between real cities and virtual spaces and between city architects and on-line system designers.

A metaphor is a cognitive tool, a way of structuring thought. In particular, metaphor is useful (and arguably essential) for thinking about abstractions[1]. The cultural and symbolic meaning of "city" helps shape our conception of what this new world should be like; using the metaphor transfers the meaning of "city" to the abstract virtual environment (Leiss et al. 1990; Eco 1984). And, while the net is "fundamentally and profoundly anti-spatial" (Mitchell 1995), a physical metaphor makes the abstract comprehensible: our constant experience of the spatial world makes such metaphors both powerful and pervasive (Lakoff and Johnson 1980).

There are parallels both between real-world cities and virtual environments as well as between real-world architect and virtual system designers. Both real-world and virtual cities are (or should be) vibrant gathering places of people, centers of commerce and entertainment. The designers of both urban spaces and of virtual system are creating environments that influence the interactions that occur within them and the culture that grows around them. But there are also

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1. See Lakoff and Johnson 1980 for a full treatment of the cognitive role of metaphor; Eco 1984 for a semiotic and philosophical approach.

important differences. In the real world, the designer creates a solid infrastructure of buildings, streets, etc., around which people and objects move. In the virtual world, the designer is working with very different materials and with a much more encompassing task. The whole communication structure and the means by which human beings are represented must be designed; it is as if an architect was responsible not only for making a building, but also the organs of sight by which the inhabitants viewed it.

2.1.1 Parallels: the real and the virtual city

Many points of comparison can be drawn between the physical and the virtual city. In *City of Bits* (Mitchell 1995), William Mitchell surveys wide range of them, examining the city metaphor in roles ranging from the aesthetic and physical to the economic and political. His analysis highlights the key points of comparison in a series of analogies: "Muscles / Actuators", "Facade / Interface", "Territory / Topology", "Enclosure / Encryption", etc.

My focus is on the cultural and social parallels: on how the structure of the city affects the life within it and how cultural vocabularies and social institutions evolve in response.

2.1.1.1 The landscape of strangers

One of the strongest parallels between the city and the virtual world is their immense populations. Modern cities are filled with strangers, huge crowds of people one passes on the street but does not know. This is very different from life in a village. It is different even from life in the classical cities – the *polis* whose agora and civil life are so often cited in discussions of electronic community.[2] This continuous exposure to unknown persons, of diverse and often unfamiliar backgrounds and habits, has been cited by many urban theorists as one of the most salient characteristics of city life (Canetti 1984; Milgram 1977; Sennett 1974; Simmel 1971; Wirth 1938).

The virtual world is similarly populated by millions of people, most of whom are strangers to each other. Examining how this population pattern has shaped real world city culture can help us understand the forces that are shaping the development of on-line cultures. Furthermore, the analogy can point to designs that may help the virtual city avoid some of the real city's problems; it can also suggest directions that may be especially fruitful to explore.

The immense population of the city means that urban social ties are relatively weak. Many of one's daily encounters with others, such as making a purchase at a register, sitting beside someone on a bus, are faceted and limited (Wirth 1938; Milgram 1977). Surrounded by strangers, the inhabitant of the city is much more

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2. Plato wrote that the ideal population of a city was 5000, Aristotle said that each citizen should know all others by sight (Kitto 1957). For the ancient Greeks, the city was a not a place of strangers; it was an extensive, but familiar community.

anonymous than the small town dweller. This can be liberating – one has more social freedom in the city – but also alienating. Anonymity also diminishes social constraints on behavior: people may be ruder (or worse) among strangers whom they are unlikely to see again than they would be if in the company of acquaintances (Milgram 1977).

Ties in the virtual world are also weak. Here too, many of one's daily encounters with others show only a narrow facet of their lives and personalities, occurring as they do in specialized and limited venues (e.g. motorcyclist newsgroups, Perl programming forums, new parent chat spaces, etc.). As in the real world, the resulting anonymity is both liberating and alienating (Donath n.d.; Sproull and Kiesler 1991). Anonymous on-line discussion spaces allow people to candidly discuss personal or controversial matters – one can, for example, seek information about a medical problem without making one's condition publicly known or discuss unpopular political beliefs without reprisal (Froomkin 1995; May 1994). Yet anonymity is also cited as one of the reasons why on-line discussions so often degenerate into angry exchanges. Anonymity hides the offending writer from retribution. Furthermore, in an anonymous setting there are few reminders of the mores of social interaction, which are often cued by the identity of the other (e.g. one speaks – or avoids speaking – in certain ways in front of children or older people or one's boss or clergy, etc.).

Yet alienation need not be the inevitable result of immense population. Many urban theorists cite internal structures, such as close-knit neighborhoods, as constructs that provide an intermediate environment between the complete anonymity of the city at large and the deep relationships of close friends and family (Jacobs 1992; Milgram 1977). For the designer of virtual environments, the analyses and solutions posed by their real-world counterparts can provide useful insights. Virtual neighborhoods are not a new concept (Rheingold 1993; Mitchell 1995), but there is much still to be gathered from the metaphor in terms of understanding what the salient features of "neighborhood" are and what makes some neighborhoods particularly successful. For instance, both Jacobs (Jacobs 1992) and Whyte (Whyte 1988) emphasize the importance of mixed-use occupancy to strengthen neighborhoods; the combination of work, recreation and residential space, they say, bring a heterogeneous population and results in fuller utilization of the existing resources, especially over time, avoiding the emptiness of the business district at night or the suburban bedroom community by day. The concept of mixed-use can be carried to the virtual realm, inspiring the creation of venues that are accessed by varied groups. An example is the notion of "surrounding neighborhoods" on the web (see the discussion in CHAPTER 4 about multiple links to *Portraits in Cyberspace* and the wide range of opinions found in the on-line discussions there.)

The characteristics of the city – its density, size, heterogeneity – have elicited cultural responses that are distinctly urban. These responses show the adaptations people have made in order to best benefit from urban conditions. An especially interesting cultural development, from the point of view of the virtual designer, is fashion. The rise of fashion is an urban phenomenon. It has been attributed, in

part, to the need to establish one's identity within a population of strangers, while also maintaining an essential privacy (Ewen 1988; Sennett 1974). Describing how immigrants to the city became acculturated, Ewen wrote:

> In such a broad milieu of strangers, style was a dramatic necessity. One was repeatedly made aware of *self as other*, of one's commodity status within a vast social marketplace, and style provided its user with a powerful medium of encounter and exchange... [S]tyle allowed one to put up a front, to protect one's inner self... True moderns, they were learning to internalize the dictum of Bishop Berkeley, that "to be is to be perceived". (Ewen 1988)

The inhabitants of today's virtual environments are similarly faced with competing desires: to be known yet not be exposed. One can see today's Web home page as the cultural equivalent of clothing, a personal display created for public viewing. As I will discuss in CHAPTER 3, elements of the home page exhibit the social features of fashion: their meaning changes over time as their use shifts to different social groups and these changes may be attributable to conflicting goals of differentiation and imitation (McCracken 1988).

2.1.1.2 The legible city

The design of the city affects not only how well its inhabitants can find their way around, but how well they can make sense of its social and symbolic complexities (Lynch 1960; Milgram 1977). Kevin Lynch, writing about importance of a "legible" environment, said:

> Obviously a clear image enables one to move about easily and quickly: to find a friend's house or a policeman or a button store. But an ordered environment can do more than this; it may serve as a broad frame of reference, an organizer of activity or belief or knowledge... Like any good framework, such a structure gives the individual a possibility of choice and a starting-point for the acquisition of further information. A clear image of the surroundings is thus a useful basis for individual growth. (Lynch 1960)

The inhabitants of the virtual city have similar needs. They need to be able to get from one place to another, to know what is available and who are their fellow inhabitants. The abstract nature of the on-line world makes a legible environment especially important: a poorly conceived interface is far more impenetrable than the most twisted alleyways.

Both Lynch and Milgram asked inhabitants to draw maps of their city; their goal was to understand how the structure of the city was perceived. Comparisons of these maps showed much individual variation in the features portrayed, based on personal interests and experiences; they also showed group patterns, attributable to differences in class and other affiliations; and they showed architectural and spatial elements that were common to all. An important conclusion from their studies is that legibility in an environment is not at all the same as legibility in, say, a chart, which should have simplicity and clean, grid-like structures. Instead, it is based on memorable structures and symbolic spaces, on the existence of areas with distinctive visual styles. The overly planned space, with its clearly laid paths, may be in effect the least legible because it does not contain the richness of detail that helps one to remember a space. This is an important idea in the design

of virtual spaces, where the temptation to create geometrically striking, but indistinguishable spaces is strong.

2.1.2 The architect and the system designer

The city metaphor extends also to the parallels between their respective builders: the urban architect and the designer of virtual spaces. The metaphor of system designer as city planner and architect is the basis of the methodology of this thesis.

Design is not a quantifiable science. Though the usability of certain features can be measured (much as ergonomists measure stair-treads for safety and human factors specialists measure menu designs for speed), much design assessment is subjective. One studies things that have been built, to see how they were used and how people changed and adapted them (Brand 1994); from this, one develops an approach to the design of new spaces.

The architect must understand the technology of buildings, the properties of materials and the forces that make buildings stay up (or fall down); the architect must also understand how the buildings and street plans and lighting designs will affect the people who inhabit them.

> On one side there is the engineering side of building: a matter of calculating loads and stresses, of making joints watertight and roofs rainproof, of setting down foundations so solidly that the building that stands on them will not crack or sink. But on the other side there is the whole sphere of expression, the attempt to use the constructional forms in such a way as to convey the meaning of the building to the spectator and user, and enable him, with a fuller response on his own side, to participate in its functions – feeling more courtly when he enters a palace... more businesslike and efficient when he enters an office.... and more citizenlike, more cooperative and responsible, more proudly conscious of the community he serves when he goes about his city and participates in its many-sided life. Architecture, in the sense that I here present it to you, is the permanent setting of a culture against which its social drama can be played out with the fullest help to the actors. (Mumford 1952)

Like the architect, the designer of the virtual space must also understand the technology, knowing what is feasible to build today or next year, and what problems, often seemingly simple ones, are still very far from a solution. And, like the architect, the designer's primary role is to create a social environment.

> Architecture may not *determine* human behavior, but... bad design can numb the human spirit and good design can have powerful, positive influences on human being. Of the many values designers seek to build into their designs perhaps none is more important than fostering community and human interaction. (LeGates and Stout 1996)

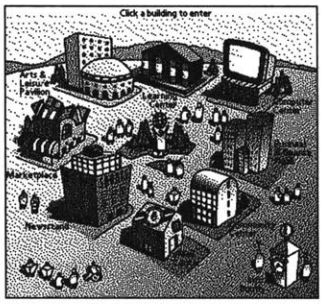
There are, however, important differences between the role of the architect and of the designer of virtual spaces. In the real world, the built environment is only a small part of the environment as a whole. In the virtual world, the built environment is everything: it is a wholly mediated and synthetic world. The participants in a virtual world are wholly dependent upon the tools supplied by the creators of the space to communicate. The choices made by the designer of a

virtual environment thus greatly influence and constrain the means of communication and the ways in which a cultural vocabulary develops.

The architect of a virtual space shapes the community in a more profound way than does his or her real-world counterpart. People eat, sleep, and work in buildings; the buildings affect how happily they do these things. But the buildings do not completely control their perception of the world. In the electronic domain, the design of the environment is everything. Whether or not you know that other people are present or privy to a conversation, whether you can connect an on-line identity to a real-world person, whether you have only a faint notion of the personalities of those around you or a vibrant and detailed impression - this is all determined by the design of the environment.

2.1.3 Designing the new

The city metaphor has resonance and depth, for there are many parallels between the city and the virtual world, and the city metaphor provides many striking images with which to think about building on-line environments. It is thus not surprising that the metaphor is in common usage: Digital Cities and Electropolises and Downtown Cyberspaces abound. Yet, too often, the city metaphor is taken literally and the resulting interfaces do not provide the functions of a city; they merely replicate the facade.



Apple's eworld takes the city metaphor quite literally.

"Attention Virtual Shoppers... Now Entering Cyber City!" is the welcoming banner on the web-page of `alltelga.net`, home thus far of Beckler's Carpet Outlet, Club Atlanta Travel and Kinard Realty, and where a cartoon of the still empty Main Street awaits more tenants. On many sites the city takes the shape of a graphical map, where various functions have been placed in appropriate, clickable buildings: email in the post office; shopping sites in the store; customer service complaints in the courthouse. Here the metaphor is used, but only superficially, the pictures simply substituting for a category label.

On other sites, the metaphor draws from rather questionable features of the subject. In GeoCities, "our Homesteaders set up residency in one of our twenty-four themed communities, based on the content of their home page." Here, the creators are replicating the feel and function of carefully monitored, gated neighborhoods and regulated facades, what Sorkin called "a generic urbanism inflected only by appliqué."(Sorkin 1992b)

The electronic city is endlessly mutable. Its structure can grow and change at rates inconceivable in a world of brick and stone; its appearance may be highly subjective, individually tailored to the taste of every visitor. The city metaphor works when it is applied functionally, i.e. when we think about the role of public spaces in social life and the use of landmarks in building collective memories.

As technology advances, it becomes increasingly possible to recreate the experience of "being there" while separated by thousands of miles. In this thesis, my emphasis is on understandable, yet novel forms of communication and representation – on interfaces that go "beyond being there" (Hollan and Stornetta 1992). While it may be possible soon to have full video/audio in a synthetic space

– or to recreate Rome in a 3D walk-thru – my emphasis is with what can be done that is new, that goes beyond the literal re-creation of the physical world.

2.2 The social function of the body

The fundamental difference between inhabiting the real city and its virtual counterpart is the lack of a body. I will next look at several basic social functions of the body, such as individual recognition, gestural communication, and corporeal discipline. Their absence in the virtual world is a fundamental design issue: the key feature of many designs is either to re-create these functions or to explore new modes of interaction made possible by their absence.

Understanding the social function of these physically-based qualities makes it possible to evaluate the impact, both positive and negative, of their absence in the on-line world. In some cases, their absence may be beneficial, making new forms of modes of communication possible; in others, where the absence of a quality is detrimental, it may be possible to reconstruct its function – possibly in a very different form – on-line.

2.2.1 Expression

Much real-world communication is nonverbal, consisting of physical actions such as gestures, facial expressions, vocal tone, etc. Many social signals, especially, are communicated this way: subtle (or not so subtle) expressions of approval, status recognition, comprehension, etc. Unlike the written word, which is deliberately produced and passes through much conscious filtering, nonverbal expressions are often made subconsciously, often revealing a great deal about their maker's ideas and opinions.

Expression has many social roles. It is an integral part of speech, conveying cues about turn-taking and attention (Cassell et al 1994); it communicates emotion, both real and feigned (Goffman 1959; Hauser 1996); it is the fundamental channel for social communication (Landau 1989), signalling agreement, doubt, sympathy, etc.

This sort of expressive gesture is missing from today's text-based on-line environments. A number of researchers have studied the social effects of this lack (Sproull and Kiesler 1991), as well as some innovative attempts to reintroduce social cues (Reid 1991). The remedying of this situation is a very active research area, both in the creation of facial and gestural interfaces (e.g. Waters and Terzopoulos 1992, Cassell et al 1994) and in the perception of gestural input (e.g. Thórisson 1995).

A growing number of studies of faces and facial expression in computer environments provide very useful insights into how these reactions are transferred to the computer environment. (Sproull et al. n.d.) looked at viewer's responses to computer interfaces with simulated, human-like faces. They found that people responded to a facial interface in a more socialized way: they

attributed personality to the face and presented themselves more positively in interactions with a facial rather than text display. This is consistent with (Nass et al. 1994)'s findings that people very easily and "incurably" apply social norms and rules to their interactions with computers.

These experiments also point out the importance of evaluating all of the effects of a face in the interface. A face, even a simple cartoon face, will convey numerous cues, about its emotional state or attentiveness, etc., even if none were meant. If the goal is to have an interface that can, say, convey a set of emotional states, or turn-taking cues, a facial image may be the solution, but it will also affect the character of the interaction in other, complex ways.

Our perception of facial expressions is both innately hard-wired and culturally learned. We are highly receptive to facial expression. There is evidence that babies several hours old recognized faces: they respond to face-like configurations, but not to random ones (Hauser 1996). Once we perceive an arrangement to be a face, we ascribe an emotional state to it: "any configuration which we can interpret as a face, however badly drawn, will *ipso facto* have such an expression and individuality." (Gombrich 1972) Furthermore, there is growing evidence that *what* emotion we will ascribe to it is also to some degree innate. Cross-cultural studies of emotional expression have shown strong correlations across disparate cultures, both in field studies (Ekman 1973) and in physiological experiments (Hauser 1996). These fundamental parameters of expression perception delineate the boundaries of how faces can be used in the interface: face-like configurations will almost invariably be perceived as faces, and there an existing gamut of basic and universal expressions.

On the other hand, *when* and *how* a particular expression is deployed is culture dependent, as are a great many other communicative gestures, such as bowing in Japan, or shaking the head horizontally for no (as opposed to the vertical nod for the negative which is used in North Africa). Like learning a language, learning when an expression is appropriate and how to use culturally dependent gestures is part of the process of gaining communicative competence (Saville-Troike 1982). Learning expressions and gestures is done through imitation; infants as young as an hour old have been observed imitating facial expressions. And imitating expressions can itself create the portrayed emotion. Experimental subjects, when asked to produce a smile or a frown of anger, showed significant correlated physical responses, such as raised heart rate and skin conductance in the case of anger (Hauser 1996). Thus the face plays a role in empathy (Landau 1989): we see someone express an emotion and respond by imitating the expression which in turn causes us to experience some amount of their emotion.

The presence of a expressive face on the screen is not a passive image, but a highly and often subtly interactive one. A vocabulary of computer-mediated expressions cannot be developed purely by design; rather, it need to evolve within the communicative context. In the real world, learning expression is done in a highly interactive environment: one produces an expression, it is perceived and the perceiver reacts, providing feedback to the producer. Reproducing something of this chain of action and reaction is an important part of developing

Emoticons reflect real world expressions.

And, like physical gestures, they vary between cultures. Japanese emoticons (which are viewed right side up, rather than sideways as is common elsewhere) include a girl's smile with a dot for a mouth, since it is impolite for women to show their teeth:

(^.^)

and a "banzai" smile with arms upraised in a Japanese gesture.

\(^_^)/

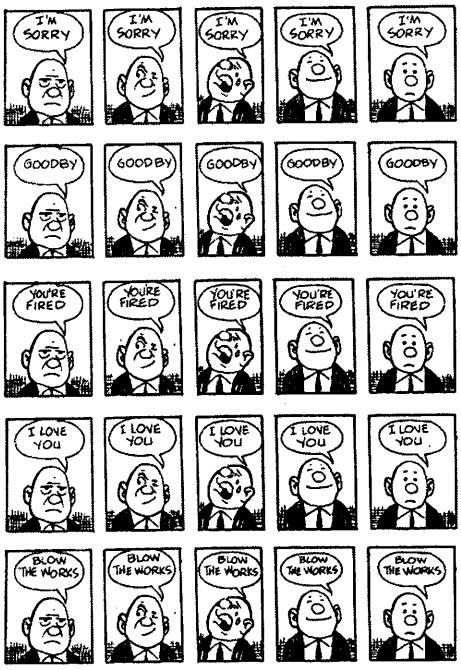
Among the most commonly used emoticons in Japan are two that have no real equivalent in the Western version – a cold sweat:

(^^;)

and one that says I'm sorry:

(_o_)

- New York Times, August 12, 1996



Facial expression affects the meaning of words.

Eisner's illustration of how variations in facial expressions transform the meaning of the words they accompany demonstrates both the care which needs to be taken in implementing expressive faces in a computer interface and the richness that even (or especially?) a cartoon rendering can bring (Eisner 1990).

a virtual expressive vocabulary; however, the sparseness of existing communication channels may prove to be quite problematic.

As will be discussed in greater detail in CHAPTER 6, there are a great many technical and interface problems still to be solved before a truly expressive face can be part of the a computer mediated discussion. The face is not the only way to portray emotion: a line can be evocative (Arnheim 1974); a bouncing ball can narrate dramatic emotional ranges (Disney). It is far from clear that re-creating the form of real world expression, such as interfaces with faces that smile or frown, is the best or only way to achieve seamless communication of expression on-line. Here, we have introduced some of *what* is communicated, expanding the possibilities of *how* to communicate it.

2.2.2 Presence

A key part of what makes a successful public social space is the presence of others (Whyte 1988). In the space-less world of cyberspace, presence is abstracted from its usual meaning of being in a shared physical vicinity. Yet it is clear that people do feel some sense of the presence of others on-line, both in real-time conversations and simply by seeing who is currently logged in.

Researchers working with ubiquitous video conferencing systems (see, for instance Isaacs and Tang 1994, Dourish and Bly 1992, Beshers and Feiner 1993) have observed that, even though a variety of conferencing and other functions are available, people used the systems primarily to gain a sense of who else is around. Bly et al record that participants in the *Media Spaces* project, who had full access to a wide range of teleconferencing functions, often chose to use the system to keep open a window showing the comings and goings of people

passing through a central area. "Although seemingly the most invisible, the use of the media space for *peripheral awareness* was perhaps its most powerful use."(Bly et al. 1993)

Presence, or at least some aspects of it, can be transmitted via media ranging from the most simple and abstract to the most seemingly realistic. It seems to transcend knowledge of real-world physical distances: studies have found that not only are people much more expressive when they are in the company of others than when alone, they are as expressive when they *imagine* themselves to be with others as when the others are actually present (Hauser 1996). Thus the common phenomenon of people on the telephone gesticulating and making faces, which are of course invisible to the person at the other end.

Seeing the signs of other people's actions is one way of conveying a sense of their presence. Seeing the patterns made by people's activities is fascinating. We are social creatures and like to feel that we are not alone; we are curious and like to know what other people are doing. An interesting example of presence conveyed by patterns can be seen on the Web. One of the search engines has a "voyeur" site that puts up, every 20 seconds, an assortment of the currently processed searches. First you see:

> new york times • architecture • hogarth print • nude celeberties actresses • playboy • pressedienst • japan spanking • woman having birth pictures • fire proof plants • october • conceptual framework • chat adult • fat acceptance • parasites • college chat • larsen judith • digital and express and provider • streamworks • photomultiplier microstrip porouse • bone thugs

And a minute later:

> denver broncos • free stuff • cindy crawford nude picture • intestinal parasites dogs • shannon tweed • snowcone syrup • erotic free pictures • porsche • nude sex • barcelona • wedding souvenirs • the weather channel • small bikinis • hot tubs • amp schematics • blonde jokes • australian soccer profiles •kodak • volkswagen fuel system • novi sad

Besides confirming that, whether or not there is a lot of sex on the net, there are certainly a lot of people looking for it, this feature provides one of the strongest impressions of presence on the Web[3]. The ongoing appearance of new searches provides the impression that many others are simultaneously at that site. The topics provide a hint of the individuals behind each search. And the return of some entries, slightly varied ("parasites" above became "intestinal parasites dogs") shows the searcher struggling with results that are too extensive or too small.

Change is essential to the perception of presence. If we believe that some immediate change in our environment occurred through the actions of another, we have a sense of their presence, even if not physically co-located. This especially so if the change is interactive, responding to some action of ours. In

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3. The solitude of the Web – there are few mechanisms for encountering or communicating with any of the millions of other visitors – is one of its main drawbacks as a social technology. CHAPTER 4 discusses designs for alleviating this.

the virtual world, this interaction is found in the real-time conversation spaces, such as MUDs and chat-rooms, where one's typed comments are immediately transmitted to the screens of all other participants. While the content of chat-room conversations may seem inane, they do successfully communicate a sense of being in a live, inhabited space. Such conversations are more about conveying presence than they are about the text of the words.

There are some aspects of physical presence that cannot be conveyed through media. A noteworthy example is the crowd – physical presence in the extreme *(Canetti 1984;* Milgram 1977*)*. Here, the physical power of the group, both as an anonymous force capable of immense and destructive feats and as a force upon the individual in the crowd, is a salient feature that is absent in the virtual world. Is the crowd wholly outside the virtual experience? Is there a design that would make palpable the sensation that one was indeed on-line in the company of millions of other people?

The experience of being on-line is in many ways a solitary one. One sits alone, facing a screen. Yet, connected to that screen is an immense population – and also smaller, more comprehensible groups, one's friends, co-workers, etc. The question here is how to provide a real sense of their presence.

2.2.3 Control

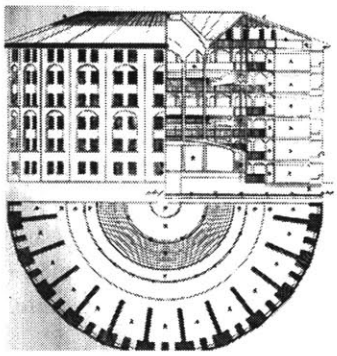
The body is central to social control and discipline: it is hard to catch a disembodied being. Without the body incarceration is impossible and less extreme aspects of social control are difficult. The ease of creating alternate personas in a virtual world raises important questions about the nature of virtual boundaries.

The role of the body in social control is addressed by a number of Foucault's writings, particularly *Discipline and Punish*, his survey of the progression to increasingly internalized forms of discipline (Foucault 1979). The book begins with the gruesome torture and dismemberment of an 18th century regicide (punishment centered entirely on the body); traces the birth and development of prisons (control through bodily constraint and, increasingly, through the reformation of the prisoner); describes the panopticon (discipline conducted through surveillance and knowledge); and concludes with what he calls "the carceral network" (in which discipline is diffused throughout society).

> The extreme point of penal justice under the Ancien Régime was the infinite segmentation of the body of the regicide... The ideal point of penalty today would be an indefinite discipline: an interrogation without end, an investigation that would be extended without limit to a meticulous and ever more analytical observation, a judgement that would at the same time be the constitution of a file that was never closed... (Foucault 1979)

Foucault's history points to a diminishing role of the body as focus for social control, and the rise of greater control through ubiquitous surveillance.

The specter of all-seeing, unseeable surveillance provides one common dystopian view of cyberspace: a regimented and monitored society, identity



The Panopticon

This penitentiary system was originally described by Jeremy Bentham as a circular architecture, designed for continuous and invisible observation of the inhabitants/ inmates from a central point.

Image from (CFUS 1996).

clearly marked, one's history fully scannable – an electronic carceral city (Mitchell 1995). Yet the body's role remains central. If the virtual identity does not connect to the physical self, the meaningfulness of surveillance on an ephemeral population is unclear[4]. In what has become known as the "The Rape in Cyberspace case", a player on a MUD committed a series of anti-social acts against other players. Eventually he was "toaded" – the virtual character, Mr. Bungle, ceased to exist.

> Yet the continued dependence on death as the ultimate keeper of the peace suggests that this new MOO order may not be built on the most solid of foundations. For if life on LambdaMOO began to acquire more coherence in the wake of the toading, death retained all the fuzziness of pre-Bungle days. This truth was rather dramatically borne out, not too many days after Bungle departed, by the arrival of a strange new character named Dr. Jest. There was a forceful eccentricity to the newcomer's manner, but the oddest thing about his style was its striking yet unnameable familiarity. And when he developed the annoying habit of stuffing fellow players into a jar containing a tiny simulacrum of a certain deceased rapist, the source of this familiarity became obvious: Mr. Bungle had risen from the grave. (Dibbell 1993)

Incidents such as "The Rape in Cyberspace" and phenomena such as newsgroup invasion and escalated on-line flaming (Donath n.d.) have made evident the difficulty of controlling virtual beings. Social scientists are beginning to examine the involved in maintaining social order without recourse to the physical self: Kollack and Smith, for example, examine the on-line establishment of boundaries and the enforcement of community regulations in the context of the classic 'tragedy of the commons' dilemma[5] (Kollock and Smith 1995). A common theme that seems to be emerging from many discussions of this problem is the importance of an established identity: a virtual self whose loss – though in no way equivalent to the body's loss of freedom or life – would be a serious cost to its real-world progenitor (Donath n.d.; Kollock and Smith 1995; May 1994; Reid 1994). On-line, identity becomes the body.

2.2.4 Recognition

> It is the common wonder of all men, how among so many million of faces there should be none alike.
>
> - Sir Thomas Browne. *Religio Medici*

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4. An equally common dystopian view shows cyberspace as an anarchic wilderness filled with anonymous beings acting with complete and heedless freedom.

5. The traditional 'tragedy of the commons' example is the village grazing green. If everyone is careful to allow their sheep to consume only their allotted portion, all will benefit by having access to this common property. If a few take more than their share, the green may still survive, and the free-riders will (unfairly) benefit by receiving more. If too many take more than their share, all will suffer since the green will become over-grazed and barren. Kollock and Smith examined Usenet news as a communications common, in which the free-riders were those abusing the technology (such as those who flood newsgroups with commercial messages) and those who read but do not contribute.

Recognition is closely associated with the face. We have an innate ability to recognize faces, even at a distance or at an angle or changed by various facial expressions. (Hochberg 1972, Brennan 1982). We recognize types as well as individuals, grouping people by the resemblance of their features and expressions. In the face, a vast number of social cues are provided to us at a glance.

Recognition is not limited to the face. We recognize handwriting, gait and tone of voice; law enforcement agencies find a fingerprint or retinal pattern to be more reliable forms of recognition than the variable and disguiseable face. Still, the face is central to the idea of recognition: "it is in the face that we recognize each other, and identify ourselves" (Synnott 1993). In this section on recognition I will focus on facial recognition, to provide a foundation for thinking about the representation of individual identity on-line.

Face recognition has a biological basis. Patients with certain brain injuries are unable to recognize the identity of familiar faces, though they recognize the stimuli as faces and recent work in neurological imaging has shown that specific areas of the brain are active during face (and expression) recognition. (Hauser 1996). Yet the full cognitive process of facial recognition is still not fully understood. The many attempts to reproduce it computationally have made its complexity apparent. Today, most work in computational face recognition depends on constrained datasets: reproducing the human ability to recognized individual faces in widely varying conditions is still beyond computer vision.

Face recognition is a social, as well as biological, task. It involves perceiving what distinguishes a particular person from all others. Perceptual psychologists and other researchers have proposed that we have an internal representation of a normal, or prototype, face and that we process and store other faces in terms of their deviation from this norm (Brennan 1982; Gombrich 1972; Hochberg 1978). "It is not really the perception of likeness for which we are originally programmed, but the noticing of unlikeness, the departure from the norm which stands out and sticks in the mind." (Gombrich 1972) This theory accounts for several phenomena, including why people have difficulty differentiating and recognizing members of unfamiliar groups; it suggests that the normative face (or faces – different categories may be represented by distinctive norms) is created in a continuous process of categorization and that members of groups for which one has little familiarity will all register as "outsiders", rather than as specifically differentiated individuals (Landau 1989; Gombrich 1972).

Caricature works from a similar principle. Caricatures are drawings in which the subject's most characteristic features are exaggerated (Gombrich 1972; Brennan 1982). They thus require the existence of a norm, the baseline from which to diverge. Brennan (Brennan 1982) created an early computer "Caricature Generator". A "normal" face was created and the subject compared to it, feature by feature. The subject was then redrawn with the differences between it and the norm exaggerated. An interesting feature about this work was that the "norm" could be easily changed, making explicit the subjectivity of the caricature, and, by extension, of recognition. Caricatures are often said (though it has not been

decisively proven) to be more quickly recognizable in some circumstance than photographs or line drawings (Hochberg 1972; Brennan 1982); their emphasis of the way a subject differs from the norm provides the perceptual basis for why an "incorrect" rendering could be more recognizable than an accurate one.

Recognition is a product of experience, both of people in general (the prototype forming experience) and of one's experience and impression of the individual.

> What people experience as likeness throws light on their perceptual categories. Clearly we do not all have the same impression of a person's *aria* or characteristic face. We do see them differently according to the categories with which we scan our fellow creatures. (Gombrich 1972)

The face has so far been seen little on-line, though this is rapidly changing with the advent of the Web. Still, it is thus far a very limited face – the still, photographic portrait – and not found in a context where it is used for recognition. As graphics becomes ubiquitous, will the face become the primary means of on-line recognition? Or will other patterns become recognizable as immediate markers of identity?

2.2.5 Remarks

These topics that were discussed here will reappear throughout the thesis, in designs that recreate their function or institute an alternative. Questions about expression and recognition will arise in the discussion of *The Illustrated Conversation*, when I examine issues concerning the use of graphical representations of people in a conversational interface. The question of recognition will also return, in more abstract form, in the discussions about on-line self-portraiture. How control is maintained in an on-line environment is part of the discussion of public space and providing a sense of presence in a virtual space is a motif in several projects, including *Visual Who*, *WebTalk*, and *A Day in the Life of Cyberspace*.

This is only an introduction to the immense topic of the social function of the body. There are many other functions. The senses, for instance, are embodied (see Synnott 1993 for a discussion of the social aspects of each of the senses), so is physical attractiveness (Landau 1989; Synnott 1993), gender, sexuality, etc. A considerable amount of recent work has been done on gender, body and cyberspace (Herring 1994; Turkle 1995; Stone 1992b; O'Brien n.d.). The role of the body in society is pervasive – so much so that it is often unrecognized. The emergence of entirely mediated cultures sheds new light on the body's role through its very absence.

In the next chapter I look at some current mediated cultures, and how identity, without a body, is expressed within them.

3 Contemporary on-line social environments

This chapter addresses questions about the nature of identity and community in an on-line society. My focus will be on identity, but the two concepts are closely interrelated: one establishes an identity as a member of a community (or communities) and it is the evolution of social meanings within the community that provides the vocabulary for one's self-representation.

Contemporary on-line systems provide the focus of the discussion. Although these systems are relatively primitive - often text-based, asynchronous, and with a minimal interface – there is a great deal to be learned by observing at how people use them. Both Usenet news and the Web were initially designed for exchanging data within a technical and scientific community, yet have been adopted - and adapted - for social and recreational use by a much wider population. Some on-line communities have developed their own vocabularies, often in response to the expression-deprived medium. Text-based conversational systems in particular have developed whole sets of interactional social cues and the use of smiley faces, acronyms, or MUD-specific locutions marks the writer as a member of particular on-line communities(Cherny 1995; Donath n.d.; Marvin n.d.; Reid 1991).

3.1 Community and identity

Champions of the virtual world have long claimed that the features of true community – affiliation, support, a sense of belong – could be found on-line (Rheingold 1993). Many social scientists are now in agreement. They point to the support found in sympathetic newsgroups (Sproull and Faraj 1993), the many opportunities to establish and maintain social ties (Turkle 1995), and the evolution of cooperative strategies (Kollock and Smith 1995) as evidence that real and significant social structures exist in the on-line world.

As Wellman & Gulia discuss, the on-line world supports a wide variety of community structures (Wellman and Gulia 1996). Some are purely virtual: the members have never met in real life and interact solely on-line. Others, such as mailing lists of friends or co-workers, are electronic supplements to real world

communities. Some are public communities, "social networks" of people who interact regularly, such as the members of a discussion list, MUD or newsgroup. Others are personal communities, consisting of one's friends and colleagues.

The community types cut across technology usage: email is used for communication between strangers and between spouses; discussion lists can be a forum for a virtual group or a set of co-workers. The designer of on-line environments needs to be aware of this range, for the inclusion or absence of features can have quite varying effects. A simple example is a picture: for those who know the subject in real life, it serves merely as a reminder or as a quickly recognized representation. For virtual acquaintances, a picture may serve as the sole – and possibly unreliable – provider of key social cues, not only obvious ones such as age or gender, but also subtle hints about political beliefs, social status, etc.

Identity plays a key role in virtual communities. In communication, which is the primary activity, knowing the identity of those with whom you communicate is essential for understanding and evaluating an interaction. Yet in the disembodied world of the virtual community, identity is also ambiguous. Many of the basic cues about personality and social role we are accustomed to in the physical world are absent. A great deal has been written about the nature of identity in the on-line world (see, for example Curtis 1992, Dibbell 1993, Kilger 1994, Rheingold 1993, Donath n.d.). Some claim that the ability to establish an independent and disembodied identity is one of the most valuable aspects of on-line culture – that it allows people to explore roles and relationships that would otherwise be closed to them (Stone 1992a, Turkle 1995). Others claim that anonymity encourages irresponsible, hostile behavior – and that an anonymous community is an oxymoron.

The relationship between an on-line persona and a physical self is handled differently in various on-line environments, often as a result of interface decisions built into the system technology. Some systems make it impossible to trace a participant's real-life name; others try to ensure that messages are ascribed to their author's physical being – and the cultures that evolve are strikingly different. Social conventions also play a role. In some environments, people sign messages with not only their full names, but also their place of employment, job title, and phone number. Elsewhere, virtual identities are not only anonymous, but ephemeral: names are taken temporarily, characteristics have little or no persistence. Even the most seemingly simple design decisions, such as how prominently a writer's name is displayed, influence the ambience of an on-line community.

The presentation of self in the virtual world is often a conscious and deliberate endeavor: from the role-playing MUDs to the resume-style home-pages, people are consciously attempting to create a particular persona. Goffman's observations in *The Presentation of Self in Everyday Life* are thus particularly apt for looking at on-line identity. His theatre metaphor highlights the role-playing aspects of daily communication – he describes behavior in social situations as "performances" designed in part to guide the impression others have of the

performer and which require the performer to act "in character" with the projected self. The construction of self-presentation is also investigated in the field of material culture studies. The objects (e.g. clothing, souvenirs, furnishings, etc.) used in creating a public persona are cultural productions: their symbolic meanings have developed through use and custom. Analyses of this process provide a useful framework for thinking about the similar process in the creation of one's virtual persona (Appadurai 1986; Csikszentmihalyi 1991; Davis-F. 1992; Hall J.R. 1992; Halle 1992; McCracken 1988; Miller 1987).

3.2 Identity in three virtual environments

In this section I examine how identity is established in three different contemporary on-line environments: MUDs, Usenet news and World Wide Web home pages. My focus in the analyses is on identity – on how self-presentation and social comprehension vary among different on-line communities today.

Researchers interested in on-line identity have often turned to MUDs, for their role-playing culture provides a novel environment for exploring gender and other identity issues (Curtis 1992; Dibbell 1993; Turkle 1995; O'Brien n.d.; Reid 1994). Many MUDs are primarily fantasy playgrounds for identity experimentations where players take on an imaginary persona and interact with each other in the virtual world's equivalent of the masked ball. Conversations here are live (synchronous) and ephemeral, their function primarily social. Thought identity is a major focus of MUD culture, it is identity as theatrical role, both highly mannered and expendable.

Unlike the fantasy world of MUDs, most of Usenet is meant to be non-fiction; the basic premise is that the users are who they claim to be. There is, however, a significant variance between newsgroups as to what constitutes a real or legitimate identity. And there are numerous cases of identity deception. Compared with MUDs, relatively little has been written about identity in Usenet newsgroups. Sproull and Faraj (Sproull and Faraj 1993) wrote about group affiliation and the establishment of trust in their discussion of newsgroups as affiliative, social environments; identity is also discussed in Kollock & Smiths' analysis of social control in Usenet (Kollock and Smith 1995). Much of the following discussion is drawn from my study of identity deception in Usenet (Donath n.d.); this work used anthropological methods and game-theoretical analysis to look at identity and identity deception.

Home pages on the Web are somewhat different. MUDs and Usenet are communicative environments in which identity is established within the context of a social interaction. Home pages are more like self-portraits; they are declarations of identity. Home pages are a recent phenomenon (the Web itself is only a few years old) and both the technology of the Web and the social structure of home page self-presentations are evolving rapidly. The following analysis is therefore a snapshot, based on the state of the world in the late summer of 1996; it is likely that the near future will see a very different Web environment. Relatively little has been written about home pages as a social phenomenon (at

least within the academic community) and I will thus go into somewhat greater depth here.

3.2.1 MUDs

The opportunity to explore novel self-presentations is, for many participants, one of the main features of MUDs and other real-time conversation systems such as chat rooms. The appeal is both that alternative roles can be explored (gender swapping is a very common activity on almost all MUDs and chat environments) and that the identities can be abandoned at will.

In *Life on the Screen*, Turkle examines identity experimentation from a psychoanalytic perspective (Turkle 1995). She sees the net as "a significant social laboratory for experimentation with the constructions and reconstructions of self that characterize postmodern life"; her interest is not only in how people establish identity and relationships on-line, but also in how the virtual activities affect the real world personality of the participants. Turkle's account emphasizes the psychological significance to the participant of being able to act out behaviors, such as gender swapping and sexual experimentation, that are difficult and risky in the real world.

Other researchers, pointing to the ease with which these transformations and experimentations are effected on-line, are more skeptical about how enlightening these behaviors are. O'Brien argues that the roles played out on MUDs are projections of the player's existing fantasies, that a man playing a woman on-line is not learning about what it is like to be female, but reaffirming his existing "categorical assumptions" (O'Brien n.d.). "Disembodiment, far from being an occasion for stretching these gendered forms, may in fact result in more stringent attempts to (re)mark that which we have come to rely on as a primary basis for structuring interaction." In this interpretation, the sparseness of cues in a the on-line world leads to a highly stylized and stereotypical self-representation.

Both may be right. The role-player may be making a highly stylized mask out of the stereotypes of the real world, but over time this mask may develop into a complex alter-ego. The characteristics and reputation of this alter-ego are drawn not only from the real-world characteristics it references, but from its history within the virtual community. The player may learn quite a bit from the experience of constructing an alternate, bodiless, textual persona, but that knowledge may be about social roles and institution, rather than specific insights about the psychology of others.

The key element is that in order for the alter-ego to matter, it must be an established persona, not simply a lightly made claim. While identity experimentation is one of the great attractions of MUDs, the stability of these constructed identities is what makes MUDs flourish (Reid 1994). They are the key to the community's creativity and also to the maintenance of social order (Reid 1994). The desire to be popular and influential within the MUD encourages the participants to do things that enhance their character's reputation, such as creating unusual rooms and useful objects and being friendly and helpful to other

players (Reid 1994). By developing a well-known and liked reputation, a player gains status and power within in the community.

In the virtual world, with no body to detain, no tangible being to hold responsible, reputation becomes the primary source of social control. Goffman (Goffman 1955) said concern for reputation (or 'face' in his terminology) "make[s] of every man his own jailer"; it is the maintenance and enhancement of reputation that induces people to uphold the social order. He pointed out that in encounters with people with whom one will not see again, these constraints are loosened, and one is "free to take a high line that the future will discredit, or free to suffer humiliations that would make future dealings with them an embarrassing thing to have to face". In the MUD world, such constraint-free encounters are common. The player who is ejected for breaking the rules can jettison the offending character and return as a new one (Dibbell 1993); if the cast-off character had no real value to the player this forfeiture has little cost and is thus no deterrent. Cherny corroborates this analysis (Cherny 1995). "Guests", she says "are a troublesome category". Guests are visitors who enter with no character of their own. Sometimes they are simply new players, or they may be established players seeking to do something destructive while in a disposable guise. Having no long term commitment to the guest character, their actions are unconstrained by any concern for its reputation.

3.2.2 Usenet news

Identity is not the ostensible topic of most Usenet discussion, though it is often the subtext. People participate in Usenet newsgroups for a variety of reasons. They may be seeking information or companionship, advocating an operating system or a religion. As in the real world, their motivations may be complex: both the desire to be helpful and the desire to be noticed may prompt the writing of a lengthy exposition. With any of these goals identity – both the establishment of one's own reputation and the recognition of others – plays a vital role.

For example, for the information seeking reader knowing the identity of those giving advice is useful: is there reason to think they have the requisite knowledge? are they sincere – or do they have some ulterior motive? If a writer has established a reputation within the group, this may provide sufficient information for the reader's evaluation. However, newsgroups are open territories, and many postings are from occasional or unknown contributors. Though identity cues are sparse in these discussions, the participants have learned to infer quite a bit, both from writing style and from clues hidden in the posting data. For instance, participants in the *rec.motorcycles* newsgroup decided that one contributor was a "troll"[1], in part because he claimed to be a college junior at Tulane yet was posting from an America On-Line (AOL) account: a real college junior, they reasoned, would have a school account and furthermore, AOL users have a reputation of being the perpetrators of pranks[2] (Donath n.d.).

Participants also make an effort to establish their identity. Here, as in MUDs, reputation building is the motivation behind much of the effort put in by contributors. Signatures, which can be extensive, are useful both for immediate

recognition (they provide a common visual pattern to all of one's postings) and for connecting one to an outside institute or to a net subculture. Signature styles vary significantly from newsgroup to newsgroup, reflecting the aspects of identity that are salient to the group. In many of the *comp* groups, which are technical discussions about computers, networks, etc., writers include detailed information about where they work, how to reach them, their title, etc. This is both a claim of expertise (I know this material because it is my profession) and an authentication of identity (if you don't believe my claims, you have the means to check up on me). Signatures are also used to establish one's ties to on-line groups, often using inside jokes and puns to make references that are comprehensible only by insiders.

For years, one's sense of the other participants in Usenet was rather spotty. People who frequently posted to groups one read grew to seem familiar, but it was often a very one-dimensional familiarity. You might know them as the person *on comp.lang.c++* who adamantly fought against removing templates from the C++ language spec or the person on *rec.pets.cats* with the Persian tabby that only ate sushi grade tuna. You were unlikely to know of any other sides of their personality - their other interests or marital status or even what other newsgroups they participated in. Unless someone was unusually voluble about themselves, one's impression of other Usenet participants was quite sketchy.

Two current developments – searchable Usenet archives and the Web – are changing this.

Until recently, Usenet postings were ephemera, remaining available for only days or weeks before they disappeared from the net. Starting in 1995, several news archives have become available. These extend the lifetime of a posting indefinitely; more significantly, they are searchable. One can request a listing of someone's entire Usenet oeuvre. Without such a search mechanism, finding all of someone's postings was nearly impossible: you might know that they were a frequent contributor to, say, the nutrition and medical groups, but have no idea that they spent their evenings as a verbal warrior in the ethnic disputes on *soc.culture.turkey* or writing baby-talk "meow-chat" postings to *rec.pets.cats.*

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1. Trolling is a game about identity deception, albeit one that is played without the consent of most of the players. The troll attempts to pass as a legitimate participant, sharing the group's common interests and concerns; the newsgroup members, if they are cognizant of trolls and other identity deceptions, attempt to both distinguish real from trolling postings and, upon judging a poster to be a troll, make the offending poster leave the group. Their success at the former depends on how well they – and the troll – understand identity cues; their success at the latter depends on whether the troll's enjoyment is sufficiently diminished or outweighed by the costs imposed by the group.

2. This is also an identity based phenomenon. AOL users, accustomed to the anonymity and fleeting identities of their service's chatrooms, are more likely to see the net as a role playing environment. People who log-in from a work or school site know that unacceptable behavior on-line can have real consequences for them in their job or university. The person logging in from a commercial service, however, is less answerable, risking only the loss of that account.

The archives bring forth all of one's contributions for public examination, removed from the social context for which they were written. It involves a paradigm shift, from perceiving Usenet as a series of effectively private areas, bounded not by technical means but by their sheer numbers and parochial focus, to seeing it as a public repository of neatly cross-referenced postings.

This is not necessarily a harmful development for the Usenet community. One of the drawbacks of the virtual world has been that one's view of others is sketchy and one-sided. Being able to gather a more complex image of one's fellow participants can deepen the social ties as the users see each other as more fully-rounded individuals (Sproull and Kiesler 1991). But prediction is tricky. As awareness of the new paradigm increases, people may become far more concerned with managing their on-line reputation, resulting in widespread use of multiple pseudonyms – and an even murkier view of who's who on-line.

The Usenet reader's picture of the other participants is also being filled in by the Web. Postings are now often signed with a pointer to the writer's home page. Whereas the archives present a documentary recording, the Web-based home page presents a crafted self-presentation, showing how one wishes to appear. The home page may reveal the writer's age, profession, race, hobbies, family life, religious affiliation, etc. – a great deal of social information that was, for the most part, previously unknown in the Usenet community.

Knowing with whom one is communicating – knowing their social identity – is not only an important part of interpreting the text they write, it is also basic to establishing the framework of the conversation (Tannen 1994; Goffman 1959; Goffman 1979a). Participants in a conversation play certain roles and conversely, their actions are interpreted in light of the role others believe them to be enacting. Tannen (94) shows how the actions of all the participants in a conversation shift according to the composition of the group, with gender and relative status shaping the interactions. A repetition of the identical conversation, but with the roles reversed, is, she says "the stuff of comic theater". The point is not that people *should* act these roles, but that they *do* and that part of our understanding of the social situation has to do with our knowledge of the participants' social roles and our resulting expectations.

This "comic theater" – the result of mistakes in identity cues – happens easily on-line. For example, it is very common for people to assume that anyone, unless they have evidence to the contrary, is a man. Assuming a woman to be a man, they are likely to misinterpret the tone and sense of her remarks, for they will be interpreted as if "performed" by a man. As the Web and Usenet become integrated, social framing information such as gender will be easily available to the participants in a conversation.

And, while it will alleviate misunderstandings and help the discussion flow smoothly within the cultural norms, it is not entirely beneficial. The same information that provides social framing is at the root of many of our most intractable stereotypes (Aronson 1995). For many, the appeal of the net has been than others did not "know" how to treat them – in a more anonymous world, they could be judged by what they said, rather than who they were.

3.2.3 Home pages

The Web did not start out as a social technology: it started as a way to distribute physics papers. It has swiftly evolved far beyond its original academic domain: today, there are pages that represent giant corporations and pages that represent grade-school children. The Web contains short stories, reference manuals, price lists, pornographic pictures, classroom assignments - the list is growing to encompass every aspect of human endeavor. Its emergence as a social technology is marked by two phenomena: the rise of the personal home page as a necessary part of on-line presence and the ongoing attempts to introduce interpersonal communication to the Web's publication-only model. The latter is the focus of CHAPTER 4; here, I will look at the home page as a sociological phenomenon.

Home pages are deliberate self-presentations, places where people present their credentials, whether as established research scientists with impressive vitae and selected bibliographies, or as electronic trend-setters with eclectic web links and obscure lists of outrageous bands. Pages, like individuals, vary greatly. Some are elaborate creations, others simply a few links and an apology for the meager offerings. Some are stiffly formal, reading like the cover letter to a resume. Others are almost embarrassingly personal, detailing the owner's emotional states and family psychodramas. A common home page format contains a bit of personal information about the subject, a bit about work, and then a list of favorite links. The choice of personal information is often shaped by what one can say with links: "I like *coffee*" with a link to an on-line coffeepot or "I was born in *Wisconsin*" with a link to the state's page. Still, even the blandest self-description can be revealing. From graduation dates the reader can infer age, tone of voice can be heard through even the briefest sentence, and photographs show gender, race, hairstyle, facial expression - the basic clues of first impressions. The list of links is particularly revealing. Good Web citizens provide links to the Perl info page, the beginner's guide to HTML and a search engine or two: they want to help and encourage their fellow page builders. The distinctive Blue Ribbon Campaign for Free Speech graphical link – one of the 10 most common links on the Web – shows a political stand. Teenagers on the Web have the electronic equivalent of the black concert T-shirt: links to Wired, to Anime galleries and to their favorite chat sites. For the home-page builder seeking to create a self-portrait in hypertext links, the Web provides a vast and varied selection.

Goffman, in his classic work *The Presentation of Self in Everyday Life* distinguished between the "expressions given" and the "expressions given off"(Goffman 1959). The former are the deliberately stated messages indicating how the one wishes to be perceived; the latter are the much more subtle, and sometimes unintentional, messages communicated via action and nuance. His use of a theater metaphor – interactions as performances – to describe daily life is very useful here because it emphasizes that people are always playing some sort of deliberate role. Our impression of others, whether face to face or on the Web, is an interpretation of the face they have chosen to present. Certainly, in a setting such as the Web, in which the presentation is carefully and self-consciously manufactured, control over one's self-presentation is greater; still, there is often enough material so that the viewers may read into it more than the writer

intended – the "expression given off". The choice of links, the tone of the text, the contents of photographs, etc. provide cues that resonate with our real-world knowledge.

Self-presentation in the physical world is not limited to one's immediate personal appearance. The home, for instance, is another arena in which cultural categories are expressed and status claims made (McCracken 1988). Indeed, the metaphor of "home" in "home page" is a useful one. Though a home page provides little in the way of shelter, it is, like the home, a site for constructing an expression of identity through an array of objects, both self-made and acquired, decorative and functional.

Csikszentmihaly studied which objects in their homes people cared most about.

> [W]e found that each home contained a symbolic ecology, a network of objects that referred to meaning that gave sense to the lives of those who dwelt there... to be effective in conveying meanings, the owner had to be personally involved with the artifact... the owner had to enter into an active symbolic relationship with it. (Csikszentmihalyi 1991)

Some objects, he found, have value for their subject matter, such as photos and home made items; others, for the personal events they represent., such as souvenirs. Some consumer goods such chairs, tables, posters may become meaningful to their owners through long use; others are valued because they represent a goal or ideal – they express who the owner would like to be[3] (McCracken 1988; Leiss et al. 1990).

The objects on a home page represent a similar span of meaning. There are personal objects, such as photos and text written by (and about) the author. Links to external sites are very often presented in the context of their personal meaning: the author's university or favorite TV show or hobby. And, like the home, some items are there for the owner's use: 8 out of the top 25 most linked to sites on the Web are to search engines (). (An interesting note is that while some pages present these as links the author uses often and keeps there for references, others politely present these utilities on the home page as being for the convenience of the visitor, much as a host offers his own chair to a guest.)

Today, there are an increasing number of "consumer goods" on home pages: pictures and applications that were not created by the author, but acquired from an outside source. These range from clip art divider lines to applications such as search functions and guest books. One result is that the pages are much more 'visual'. Though the result is often a cacophony of graphic links and backgrounds and doodads, the pages are becoming more distinctive, compared to the sedate, unending landscape of grey-backgrounded text of a year or two ago[4]. The growing complexity permits emergence of certain types, such as the "guy who has to have the latest of everything" - frames, tables, java applets – the virtual

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3. The goal of much advertising is to induce this use of "goods as satisfiers" (Leiss et al. 1990) - to transfer the meaning of the idealized lifestyle to the advertised good so that the consumer will buy the good as a symbol of the idea. (Fiske 1989a; *McCracken 1988; Leiss et al. 1990).*

equivalent to the audiophile. As there are more choices, the pages can be more evocative - there is more opportunity to gather an "expression given off".

One problem that faces many home page creators – and that highlights one of the big differences between this self-presentation and a real world identity (or even a MUD or newsgroup persona) – is that the home page is static and, initially, disconnected. There is no "situation" in which it acts. What will get people to see it – how does it become part of the interlinked network of the Web? The following advice is from a home page in Singapore:

> How to make your homepage known:
> They are two ways to make your homepage known. They are,
> 1.telephone as many people as you can and tell them your homepage's address.
> 2. Submit your address to search progams like,"Yahoo!"under the catergory people/entertainment.

The latter is how I found it - clicking randomly here and there among the 50,000 or so home pages alphabetically listed there. But I am a researcher looking specifically for home pages of people who are trying to get others to see them – I am not sure how much traffic a page receives from being on this immense list.

The creator of a home page wants other people to link to it. This will happen if the page is outstanding – the definitive site for some esoteric subject or a truly interesting work of art. It will also be linked to if the creator is a member of a group with its own home page. Many such on-line linkages are reflections of real-world groups: all the students in a department are listed on the departmental page; groups of friends link to each other. The latter is an especially interesting phenomenon, for knowing something about someone's social circle is a very important social cue. Your view of a person whose home page seemed fairly neutral – basic links to home town, favorite bands, some friends etc. – may change if you see that many of the friends are involved in say, survivalist and militia activities.

A related phenomenon is the rise of link exchanges. Although somewhat peripheral to the discussion of identity, they sheds some light on the Web's emerging fame economy – and fame is both the transposition of one's personal identity to a larger stage and an important form of status in an information based world.

In the future, everybody will be famous for 15 minutes.

- Andy Warhol

There are a number of these link exchanges. One of the largest and most sophisticated is called the Internet Link Exchange (ILE). Participants agree to run a banner ad on their site in exchange for one of their ads being run on another member's site. The banners themselves link to the advertised site; a note under the banner links to the ILE site. The image in the banner and its link is created

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4. Many of the most colorful images are graphics supplied by commercial sites to go with links to them. There are home pages that are essential advertising bill-boards for products and services ranging from browsers to shoes to entertainment conglomerates. A study of the construction virtual identity through commercial symbols would be quite interesting: the presentation of self as advertising medium.

dynamically on the hosting page via ILE: ILE thus not only can control what ads get run where on a continuously updated basis, they also can keep count of how many times each participant's site is accessed. The more often a participant's page is accessed (and thus the more that site contributes to the pool of banner ad accesses) the more frequently that site's ad is run on other pages. It is a technologically assisted barter of public exposure.

ILE is a fairly open group, including home pages and many small businesses. Other exchanges are more specialized (if technically simpler): there are link exchanges for christians, for teens, for cats. These ensure that there will be a growing pool of places with links to each participant's site from similar ones.

Once the page is made, and links to it exist, there is still the problem of seeing the visitors. Identity is created in the context of interactions with others, in seeing how they react. In real life we are extremely aware of being looked at: people are very interested in their own performance and in what others think of them. On the Web, it is impossible to know if you are being seen. I will return to the this topic from a design perspective in CHAPTER 4; here I will make some initial comments about how people have been approaching the problem.

A common home page accessory is the access counter. This is a little graphic (resembling a automotive mileage counter) that shows how many times a page has been accessed. They are usually implemented through an outside service which not only relieves the page owner from having to implement a script, but also keeps the counting honest: the counters are popular enough to have spawned parody counters, sporting obviously imaginary numbers. For the page owner, it provides a measurement of exposure; for those whose accesses reach into higher numbers, it is often featured as point of pride on the page. It also can provide a sense of the vast scale of the net to realize that hundreds of people have viewed one's small, home-made page.

Another popular accessory is the guestbook, a place for visitors to leave comments and read the comments of others. The guestbook illustrates both "fame economics" and status display on the Web. First, the guestbook itself has gone from being a somewhat rarefied commodity to one of mass consumption; second, it's purpose is to display the "scarce" resource of attention.

Guestbooks were initially available only to those who were able to program Web scripts (which requires both the programming skills and a page on a site that, unlike many inexpensive "Web presence" providers, allows individuals to execute scripts from their pages). Today, they are within the reach of all due to guestbook services, which provide people with individual guestbook pages that reside on the service's machine and are simply linked to from the home page.

The movement from rarity to item of mass consumption is part of the phenomenon of fashion. At the turn of the century Simmel described what would become known as the "trickle down" theory of fashion, stating that the point of fashion is social differentiation and imitation: those at the top are trying to differentiate themselves from the ones below, who are trying to imitate those above in order to ascend (Simmel 1971; McCracken 1988). While this theory has

been elaborated on and modified – in particular, the single path of class-linked status has been refuted and replaced by a heterogeneous view of many trajectories of status (McCracken 1988; Hall J.R. 1992) and identity formation (Davis-F. 1992)– the basic model of distinction and imitation remains.

In the progress-oriented technical world of the Web, one such trajectory points to the forefront of technology. While a guestbook is not a technological marvel, the early ones, possible only for those with access and technical ability, were more interactive than almost anything else on the Web; they were at the front of the technological status chain. Shareware copies of guestbook scripts were soon put on-line, the barriers to having a guestbook were lowered, and they ceased being noteworthy. They became a mass-market item when they were implemented as an external service, require little more of the page author than adding a link. While people who see themselves as leaders in the technological fashion may still have guest books, they are no longer featured as a symbol of cool; there role is now just functional.

The contents of the guestbook are themselves a form of status display, for it is a place to exhibit, as well as record, visitors' comments. The display opportunity is its main feature: if one was interested only in feedback, one could simply invite people to send email. The exhibited comments represent attention, people who have come to the page and were engaged enough with it to stop and leave a comments. The comments represent attention, a scarce resource in high demand in the fame economy of the Web.

Part II: Design for the virtual city

> But why do birds sing rather than speak Mandarin? Why don't human infants scream and cry when they are content as peas in a pod, but coo and gurgle when they are angry, annoyed, or in pain? And why doesn't Jesse Jackson simply convey his expressive skills by blinking his eyebrows, Morse code style? These are questions about design, and what is true of all communication systems that work is that they have specific design features. The design features of a communication system are the result of a complex interaction between the constraints of the system and the demands of the job required.
>
> - Marc Hauser

This is the design half of the thesis. Here, the ideas about identity and society discussed above form the basis of an approach to the design of on-line social environments.

CHAPTER 4 (*Sociable information spaces*) discusses the symbolic and cultural context for on-line communication. Here, the architecture metaphor is used to think about published media as the environment in which virtual activity occurs. Three projects are presented which integrate interpersonal communication and the Web.

CHAPTER 5 and CHAPTER 6 (*Social visualization)* argue for the importance of visual interfaces in a social environment. Images are well suited for portraying concepts and situations that are difficult to communicate through words alone. They can show patterns and trends, they can viscerally communicate emotional expression, and they are well suited for conveying symbolic meaning. *Visual Who* (Donath 1995a) addresses the problem of making the underlying social structure of a community visible: it creates an interactive overview of the social patterns and activities of a large on-line community. *The Illustrated Conversation* (Donath 1995b) is a visual setting for a conversation, which allows the participants to indicate presence and attention by their appearance in the conversation space.

CHAPTER 7 (*Inhabiting the virtual city*) brings together the concepts developed in the preceding design chapters. Its focus is on the *A Day in the Life of Cyberspace* Web site, which integrates interaction and visualization in an on-line environment.

4 Sociable information spaces

Physical spaces have important social functions. They demarcate public and private, formal and casual, natural and man-made. "A vivid and integrated physical setting, capable of producing a sharp image, plays a social role as well. It can furnish the raw material for the symbols and collective memories of group communication." (Lynch 1960) My argument in this section is that a vivid and integrated *virtual* setting - one made of information rather than rocks or benches or bricks - can play a similar role.

Published media – books, television shows, newspapers, etc. – can be thought of as neighborhoods, inhabited by the publication's readers and viewers. Like real-world neighborhoods, virtual neighborhoods are both a community's home and an important source of its cultural vocabulary.

Neighborhoods are the spatial manifestation of community, "a place where people live and associate on the basis of certain shared myths, or assumptions about the world" (Greenbie 1981). The audience for a publication, like the inhabitants of a neighborhood, is often a homogenous group, with shared myths and assumptions about the world. As Fiske put it: "Choosing texts is choosing social allegiances" (Fiske 1989a). An action movie, a scholarly journal, a fundamentalist website – all are "texts" that bring together a group of people united by common interests and concerns; in the world of information, publications are neighborhood enclaves, places where a community gathers.

Yet as many urban theorists have noted, a neighborhood is not merely a container for the community. As Lynch pointed out, its architecture, its history, and the things within it – stores, parks, signs, etc. – provide the community with the settings and symbols for their collective memory. The virtual neighborhood is even more strongly the source of a community's cultural vocabulary: from song lyrics to political rhetoric, our cultural references are drawn from common media experience. Even our understanding of facial expressions may be drawn from this source. Ekman postulated that "John Wayne's look of anger on the TV set – not man's evolutionary history – may be responsible for people's ability to recognize the same anger expression across cultures" (Ekman 1973).

Today, the neighborhood as a source of cultural material has been surpassed by media. In *No Sense of Place* Meyrowitz wrote:

> Electronic media have had a tremendous impact on group identity by undermining the relationship between physical location and information access... Electronic media begin to override group identities based on "co-presence," and they create many new forms of access and "association" that have little to do with physical location. (Meyrowitz 1985)

But the neighborhood still provides a powerful metaphor. And as such, it points out an important thing absent from traditional media - the presence of people. Traditional media is not in any real sense "inhabited". The viewers of a television program or the readers of a magazine share a common experience in collective isolation.

Publishing media (TV, books, etc.) which are rich in cultural material, have traditionally been separate from communication media (telephones, email, newsgroups, etc.), which is where the people are. Existing technologies enforce this segregation: the newspaper is inert; the TV set only receives. Today these technological constraints are dissolving: the computers that house the text-based virtual-communities are now also capable of playing movies. Yet the point is not simply to unify the machinery. Playing a movie in one window while writing a letter in another does not constitute the integration of publishing and communication. Rather, the point is to create environments that combine a rich information landscape with the ability to communicate with others – information spaces that provide a context for community.

The dissolution of the boundaries between publication and communication is most noticeable on the Web. For example, discussion forums accompany a variety of Web-published materials: *City of Bits* (Mitchell 1995), William Mitchell's book about virtual society, is available on-line, with section by section reader commentary; *Hotwired* (GNN 1996), the electronic version of *Wired* magazine, includes a wide range of ever-changing reader forums. These discussions occur within an information context provided not only by the host publication, but by the Web as a whole. Each statement can link to other information sources and the participants themselves may be represented by links to their home page self-portrait.

The Web's emergence as a sociable information space – and the limits its design imposes – is the focus of this section. I will discuss three projects here, each of which incorporates a different type of communication with the Web.

- *Portraits in Cyberspace* (Donath 1995d) is an on-line art exhibit that was judged and is displayed on the Web. Here, the communication among the jurists and the gallery visitors is asynchronous, a cumulative record of impressions and critiques.
- *The Electric Postcard* (Donath 1995d) combines email and the Web. I will discuss some reasons why this extension of person-to-person messaging has proved to be so very popular.
- *WebTalk* (Donath and Robertson 1994) is a modified server and browser that bring real-time communication and awareness of presence to the Web.

4.1 *Portraits in Cyberspace*

Portraits in Cyberspace main entrance

Portraits in Cyberspace is an on-line exhibit about identity in the virtual world. The call for entries said:

> We are seeking images that address: Who is on-line? Who inhabits the edges and margins of the on-line world? What constitutes identity in cyberspace -- and how can it be portrayed? How are essential human experiences -- such as family, religion, community, sex, ethnicity, childhood, personality -- being transformed in the digital era? We are interested both in documentary portraits of people in the virtual world and in experimental depictions of on-line society.

All aspects of the exhibit are virtual: the competition was publicized via email and announcements in art-related sites; the jury deliberations were held on-line; and the exhibit itself is a Web site, where viewers can see the works and participate in discussions about them.

4.1.1 The jury site: the web as a tool for collaboration

Judging the *Portraits in Cyberspace* entries on-line made it possible to convene a group of experts in the field of new media art without regard to geographical location: there were jurors in Boston, Finland, the Netherlands, Germany and Japan, plus one judging while en route from Croatia to Israel[1]. The virtual jury

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1. The active jury members were: Erkki Huhtamo (Professor of Media Studies, University of Lapland, Rovaniemi, Finland); Machiko Kusahara (Associate Professor of Media Art, Tokyo Institute of Polytechnics); William Mitchell (Dean, MIT School of Architecture); Michael Naimark (Media artist, Interval Research Corporation); Itsuo Sakane (Professor, Keio University Environmental Information Science Department); Jeffrey Shaw (Director of the Institute fur Bildmedien at the ZKM Zentrum fur Kunst und Medientechnology, Karlstruhe); and John Thackara (Director, Netherlands Design Institute, Amsterdam). I was the curator, as well as the site designer and implementer.

had neither the scheduling difficulties or nor the expense of a face-to-face meetings. And, since the works were designed for on-line viewing, the judges were seeing the pieces in their intended viewing conditions.

The members of an art jury work together to come to a consensus about the submitted works. Though they may have strong and conflicting views, their task is to decide, by compromise or persuasion, which works are to be accepted to the show or awarded a prize. The on-line jury site thus needed to be a place where the judges could rate the works, exchange opinions about them, and reevaluate their judgements as the process continued. Over 300 works were submitted for consideration. The number that would be accepted into the show was not fixed: with no constraints of limited wall space, all entries judged to be of high quality could be accepted. In addition, up to 6 prizes were available to award to outstanding works. The judging process is a sorting problem: first the unacceptable pieces are rejected, then the uninspiring ones, and eventually the top pieces are culled from the field of accepted works.

The jury site opened with a list of all submitted works. The works were referred to by the artist's name and an entry number; next to each name was list of the jurors who had already rated this work and the work's current cumulative rating, e.g.

> **Morrison.121** Sakane Kusahara Shaw Huhtamo Mitchell Naimark (3)
> **Dunn.249** Sakane Kusahara Mitchell (2.3)

The list started in alphabetical order and was grouped by rank as the jurists rated the pieces. Upon entering the site a juror could thus quickly see which pieces still needed to be reviewed, and approximately where a piece was ranked in the group's opinion. From this list, the jurors could access the individual pieces.

Each artwork had its own page, which included the artwork itself, plus the jurors' ratings and comments about it. For this show, an artwork had to include an image and a short statement by the artist. A link to an external site was also permitted; if included, that site was considered an integral part of the artwork.

The jury ranked the works on a scale from 1 (Does not belong in show) to 5 (Should win a prize). They could comment on the work in a private forum seen only the other jurors (and the curator); they could also leave public comments about the work, quotes to be available for the catalog or articles. The jurors were free to amend their ratings throughout the judging period.

Aside from some technical difficulties, this experiment in virtual judging worked well. During a ten day period, the jurors viewed and rated a large number of pieces. Their comments reveal a range of approaches to judging the aesthetics of this new medium, but also a great deal of agreement about what constituted a creative and expressive "portrait in cyberspace". The most highly rated works explored ways of using the Web as a new medium, and were unanimously praised by the jury.

The intra-jury communication – the commentaries and the ability to see each other's ratings – was certainly very important. Jurors pointed out features they

felt others had missed, from relevant notes about an artist's background to suspicions of irregularities in the attributions[2]. They also argued among themselves: a work that one juror praised as a "beautifully crafted image" was described by another as the "kind of kindergarten metaphysics [that] gives the net a bad name." (The former view prevailed and the piece was awarded one of the prizes). Also helpful was the list of entries accompanied by the names of the jurors who had completed their review. Here, as the list filled with jurors names and the best entries emerged at the top, the jurors could see the progress of the ongoing collaborative task.

The most serious problems with the judging process were slow network connections and difficult access. Several of the jurors were travelling during the jury period and had only intermittent or very slow connections. Downloading the images took considerable time, which limited the amount of time jurors could spend on commentary. Also, some of the external sites were themselves slow or not always accessible: one of the prize-winning pieces came close to rejection since its site was down when several of the jurors tried to see it. A jury convening simultaneously on four continents to judge a show of cyberspace portraits was conceptually engaging, but the state of connectivity in the fall of 1995 made it come close to falling short of fully practicable.

4.1.2 The exhibit

Portraits in Cyberspace opened on October 10, 1995. It is superficially similar to the jury site: there is a list of the included works, from which one can access the individual pieces. There is also a "Gallery of Prize Winners" entrance, with short introductions to the top works. There are about 80 pieces in the show, and they range from naive art to pretentious undergraduate pieces to some serious explorations of the web as a portrait site. Comments about the works are invited and most pieces have by now accumulated a lengthy and often lively series of remarks.

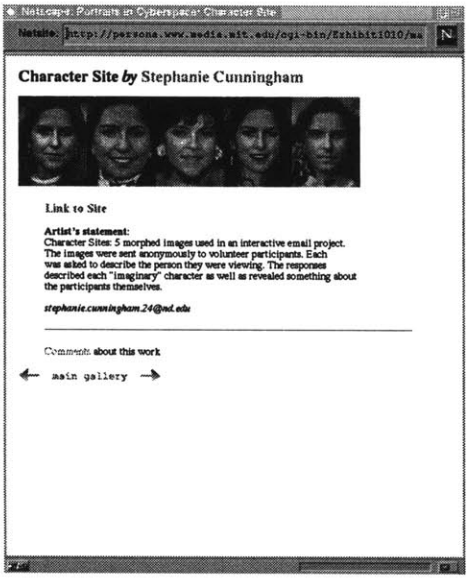
The exhibit site is differs from the jury site in several significant ways. The jury site was a tool for accomplishing a specific task; the exhibit site is a cultural space for seeing the art works and, if one chooses, the reactions they have provoked in one's fellow viewers. Most significantly, the jury site and the exhibit have very different audiences.

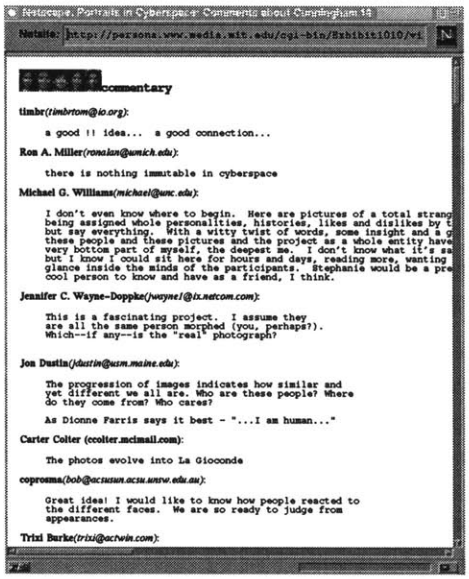
Access to the jury site was limited to a select group of professionals, most o whom knew each other, by reputation if not personally. The exhibit is open to anyone. Although comments must be signed, there is no verification of the names and many of them are clearly pseudonymous[3].

Several paths lead to the *Portraits* exhibit. In the topology of the Web, these incoming links are the site's surrounding neighborhoods. It is featured on the *A Day in the Life of Cyberspace* site and listed in various arts related links. *The*

---

2. E.g., some entrants tried to circumvent the limit of three entries per person by entering three works under their own name and additional ones under the name of a wife or friend.





Character Site, *by Stephanie Cunningham. Work displayed in the Portraits exhibit.*

On the left is the piece itself: an image, the artist's statement, and a link to the site.

On the right is the top segment of the commentary page for this piece. (The scroll bar on the right shows how much further the discussion continued).

The strength of this piece (the most highly rated in the judging) is the site rather than the displayed image. The five faces were created by morphing: they are thus recognizable but with no specific identity. On the site, people were asked to write what the imagined the character of each woman to be. It is a fascinating record of what we read into the face.

Electric Postcard includes several of the pieces and a number of the artists in the show link to it from their own home pages, as do other people who particularly like the site. People arrive at the *Portraits* exhibit by following links from one of these neighboring sites. The nature of those sites thus determines the exhibit's audience, which, in this case, is rather eclectic. From the arts links come serious art viewers, other artists, and budding cyber-media critics. From the artists' home pages come their friends. And from *The Electric Postcard* and the *Day in the Life* site comes the full range of Web explorers.

The diversity of the audience is apparent in the commentaries on the artworks. There are sophisticated critics, conversant with irony and postmodernism, who think art should be thought-provoking and there are visitors who think art should be pretty pictures. The commentary often takes the form of debate, with subsequent visitors arguing the merits of both the work and of the preceding comments. In the *Portraits* gallery, there are debates about abstraction, about whether the artist should paint a universal or personal message, about whether art should have any message at all, and whether it is art if it was easy to make. There are pieces that have sparked arguments about race, feminism, and pornography.

As new art forms and technologies emerge, they engender new controversies about the role of the artist, the necessity of representation, etc. Abstraction in art has been controversial since painters began turning away from realistic

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3. Not surprisingly, signed comments tend to be positive, or at least thoughtful. Hostile or childishly rude comments are almost invariably anonymous. There is little one can do to verify a name given in a Web form, short of implementing a protected site in which passwords are mailed to applicants for admission, thus guaranteeing that they have at least provided a valid email address. Here, I have relied on the style of the site to set the tone of the discussion, which by and large has worked. (This includes removing comments that are simultaneously hostile and pointless.)

representation; photography as an art form took decades to achieve academic respectability (Grundberg 87). In the commentaries of this exhibit, one can see a new set of debates emerging, centered on the issues of interactive and collective art.

The call for participation for this exhibit invited pieces that used the net as an artistic medium, not merely as a distribution mechanism. A few of the pieces, and arguably the strongest ones, do so and these were generally the pieces that the jury (and curator) found to be the most original and thought-provoking. In the exhibit, they have proved to be the most controversial. For instance, a piece called *Curator: Not Quite Nirvana* (Scott Matthews) is an installation of images from a kiosk the artist created. The kiosk, which was installed in several Soho galleries, allowed visitors to draw over digitized versions of art on display. *Curator* was one of the prize-winning pieces. Juror Itsuo Sakane wrote in his critique:

> The idea of "Interactive Kiosk" for everybody is excellent. Especially the image selected for this contest was appealing with its rather primitive but mystical folk art taste.

The audience on the net was of mixed opinions. The originality of the piece was questioned:

> Hey Scott, how can you call this YOUR work when it was actually created by numerous people in a real-world setting? It seems to me you let someone else do the work and you take the credit.
>
> - NOMAD4

As was the quality of the resulting images:

> The process is more intriguing than the result. Much the same as the hitting of a golfball on the moon. It is oddly disappointing that for all this technology we have acheived communal doodles. The minds reflected in the comments are more telling than the work itself. In that vein, I suppose the work was necessary as a catalyst. It seems moreso that an intricacy of a Star Trek episode would gaurantee an equal deluge. The exchange of ideas in this medium is often counteracted by the dumbing effect anonymity has on the worth of contributions.
>
> - Quinton Donleavy

And some viewers championed the idea of interactive art:

> Forget "dumbing effect" I think that for some visitors to this exhibit, being able to interact with the art may have made it more accessible! I believe that creative impulses are deadened by the influences of menial work and subsequent television watching. An exhibit such as this one allows otherwise artless persons to participate (albeit in a limited fashion) in the creative process.
>
> - tlarson@teleport.com

Opinions about the other interactive pieces were equally wide-ranging.

In a real-world gallery, one may overhear a conversation or two, but in general, one sees only the opinions of art world professionals – the curators and critics, steeped in the history and language of art, who write wall plaques and reviews.

How other visitors react to a piece remains, for the most part, a mystery. Here in the on-line gallery, however, the viewer can read – and respond to – the comments and reactions of a wide range of fellow viewers[4]. As many social observers have pointed out, debates about art are often at heart debates about class and social values (Bourdieu 1984; Halle 1992; Fiske 1989a). The discussions. while grounded in their critique of a specific piece, reflect the participants' underlying beliefs about the nature of beauty, the role of the artist, the significance of technology – topics that in the real world are seldom debated among people of widely varying backgrounds[5].

4.2 *The Electric Postcard*

***The Electric Postcard*'s Pick Up Window**

The Electric Postcard is a simple concept. On the postcard site there are a number of images (famous paintings, urban photographs, drawings of insects, etc.). You choose an image, write a message, fill in the recipients email address, and send it off. The recipient is automatically notified, by email, that are card awaits. Upon

4. Viewing the commentary is optional. The artworks are each displayed on their own page, with a link to the comments. Most visitors view many pieces, but follow the commentary to only a few. (Having an interface that forced one to view the comments on all pieces would be like wandering through a museum on a day when it was also visited by many loud and opinionated, but not necessarily knowledgeable, tourists.)

5. I have no hard demographic data about who are the visitors to the site, but it is likely that the audience for the *Portraits* site is broader than for the average gallery or museum show, limited as the latter are to people who consider museum-going to be a worthwhile leisure time activity and who are interested in the works on display. The *Portraits* site is easier to get to, a journey of a few minutes rather than an afternoon.

```
Date: Thu, 13 Apr 1995 14:20:01 -0400
From: cardmaster@postcards.www.media.mit.edu
To: <recipient>
Reply-To: <sender>
Subject: Greetings from Cyberspace

There is postcard waiting for you in the Post(card) Office.
You may claim it at the Pickup Window, which is located at
http://postcards.www.media.mit.edu/Postcards/
Your claim number is:<recipient>.170227
Please have this number available when you claim your postcard.

                              Thank you,
                              The Postmaster

Messages left unclaimed after 2 weeks may be discarded.
```

The Electric Postcard recipient notification.

The Web address was left deliberately unexplained: while a notice that acknowledges that WWW address are still rather esoteric and explains the downloading process may be more "user-friendly" it is not as striking as the unadorned one, with its implied belief that an electronic postcard is an everyday object (and its terse parody of a real world delivery notice).

going to the site and giving the claim number to the postmaster, the recipient is presented with a page showing the chosen picture and the message.

What is interesting about this project is its unexpected success. It went on-line at the end of December 1994; a year later, about three-quarters of a million cards had been sent; half a year later, late spring in 1996, it was close to 1.7 million. It started slowly: 10-20 cards a day in the first weeks, 1000-2000 a day over the first summer, and then it gained momentum rapidly. During the 1995-96 Christmas season, there were days when over 19,000 cards were sent (and there would have been more had the server been able to keep up).

It is much more time consuming than sending email – you have to go to the site, the pictures take time to download. Why do people like it so?

When I built the Postcard server, I thought that the fact that the message contents can be hypertext would be a big appeal. Images and sounds can be interspersed with the text and one can send, along with one's words, links to anything within the Web's vast store of information and arcana. Yet it turns out that relatively few people use this capacity, perhaps 1 in 15-20 cards has some HTML embedded in the message. The appeal appears to be more social.

It is often used as a lure to get a reluctant friend to explore on-line:

> Hi!
> Just wanted to say I think this is one of the best sites on the net... I have introduced many of my frineds to the internet by sending them postcards.. it becomes an adventure for them to browse through and find a way to retrieve their postcard! :-)

It is an amusing twist on ordinary email:

> I really like The Postcard Store. What a great idea! Email can get dull after a while, this is a great way to spice it up.

And it is a way to show friends and colleagues that one has found something new and different on the Web:

```
Hi there!
Your page is a hit! I have sent several cards out and
everyone loves them!
```

The most significant function of the postcard, and the reason, I believe, for the great popularity of *The Electric Postcard*, is that they allow people to keep in touch without having to actually say anything. A notable thing about postcards is how trite the messages often are: "The weather is great. Wish you were here." A letter like that would be ludicrous, even rude. Yet the main point of a postcard is its subtext: I'm thinking of you, just checking in, making the rounds remotely. The picture on the card takes the place of the message. It lets the sender express a bit of his or her taste (for humor or for the macabre or, most popularly, for Impressionist prints), like sending a little gift.

```
What a fun thing on a cold and dark December eve to get a
nice warm postcard. Thanks for a cool service :)
```

The Electric Postcard is an interim technology. A real integration of email and the Web is not far off - the intermediary step of having a claim number and a pickup window are only temporary measures. Yet the "Postcard" metaphor is a good one to retain, for it captures the sense that these electronic messages are *from* some place. Postcards, both real and electronic, indicate where you have been: they are a means of letting your friends know that you are in Paris – or that you have found a cool site on the Web.

The Electric Postcard lets the user send a piece of the Web as a personal statement. The postcard itself, in addition to the picture, includes links to the image source, such as the artist's home page or the Web exhibit that houses the "original". These links can be an integral part of the card's appeal: the *Artamnesia* cards bring the viewer to a virtual club; the *Alice in Wonderland* cards feature the Tenniel drawings and have link to the chapter from which each illustration was drawn.

Postcard sites are becoming increasingly common on-line. There are card sites in China, Syracuse, and the Boston Computer Museum; there are card sites that feature the *Car-Talk* mechanics and characters from *Griffin and Sabine.* There are sites that have transformed the metaphor and that let you send virtual flowers, Indian candies or imaginary presents. "What's the point of visiting a really nice web site if you can't make all your friends insanely jealous of you?" asks Royal Caribbean Cruise Lines in their version of the postcard site.

> Everywhere in the minutiae of our material culture, we encounter reminders of the availability of authentic experiences at others times and in other places.... Picture postcards circulate throughout the world tying tourists together in networks and linking the tourist to the attraction and to his friends at home. (MacCannel 1976)

Here, the "authentic experience" is a virtual location; the postcards make the information space into a source for personal expression.

4.3 *WebTalk*

The third project I am discussing in this chapter is a bit different than the first two. Both *Portraits in Cyberspace* and *The Electric Postcard* are active sites, accessed daily by people from around the world. They are design experiments that show how particular interfaces and metaphors resonate in real use. *WebTalk*, on the other hand, is a technological experiment, a proof of concept implementation for extending communication and awareness on the Web.

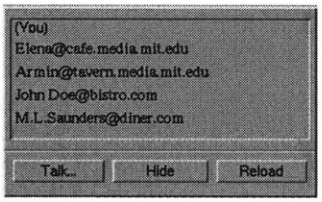
The Web was designed for publishing, not communication. At the time that *WebTalk* was built (1994-95) neither the httpd protocols nor the available browsers supported live, synchronous communication nor was there any mechanism for awareness of the presence of others on a page.

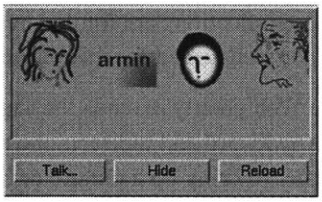
Though unsupported, the demand for Web-based communication was – and is – strong, as evinced by the numerous ways people have devised for communicating with each other within the Web's context. There are "graffiti wall" and "guest books" where visitors can post comments (e.g. *Portraits in Cyberspace*) and Web pages with links that jump to Usenet newsgroups or that bring up telnet windows to MUD sessions. There are collaborative annotation systems and cooperative story building mechanisms; there are voting systems where you can rate Star Trek episodes or recent movies. Some of these function quite well for the communicative task they address; others are clearly interim solutions, waiting for a more elegant and integrated solution.

In particular, two social functions remain unaddressed by the systems described above. First, exploring the Web is remains a solitary pursuit: one is unaware of the presence of the many fellow visitors. Second, one cannot communicate directly to another person on-line within the rich hypertext space of the Web.

The *WebTalk* project (Donath and Robertson 1994) was a modified Web server and browser that addressed these problems. Most notably, it showed who else was on a page and it allowed the user to strike up a conversation or to join an ongoing discussions. Unlike the graffiti boards and other Web-messaging techniques *WebTalk* was real-time – one came to be engaged in dialog, rather than to write a message and leave.

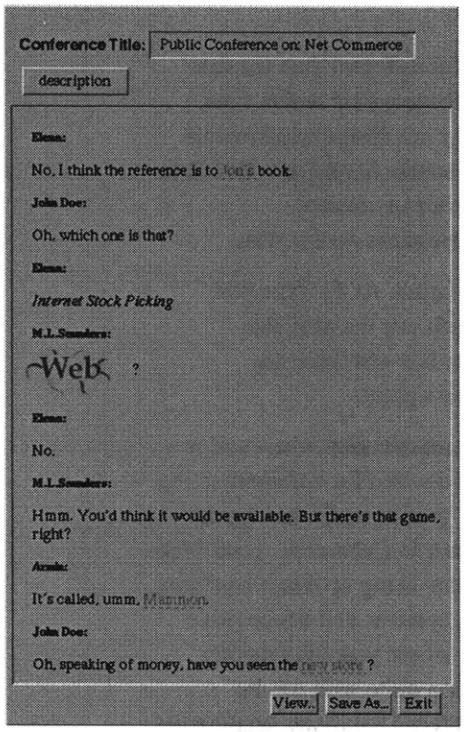
WebTalk provided a sense of the presence of others. A "Who's On-line" window showed who else was on the page. One could quickly scan for a particular person, such as the owner of the page or an acquaintance often found at this spot. The size of the list provided a sense of presence and of the activity level of the page: are there only a couple of people here or is this a major gathering spot, a favorite Web meeting point?





The WebTalk "Who's On-line" window.

Shown here both in text and in a graphical version.



The WebTalk conferencing screen.

Designing this feature required defining presence, a somewhat elusive concept in the Web environment. *WebTalk* was based on the concept of pages as locations: you appeared in the window of the page you were on and you could only talk to people on that page. Wandering, however, is an essential activity on the Web – following links, jumping from page to page. It would be confining to have to literally stay on the same page when conversing with others. The concept of *virtual locations* was developed to allow users to put down an anchor on a particular page - where they would appear to remain - and still wander about the Web with their main browser window. Virtual locations mandated and enabled a singular presence: you could appear to be in only one place at a time.

The main feature of *WebTalk* was its integration of real-time discussion with the resources of the Web. One could easily link one's statements to references, counterarguments and examples – and have an entire library of eloquent pictorial or auditory interjections.

Judging from the writing styles that have evolved in ASCII-only discussion spaces, the demand for such meta-linguistic means of expression is strong. Extensive punctuation, smiley faces, and emphatic asterisks and capitalization are very common in these on-line conversations. They are quite easy to use - as easy as typing any ordinary word. Yet these inflections are limited by the ASCII character set, which is neither extensive nor well-suited for this purpose.

Having access to the full resources of the Web greatly extends the expressive range. Yet HTML, the code of the Web, is awkward and indirect: one types a long address string in a source document in order to bring up a picture or link in the

viewer's browser. *WebTalk*, with its modified browser, was able to add fluency to hypertext conversation by providing point-and-click tools: one needed to simply click on an image or link in order to add it to one's message.

We conceived of the *WebTalk* conferencing mechanism as a sort of prefabricated gathering space: the basic tools were provided for the host, who then set a few parameters and opened up for business. Typically, a Web page designer is a publisher, putting text, pictures, and sounds on-line. *WebTalk* added conferences to that list, making the page designer (or owner) into a host. This new role raises several issues about control, for establishing norms of behavior becomes an important task once the visitors to one's space are no longer passive observers but active participants.

The parameters were concerned primarily with access: could anyone access the site or was it membership-based? were the conversations moderated? were all participants visible? was there a mechanism for bouncing unruly participants? A moderated, members-only discussion is more formal (and time-constrained) than an open chat space; the former may be appropriate for a scheduled debate on a specified topic, the latter may work well as a meeting place on a popular site. By adjusting the parameters of the conferencing environment, the host would be able to modify the general atmosphere of the discussion[6].

The *WebTalk* project was discontinued in the spring of 1995. The server and browser were demo-able, but not yet ready for release to the general public. Browser technologies were changing rapidly, and the most advanced and widely used ones were no longer making their source code available. Sophisticated application languages, such as Java, were not yet available but were clearly the shape of things to come. *WebTalk* remained useful as a demonstration of a sociable information space, but its incarnation as an integrated browser and conferencing system, though providing it with features that stand-alone systems can not offer (such as the point and click links), also made it impractical to introduce at large.

Today, there are a number of sites that offer on-line chat from the Web. Most are simpler than *WebTalk* and few of them allow HTML to be used in the messages at all, let alone providing an interface for it. Some are simply text-based chat on web page, while others are full graphical environments.

One feature from *WebTalk* that is not part of any mainstream Web/chat programs – and it is the one that would be the most interesting to see develop and evolve in real use – is the easy to use, point-and-click html editor. As I mentioned in the discussion about *The Electric Postcard*, I had thought that the ability to add links and other hypertext elements would be a popular feature. But writing HTML is tedious; relatively few people are familiar with it, and even those who are find typing out long site addresses a graceless interface. In a live chat environment,

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6. Of course, the context for the discussion, i.e. the contents of the page, has the greatest impact on its tone. A conference on a page devoted to molecular biochemistry will attract a very different crowd than one on a page filled with "Hot Pix of Big Chix".

with its emphasis on speedy repartee, the interminable site strings are even less appealing. So, while home pages and other carefully prepared documents are often replete with links, it still has not become an integral part of interpersonal correspondence.

4.4 Remarks

The projects discussed in this chapter each incorporate social interactions with the information landscape. In *Portraits in Cyberspace*, information (i.e. the exhibit) functions as the setting for the discussions, each of which is situated in the context of a particular work of art. Here, the information setting provides a focus and catalyst for the discussion. The *WebTalk* conferences were also designed to be situated in a relevant information setting, with a focus on making the information space inhabited, bringing live interactions and representations of presence to the on-line environment. Information is used somewhat differently in *The Electric Postcard.* Here, the information (in the form of images) is made into personal object (postcards) by means of the metaphor of the postcard and through the individual composition and addressing of a message. The *Postcard* site is also a setting – like a virtual tourist spot, it is a place from which to send a souvenir.

An information space, though it is not tangible like wood and bricks, is still a "place" in the sense that is a particular locale: specific, unique, and recognizable. In the real world, we associate specific places with particular types of discourse: conference rooms, writer's bars, kitchen tables all lend themselves to different tones and topics of discussion (Oldenburg 1991). The physical space shapes the conversation both by attracting a particular group of participants and by creating a particular atmosphere, whether of formality or casualness, intimacy or openness, etc.

An information space similarly attracts a particular audience, one that is likely to share similar interests. Gathering an audience of people with shared interests is one of the Web's strengths: many sites are narrowly topical; others, though broader, are designed to attract a specific group. And the Web's topology of links, as discussed in the analysis of the *Portraits* audience, makes an interesting flow of visitors likely. Lynch's assertion that the well-designed space should "furnish the raw material fro the symbols and collective memories of group communication" is also well served by the information space. Here, the materials – words, images, sounds, etc. – are themselves symbolic constructs, transformable from gathering space to communication element. This is encouraged by the Web's hypermedia structure, in which references to sites are easily integrated into any message. With the *The Electric Postcard*, for example, while hypertext was not often used in people's letters, the site itself is both an information space (a known and distinctive site) and an element of communication (pieces of which are "sent" as messages).

One way in which the virtual world lags far behind the real is in the creation of a distinctive atmosphere particular to a space. Today, with "information spaces" primarily represented by the Web, the atmosphere – the tonal range – of these

spaces is quite limited. Pictorial backgrounds have replaced the universal gray of early browsers and methods for adding sounds and animations are starting to appear, yet the options for interaction remain limited and our sense of the presence of others remains dim. Although the *Portraits* discussions are located in a virtual art gallery, in format they are only slightly different than say, a Web-based discussion about health or a home-page guestbook. Two such information spaces may be quite different in content, but their form and overall visual quality will be relatively similar. In the next two chapters, I discuss projects with highly visual and interactive interfaces. The eventual goal is to unite these two design directions: to make sociable information spaces that are as distinctive in their appearance and interaction as they are in their content.

5 Visible cities

> The urban world puts a premium on visual recognition.
>
> - Lewis Wirth

Wirth made the above comment about the primacy of the visual in urban life in his 1938 essay "Urbanism as a Way of Life" (Wirth 1938). He argued that city life was distinguished from other forms of human habitation by its large, dense and heterogeneous population. He described how this population results in a highly diverse and segmented society, composed of individuals whose social role is both fluid and multifaceted. Unlike the village dweller, whose primary contact is with people he already knows, the urbanite encounters vast numbers of strangers, people about whom his only knowledge is where he sees them and how they appear – hence the importance of the visual in the urban world.

The on-line world has many parallels with Wirth's description of the prototypical urban experience. The population is immense and the individual's role is segmented. Here is Wirth's description of the heterogeneity of the urban individual:

> By virtue of his different interests arising out of different aspects of social life, the [urban] individual acquires membership in widely divergent groups, each of which functions only with reference to a single segment of his personality... [T]he groups with which the person typically is affiliated are tangential to each other or intersect in highly variable fashion...Partly as a result of the physical footlooseness of the population and partly as a result of their social mobility, the turnover in group membership generally is rapid. (Wirth 1938)

This description could easily be of today's participant in virtual culture, who contributes to various newsgroups and mailing-lists and who is known in each only in the aspects that pertain to that group. Indeed, the virtual world, with its global population of millions and its highly segmented zones of encounters, constitutes a sort of radical urbanism, with the urban society's characteristics of heterogeneity, fluidity, and fragmentation carried to an extreme.

Notably missing from the virtual city, however, are the striking visuals of the physical city, from the diverse fashions of the passing crowd to the architectural landmarks. In the physical city, the visual scene provides many key social functions: it lets the observer gather information about passersby without engaging in an involved interaction (Wirth 1938, Milgram 1977); it sets the tone

and atmosphere of the city and of its neighborhoods (LaGory and Pipkin 1981); and it provides the inhabitants with the landmarks and features that make the environment legible (Lynch 1960, Milgram 1977). These functions are all relevant to the virtual city; here, however, the visual design can be created specifically to serve these functions rather than, as is often the case in the physical world, as a secondary effect of commerce or geography.

Making the virtual city visible is the topic of this chapter. Visual representations of the electronic city – the large-scale social landscape – are rare. Most graphical interfaces to electronic social environments depict small group encounters, emphasizing interaction and identity display among a limited number of participants (these designs are examined in CHAPTER 6). Here I will be looking at designs for the public, open spaces of the virtual world, interfaces that reveal the flow of the crowd and the over-all structure of the community.

There are, of course, innumerable ways of rendering the virtual city. Rather than attempt a preliminary taxonomy of designs, I will focus on one design – *Visual Who*, an interactive visualization of patterns of affiliation and presence – and use it as a basis for discussing a range of key issues, including the psycho-perceptual impact of visualization techniques, the imposition of order vs. reflection of complex structures, and the balance between privacy and public spaces.

5.1 *Visual Who*

The population of a real-world community creates many visual patterns. Some are patterns of activity: the ebb and flow of rush hour traffic or the swift appearance of umbrellas at the onset of a rain-shower. Others are patterns of affiliation, such as the sea of business suits streaming from a commuter train, or the bright t-shirts and sunglasses of tourists circling a historic site. These patterns help the inhabitants make sense of their community. Similarities in clothing choices unite the members of a cultural group (Davis-F. 1992) as do the venues and neighborhoods in which they gather (LaGory and Pipkin 1981). The structure of the community – the social, political and professional clusters of people – is made visible by appearance and location.

Commuters, Grand Central Station

The ebb and flow of rush hour traffic is one of the many visible patterns made by the population of a real-world community.

The population of an electronic community creates similar patterns. There are times of heavy usage and times when only a few late night users are about; there are mailing lists, newsgroups and chat-rooms that bring together people who share similar jobs or interests. Yet these patterns are difficult to perceive: though the flow of the crowd is recorded in the login database and the community structure is woven into the mailing list memberships, these records have no visible manifestation.

The purpose of *Visual Who* is to make these patterns visible. It creates an interactively explorable rendering of the social structure of a community, one which allows the viewer to explore the complex patterns of affiliation and also to see temporal patterns of people's arrivals and departures.

5.1.1 Patterns of association

> To be sure, it is for the sake of special needs and interests that men unite in economic associations or blood fraternities, in cult societies or robber bands. But above and beyond their special content, all these associations are accompanied by a feeling for, by a satisfaction in, the very fact that one associated with others and that the solitariness of the individual is resolved into togetherness, a union with others.
>
> - George Simmel

The physical Media Lab is the place where people come and work. Its location is a building in Cambridge; its public space is the hallways, classrooms and atrium of that building. Parallel to it exists the electronic Media Lab, an extended community of graduate students, faculty, alumni, colleagues at other institutes, etc. The electronic Media Lab is nominally centered in a computer named `media-lab`; its public space is a vast network of communications: people posting electronic notices announcing job openings and asking questions about algorithms, people holding mailing list discussions on topics ranging from narrative structure to video compression[1].

These mailing lists reflect the social framework of the community – what its roles are, what its inhabitants care about. On `media-lab`, there are administrative lists that enumerate the faculty, the technical staff or the doctoral students; research lists for discussing topics ranging from parallel compilers to music perception; and recreational lists such as the ones for extreme skiing or political arguments. In a more formal and bureaucratic organization the lists would be primarily administrative and official; in other settings, they might tend more towards hobbies and entertainment.

People are motivated to add themselves to various lists because they wish to be involved in the discussions (or because their role requires it). Those who are intensely involved in the activities of the electronic community are on many lists,

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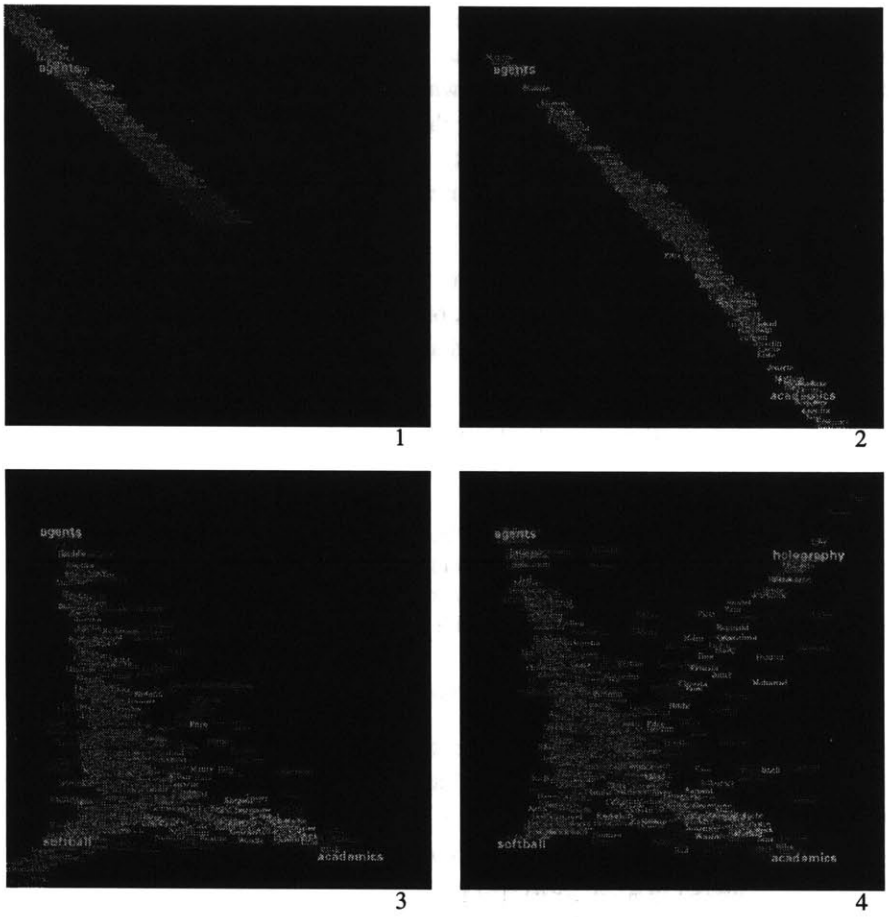
[1] Some discussions are truly public, open to anyone in the community who wishes to join. Others are public in the way a table at a restaurant is public: one can see who is sitting there, but does not join without an invitation. But they are not secret: their existence and memberships is public knowledge.



Visualizing associations

These images show the process of creating a view of the community. In this representation the faculty members are yellow; staff is purple; graduate students are red; undergraduates are green and everyone else is blue. The whole community is shown. The brightness of a name shows the strength of the person's attachment to the given anchor groups.

1. A single anchor - in this case a research group - has been added. With only one anchor, nearly all the names would eventually end up gathered in that corner.

2. An anchor representing the Lab's committee on academics has been added. Note how this anchor has pulled first the faculty members, followed by the staff.

3. The softball team is added.

4. The holography research group is added.

those whose participation is more peripheral appear on only a few. The effect is that everyone creates a simple public profile of their interests and of their role in the community.

Visual Who uses these lists to create an interactive visualization of the associations within the community. When the *Visual Who* screen first appears, the names of all the people in the community are in a pile in the center of the screen. The user can place any of the mailing-lists as anchors, anywhere on the screen. The names are pulled towards the displayed anchors as if attached to them with springs. How strong a pull each anchor exerts on an individual name depends on the correlation between that person and the mailing list; the greater the correlation, the more strongly the person is drawn towards the mailing-list anchor. By placing additional mailing-list/anchors around the screen, the user creates a conceptual map of the community.

The visualization is dynamic. People with a very close correlation to a given mailing list will quickly converge on it when it is added as an anchor; those who are less similar approach it more slowly. People who are equally related to two lists will end up in between them. A very popular list swiftly gathers to itself names from all over the screen. The dynamics of the visualization are a

simulation of a system of springs; when the system reaches equilibrium, each name is optimally situated to reflect its distance from the given mailing-list/ anchors.

Visual Who has no knowledge of a given mailing list's meaning nor of its relative importance or frivolity. Its visualization of the community is statistical, based entirely on the information in the alias file.

5.1.1.1 Clusters and correlations

Visual Who is designed to visualize group membership, a fundamental part of community structure (Sproull and Faraj 1993). Rather than showing the exact membership on a list, it shows people's tendency to be like the people on a list.

When a mailing list is chosen as an anchor, *Visual Who* looks at what other groups all the members of the chosen list also subscribe to and creates a profile of the membership pattern of average member of the list. To figure out how close someone is to that list (how strongly the list is pulling them) is done by comparing the person's pattern of membership with the average membership profile for the list. Thus, one might have a high correlation with a list one is not a member of and vice versa. (A full description of the algorithms used to determine correlations and to simulate the behavior of the spring system is found in the Appendix.)

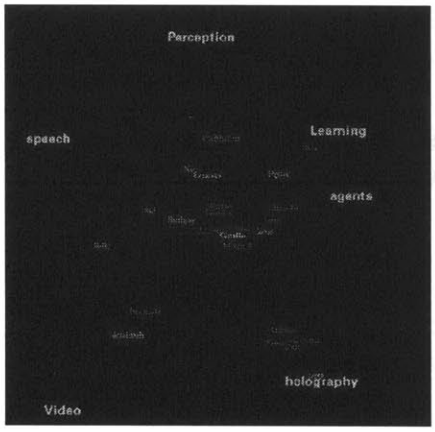
Its clusterings are not definitive; rather, they exist within the context of a situation, as defined by the choice of anchors on the screen. Within a given situation, the members are compared feature by feature (i.e. by mailing-list membership). The saliency of a mailing list is determined by its size: smaller lists are considered more salient. (See Smith 1990 on similarity measurement of cognitive categories; Lakoff G. 1990 for a broad treatment of categorization.)

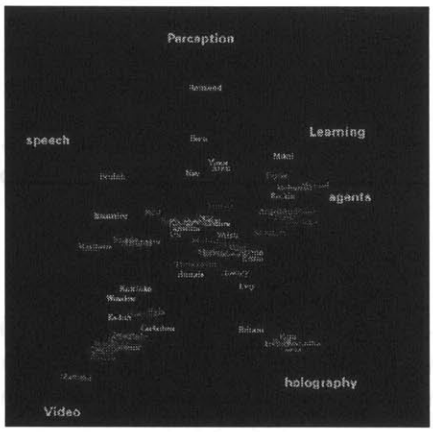
5.1.2 Patterns of presence

> The city is still the prime place. It is so because of the likelihood of *un*planned, informal encounters.
>
> - William Whyte

Activity in the physical Media Lab varies with the time of day. Weekdays, the offices are full and a steady stream of people – administrators, visitors, students, professors – pass through the hallways. Late at night, it is much quieter, but not deserted: there are students working at all hours. During the day, the opportunities for chance encounters, for running into an acquaintance or someone whose research you had been meaning to ask about, are high. At night, there is comfort in knowing that you are not alone, that others, too, are still at work.

Activity in the electronic Lab community similarly ebbs and flows. At four a.m. there are not only the late working students, but also alumni and travelling faculty logged in from distant time-zones. By noon, well over a hundred people are usually present on media-lab, busy sending mail, checking announcements, and





Visualizing presence

Here we see only those people who are actually logged in. The brightness of a name shows activity – the darkest names have been idle the longest. day.

1. Late at night (4 a.m.) Very few people are logged in and only a couple are active.

2. Midday (1 p.m.) Over a hundred people are logged in and there is much activity.

reading the news. Yet the usual window onto this community – the terminal screen – shows none of this. It looks like any other screen: a prompt, some text and a cursor. One has little sense of the presence of others.

Visual Who can be set to show only those people who are currently logged in. The names of those who are active are displayed in bright colors, while those who are idle fade into darkness. One can see the flurry of morning logins and the exodus at dinner time; one realizes that during many late hours when the real-world Lab is empty and quiet, its electronic counterpart is busy with people working at home or logged in from far away. In this mode, *Visual Who* is a real-time window onto the community, providing the user with an awareness of the presence of others.

Visual Who can also display an animation of activity over a long period of time by using recorded data. This highlights the correlations between activity patterns and group affiliations. The area near an administrative anchor will be nearly deserted at night; graduate researchers leave themselves logged in indefinitely; an upcoming deadline will show a particular research group keeping especially long hours.

5.1.3 Design analysis

The goal in building *Visual Who* was to find ways of making a community's complex and shifting patterns perceivable and legible. The solution is an image in motion: one that quickly shifts to adapt to the viewer's changing concerns; one that reveals information through motion; one that displays the ongoing changes in the community's life. To do this, *Visual Who* uses motion, color, and interaction to convey the structure of a community. This section covers how each of these methods was used and the characteristics that make it especially useful or problematic in visualizing social information.

A community is both complex and ever changing. New people join, others leave. They are in motion, their activities changing from moment to moment. The topics of interest – the ideas that hold the community together – are always evolving.

Kevin Lynch, in his pioneering book, *The Image of the City,* wrote:

> The city is a construction in space, but one of vast scale, a thing perceived only in the course of long spans of time. City design is therefore a temporal art, but... on different occasions and for different people, the sequences are reversed, interrupted, abandoned, cut across. (Lynch 1960)

The role of the designer is not to make a single, perfect path, but to create a space that, in Lynch's words, is "legible", one that is easily organizable into a coherent pattern. The image of the city – or of a community – is not single frame, but a series of impressions, an image in the round built from a series of successive views.

5.1.3.1 Information via motion

The motion of the names in *Visual Who* conveys information about the underlying database structure. Changing the anchors sets the names in motion and shows clearly who is most strongly aligned with which anchors. When a new anchor is added, the names most closely associated with its list are quick to stream towards it, followed more slowly by those with weak ties or with very close ties to other anchors. Simply shifting an anchor's position stirs up the names that are most closely aligned with it. When an anchor is deleted, the names that had been pulled towards it are released and spring away.

Motion serves three purposes here: it disambiguates the data, draws attention to changing information, and indicates the imprecise nature of the data.

Like any high-dimensional visualization, the *Visual Who* display is inherently ambiguous. With every anchor that is placed on the screen, another dimension is added to the visualization. With 2 anchors, the names form a line. With 3, they fill a triangle. Once there are more than 3 anchors, it is inevitable that some locations will be ambiguous. The dynamics of the visualization help to disambiguate the information by showing which names are most affected by changes in the anchors.

The motion in *Visual Who* draws the viewer's attention to data that has been affected by a change in the anchor arrangement. Motion is a very effective at making one take notice – Arnheim judged it be "the strongest visual appeal to attention" (Arnheim 1974: 372) – and in a visual crowded environment, the moving objects stand out clearly from the rest. Perceptually, motion is one of the "pop-out" phenomena: it is perceived very quickly by low-level visual processes (Ivry and Cohen 1990). Furthermore, we perceive objects that are moving in the same direction as a group and even in a complex scene, one can focus on the grouping formed by things moving in unison; this is the useful cognitive ability that allows us to detect a predator moving behind a cover of rustling leaves (McLeod et al 1991). In *Visual Who*, names that have been similarly affected by a change in the anchor layout form a coherent group while they are in motion, though they may eventually settle in widely scattered areas.

Finally, the bouncing, oscillating spring-like motion of the names when an anchor is added is illustrative of the fluid nature of the data. The people in the community do not fall neatly into crisply defined categories, but rather tend to cluster according to a looser set of similarities and affinities. If the names were to

snap immediately to position, the visualization would give an impression of precision and finality, which does not reflect a community's malleable structure.

5.1.3.2 Color

Visual Who uses hue to show membership in particular lists. This makes it possible to use to find specific information, such as who is an avid cyclist or who might be able to answer a signal processing question. More importantly, it is through the combination of screen location (which shows affinities through the relative pull of the anchors) and hue (which shows specific memberships) that the social patterns emerge.

Clusters of color are easy to follow. As the anchors change, the rearrangement of the color patterns is immediately noticeable, as some flow cohesively to a new location or are scattered throughout the space. With the Media Lab database I often use hue to indicate institutional roles, distinguishing faculty (orange), staff (thistle), graduate students(red), etc. In one example, adding the skateboarding anchor pulled one of the professors from the cluster of faculty at the other end of the screen, so that he stood out as an isolated spot of professorial orange in a sea of student green. It was a professor of music and, though certainly not a skateboarder himself, he was involved in many projects with the skateboarders, most of whom were musicians. Color highlights anomalies and other interesting data points.

Hue is best used as a "dimension of distinction" (Arnheim 1974), a means of separation rather than comparison. Although the visual system can distinguish many thousands of colors[2], far fewer – perhaps 20 or so at the most – can be used in an image to demarcate categories of data (Tufte 1990; see also Lakoff G. 1990 on the cultural and neurophysiological basis for color categories). And, while there are many ways to logically arrange colors (e.g. by their position in the spectrum), using them to express ordered relationships is seldom intuitive[3].

Unlike hue, brightness is well suited for showing quantitative comparison. In *Visual Who*, brightness is used to show the relative strength of all the springs attached to a name. The brightest names are those who are the most involved with the interests highlighted by the current set of anchors. Depending on the suite of anchors chosen, some arrangements may have only a few bright names, indicating that the anchors select a specialized segment of the community, while others combinations are more uniformly lit.

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2. The number of colors the human visual system can distinguish is debatable. Tufte gives a range of 20,000 for the average viewer to 1,000,000 for trained subjects doing pair-wise comparisons (Tufte 1990). Hochberg states there are 350,000 distinguishable colors, though he does not specify the viewing condition (Hochberg 1978).

3. Though again, no hard and fast rule can be made. People easily perceive orange to be "between" red and yellow, yet green is not so intuitively between yellow and blue, even though it has an analogous place in the spectrum, and, like orange, can be produced by the subtractive mixing of the surrounding primaries. Hochberg provides a full discussion on color perception and it's relationship to the visible light spectrum (Hochberg 1978).

Well used, color can be an important element in developing the ambience of an on-line environment. Color memory is strong (Salomon 1990) and demarcating borders and neighborhoods through changes in color scheme is one approach to making the space more legible.

Visual Who allows its users to set which colors mark the members of which groups and one can make a set of such configurations, each highlighting different pattern in the community. This program does not, however, provide any assistance in choosing suitably expressive combinations. Ideally, since most users are not sophisticated designers, they should not be required to pick individual colors, but should be able to choose among color suites suggested for their perceptual qualities and cultural meaning. (See Bender and Jacobson 1996 for an in-depth discussion of issues in the design of such a color choosing system.).

Though color can be very useful in visualizations, providing an additional dimension for data discrimination and enhancing the visual appeal of the design, using color well can be tricky. Tufte warns:

> Tying color to information is as elementary and straightforward as color technique in art, "To paint well is simply this: to put the right color in the right place" in Paul Klee's ironic prescription. (Tufte 1990)

One of the most difficult issues in using color in a visualization is avoiding spurious color-induced interpretations of the data. For example, some colors stand out vividly, while others recede. If two data sets are colored yellow and blue, the former will stand out prominently and will thus appear to be more important, whether or not that was the designers intent. That is, unless the background is yellowish or brownish, in which case the blue would stand out strongly and the yellow would fade. Color, said Albers, "is the most relative medium in art" *(Albers 1975).* Culture, as well as perception, affects the meaning ascribed to colors, such as the association. in contemporary Western society, of pink with femininity and of red, white and blue with American patriotism. Color can make an image look corporate or childlike, militaristic or sophisticated. The designer of any sort of graphical representation – and especially of a social environment – needs to be aware of the often subtle ways that color can shade meaning.

5.1.3.3 Interaction

Visual Who does not create a definitive view of the community; instead, it provides the means for the user to explore the social space. Each arrangement of anchors is a sketch, an impression, of the community. One gains a full picture of the community by looking at many such sketches, for each rearrangement reveals different patterns and alignment, filling in a little more of the picture of the whole community. To encourage such exploration it was designed so that it is quite easy to move the anchors about, to clear them all and start over with a new set.

One of the most important design principles in creating a visualization is to use graphics and techniques that are well suited to the "sense and substance" of the

data (Tufte 1983). It is notoriously easy to create an authoritative looking graph from subjective or otherwise inexact data. A community is complex and mutable; there is no single static image that perfectly captures its structure and relationships. For the participants, the contours of the community are highly subjective; each person sees in it in the context of his own relationships. An interactive visualization, with easily configurable viewpoints, is one way to provide the viewer with an intuitive sense of the subjective nature of social visualization.

The importance of interactivity in visualizing large databases and multivariate data has been noted by many researchers (Buja et al 1991; Buja et al 1991; Keim and Kriegel 1994; Shneiderman 1994). Reports from a wide range of interactive visualization techniques observe that interactive systems are effective because they allow the user to create numerous simple and easily comprehended images and because they clearly show the effects of query modification. Shneiderman coined the term *dynamic query* to describe systems that provide a rapid re-rendering of the interactive requests. His experiments have shown that people not only enjoy using such systems, they also learn a great deal about the data they are exploring (Shneiderman 1994).

Interactive systems appeal to our desire to adjust our environment. Whyte, observing that before sitting in a chair, people will, move it a few inches this way and that, finally ending up with it in about its original position, noted "The possibility of choice is as important as the exercise of it... These moves are functional. They are a declaration of one's free will to oneself, and rather satisfying. In this one small matter you are the master of your fate." (Whyte 1988)

5.1.4 Future work on *Visual Who*

The next stage in this work is to accommodate larger populations. The implementation at the Media Lab pushes the limit of legibility with approximately 1100 community members. To expand further, the system must make it possible to focus on specific portions of the population. Potential useful approaches include color and transparency manipulations (Colby and Scholl 1991), 3-dimensional data navigation (Drucker 1994; Rennison 1995) and zoomable interfaces (Perlin and Fox 1993; Furnas and Bederson 1995).

The data sources currently in use in *Visual Who*, the alias and the utmp file, are interim sources, artifacts of Unix and of centralized computing. How does one show a distributed electronic community? What are its definitions of member or presence? One project is to use this interface to visualize home pages on the Web, using links and phrases in place of mailing list membership; the research issues here are bounding the community and filtering the data.

Another goal is to make it an inhabited environment. Currently, *Visual Who* shows a city of data about people; people are represented in it, but the people are not in it. Presence on the screen represents presence elsewhere: you are seeing if people are logged into a central computer (or whatever data is used to measure

presence). This presence should be more tangible; one should be able to not only observe presence, but to experience it. The first step is to add basic communicative ability: if I see by the *Visual Who* screen that you are around, I should be able to send a message through it to you. The ultimate goal is for the graphical representation of one's community to be the access point to it.

5.1.5 Related projects

Visual Who, of course, only one among many potential ways of visualizing the electronic city. There is other data to show, other ways to show it.

Several other researchers have explored social phenomena using visualization techniques. These works show the patterns of individual inter-relationships, in contrast with *Visual Who*, which illuminates clusters of affiliations. Eick and Wills use email traffic patterns as one example in their network visualization research (Eick and Will 1993); Robertson et al show the organization of a large corporation in their work on visualizing hierarchical information (Robertson et al. 1991); and Krempel looks at ways of visualizing anthropological observations of social networks *(Krempel 1993)*. Visualizing social populations is not a heavily researched field and most of the work that has been done is aimed at studying the population, rather than on using the visualization as part of a social environment.

5.2 Datascapes and cybervilles

The Virtual City as visible metropolis pulsating with light and activity has thus far been built only in the realm of science fiction. Yet these fictional cities may prove to be quite influential, for they guide the imaginations of many of today's system and interface designers.

Two schools of design can be discerned in the more frequently cited works. The first, epitomized by William Gibson's cyberspace stories, is the virtual city as abstract datascape, with glittering swirls and towers of financial data and corporate secrets, extending out to the infinite black universe (Gibson 1984). The second, detailed by Neal Stephenson's Metaverse descriptions, is the virtual city as traditional town, its orderly streets lined with shops and cafes (Stephenson 1992).

> Cyberspace.: A consensual hallucination experience daily by billions of legitimate operators... A graphic representation of data abstracted from the banks of every computer in the human system. Unthinkable complexity. Lines of light ranged in the nonspace of the mind, clusters and constellations of data. Like city lights, receding....[ellipses original] (Gibson 1984).

Gibson's cyberspace has the aesthetics of scientific visualization. People are absent. Technology as isolator is central theme: he writes of plug-in sensory stimulation units, hypnotized hookers with simulated anatomically correct responses, solitary expeditions into vast datascapes. Yet it is GIbson who coined the world cyberspace and it is to his works that people often refer when talking about the future wonders of the virtual world.

Stephenson's vision of the future is more prosaic. His virtual landscape, the Metaverse, is fully inhabited. He is most well known for his description of avatars (see CHAPTER 6), graphical representations of people on-line. Though his architecture has not had the fascination of Gibson's cyberspace, it is more in accord with the spaces that people are actually building – the e-cafés and cybervilles that are popping up around the Web. Stephenson's vision draws so much from the real world that it gains little from being in an entirely new and plastic medium. There are buildings and streets and, though one can travel faster than in reality, it still takes a long time (and an appropriate vehicle of transportation) to get anywhere. What is most interesting about his world is that it is heavily populated and the experience is shared.

There are many references on the Web today to both of the literary models. There is a system called "The Black Sun" after the bar in *Snowcrash* and there is an on-line service called "SenseNet" after a multinational entertainment conglomerate in *Neuromancer.* The term avatar has passed into common use (*n.b.* Stephenson is not the sole progenitor of this usage.) As for actual interfaces, the influence is less obvious, largely because the Web's current technology is so limited. There are occasional collective art projects that create simple datascapes; there are the cybervilles, mainly Main Street illustrations as fronts for text sites. Neither of those are inhabited spaces. There are however, a growing number of avatar worlds, which are shared, graphical spaces (see CHAPTER 6).

The essential dichotomy between the datascape and the cyberville – between Gibson's cold abstraction and Stephenson's literal re-staging – is not necessarily in their level of abstraction, but in the level of planning. The cyberville is very highly planned: each piece is deliberated created as part of the city representation. The datascape is more organic: it is a representation of ongoing activity. In Gibson's version, the represented activity is corporate, yet it need not be. It can (and *Visual Who* is a prototype of this) be an image of the things people are doing, associations they are making and the data they are sending in the course of pursuing their business, their education, and their lives.

In the essay "A city is not a tree" Christopher Alexander wrote about the danger of deliberate design (Alexander 1965). A living, vibrant city, he said, is a complex structure, growing organically through the process of human activity. This complexity, which is a prerequisite for a "living city" cannot be meticulously planned, for if we impose a design it will be too simple and sterile. He criticized those who tried to recreate the great cities of the past too literally, rebuilding their "plastic and physical characteristics" instead of trying to understand their "abstract ordering principle". From this principle the city should be "grown" rather than "thought out", for it will then be sufficiently complex and interlocking to make for a living city. [4]

The cyberville is the city rebuilt in its "plastic and physical characteristics". The virtual datascape – in which the representation reflects the potentially far more complex arrangements of data, networks, messages and activities – is potentially a vastly more complex, organic structure. The point is not that the image must be

abstract - and certainly not cold and forbidding - but that it should reflect the presence of the crowd, its size and activity: the big, unplanned, patterns.

5.3 Public space and privacy

The final section of this chapter deals with privacy. Privacy is less of an issue in the cyberville model – or in the deliberate self-representations of today's Web pages: the words and images are deliberately chosen to represent oneself or one's business; they are clearly meant for public consumption. A visualization of aspects of ongoing behavior is something else - do you know where and when your actions are visible? what patterns may be revealed? New technologies, including data visualization and the monitoring of on-line behavior, raise significant concerns about the erosion of privacy. Many of these issues revolve around the ownership of personal information: who should have access to information about one's behavior? An application such as *Visual Who*, with its ability to highlight patterns within a community, could be a marketer's dream.

Yet making all data private is not a good solution: public space is important to community. There are very few paeans to the paranoid suburbs, where no one knows a neighbor's name and the shades of every house are drawn. The goal is to strike a balance, to have a clearly defined public space where one assumes that actions are visible.

Public spaces[5] serve many functions. Streets, for example, are for transit – for getting from one place to another. They are also informative: walking about, the inhabitants learn what is available in the city. "Public space is the stage upon which the drama of communal life unfolds. The streets, squares and parks of a city give form to the ebb and flow of human exchange."(Girouard 1985)

In a city, there are many levels of privacy. Streets and many parks, for instance, are fully public areas: they are open spaces that anyone may enter and one's actions and appearance is viewable by all. There are also semi-public places, such as stores and restaurants. Here, one's behavior is more constrained and access may be limited, e.g. by price or dress code. Furthermore, within these more or less public spaces there are smaller, more private gatherings, such as one's table at a restaurant. There are complex social rules about the privacy and accessibility of these groups and an important part of cultural fluency is knowing when one is free to join a group (or to exclude others). For instance, joining a

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4. Though Alexander does not mention natural selection, his account very much in the spirit of Darwinian evolution and its explanation of how a simple process can, over time, produce the most complex formations known. There is some research in using genetic algorithms to simulate evolution as a tool for urban design (e.g. Soddu and Colabella 1995). For a more in-depth discussion of evolution as a cultural force see (Pinker 1994) on the human language development and (Hauser 1996) for a very thorough examination of the evolution of communication in both humans and animals.

5. By public space I mean any area in which one is likely to encounter other people. In a work environment, for example, the hallways are public space, but one's office is not. This is public space in a social, rather than political, sense.

table of strangers in a restaurant may be a friendly gesture or an outrageous breach of social mores, depending on what country one is in, the type of restaurant, the number of people involved, and the time of day. As social beings, our involvement with others can be on many levels of intimacy: people flock to restaurants to be in the presence of others, but simultaneously protect the privacy of their conversation and their immediate physical proximity.

Public space, in the virtual world, is public data. Public, however, does not necessarily mean open to the entire world. A better phrase is communal data: information that individuals knowingly contribute to create their community's public space. *Visual Who* is created with communal data; it is designed to be a tool for use within the community. It is can enhance privacy or damage it, depending upon the circumstances of its use.

A well designed interface to a virtual environment should be able to support a range of public and private spaces. One of its functions is to differentiate the public from the private. In the physical world, one knows that one's actions on the street are public and one believes one's actions at home are private – and adjusts behavior accordingly. In the virtual world, establishing clearly demarcated *public* space can enhance privacy by increasing people's knowledge of what information is private and what is known to all.

Researchers at Xerox EuroPARC found that introducing a series of privacy protections and awareness mechanisms into a virtual space (in this case, a shared audio and video environment) made the participants much more willing to make themselves available – to present themselves in public – in the environment. Dourish (Dourish 1993) observed three reasons for this: they trusted that they could remove themselves from the public space when they wished to; the awareness mechanisms gave them feedback about how open or sheltered was the space they were in; and multiple levels of access were provided, giving the participants control over how visible and accessible they were.

With social interfaces, it is important to consider the privacy of the data underlying the design. *Visual Who* used data – the mail aliases and the login record – that were already public within the community. Compare this with a project such as *HierNet (Eick and Will 1993)*, an interactively explorable visualization showing the pattern of individual mail messages passed within an organization. In many communities, who communicates with whom is considered quite private. The appropriateness of either visualization depends on the community's standards of what is public data; similarly, the community may consider data to be public within its confines, but not viewable from outside[6].

Visualizations can reveal previously invisible patterns – that is, in fact, their purpose. Data that is publicly accessible in its raw state may seem far less innocuous once it is compiled or visualized. The Usenet search engines mentioned in CHAPTER 3 are an interesting example. These are services that have

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6. For public talks and papers about *Visual Who* I use images with pseudonyms for both the aliases and user names.

made databases of postings publicly available, along with the capability to search for all the articles by a given author. While Usenet postings have always been public, people often considered newsgroups to be semi-private spaces: though no walls kept Aunt Emily out of *alt.sex.bondage,* one assumed she wouldn't venture there and thus one's postings were safe from her eyes. With the ability to easily compile a comprehensive list of someone's postings, this assumption of tacit privacy disappeared. Now, anyone – friends, employers, aunts – can quickly see all the newsgroups one participates in and all the postings one has made.

This is not necessarily a bad thing. For example, there has been relatively little outcry about the Usenet search services; instead, the implicit understanding about what is private space in Usenet seems to be changing (Donath n.d.). Perhaps one reason that this loss of privacy is tolerated is that the Usenet community itself benefits from this service, for it gives participants the chance to see a more well-rounded view of their fellow contributors.

This fundamental trade-off, between personal privacy and social identity, occurs in both the real world and the virtual. The archetypal village that is so often invoked as the ideal of community togetherness is also a place of minimal privacy, a small world in which everyone's comings and goings are noted and judged; its opposite is the suburb, where all activity occurs in private homes and the inhabitants shuttle off to school and work secluded in their individual automobiles. The inhabitants have privacy, but not community, for a community cannot form if its potential members are seen only as ciphers.

Today's on-line world resembles the suburb more than the village: our fellow inhabitants are vaguely featured individuals glimpsed in occasional exchanges. By moving to a graphical environment in which we see each others patterns of activity, we lose some privacy and gain a clearer picture of each other. Whether this shift in the balance between private and public is beneficial depends in part on how the new environment is designed: does the community accept the revelation of the information? who has access to it? how clearly are the distinctions made between the private and the public?

Technologies that make these distinctions clear and intuitive in the virtual world make public space more vital and private space more secure.

6 Illustrated conversations

The previous chapter discussed the design of visual interfaces to large on-line groups; the goal being to provide an overall sense of the size, structure and activity of a community. In this chapter the focus shifts to smaller groups, gatherings of people who are actively engaged in some form of on-line discussion.

Many forms of collaboration and communication among groups of people on-line are essentially conversations. They include the real-time discussions that take place in the social MUDs, on Internet Relay Chat and in the "chat rooms" of America Online, as well as the asynchronous exchanges of Usenet news and bulletin boards. These conversations are entirely text-based. Lacking visual cues, the participants in these conversations cannot see how many people are involved in the discussion, where the attention of the group is directed, or who is currently present.

A visual interface can provide much of this information. Furthermore, it opens up new communication channels, supplementing textual statements with non-verbal cues. Arguably, by making the participants visible and their conversation more expressive, a visual interface deepens their sense of each other's identity.

Yet visual interfaces, especially if they are poorly designed, can obscure communication. We are, in general, far more accustomed to expressing ourselves with words than with images. At the same time, we are very attuned to images and their meanings, particularly when the images are of people. A poorly designed graphical interface can easily and efficiently communicate highly misleading social cues.

There are a wide range of visually enriched virtual conversations, from shared video environments (Beshers and Feiner 1993) to computer supported cooperative work (CSCW) interfaces (Roseman and Greenberg 1996). In this chapter I will be focusing on what are often called *avatar systems*: shared graphical environments in which participants, each represented by an image (or avatar[1]), converse with others who are logged into the same space. The reason for

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1. The use of the word avatar to describe these representations was coined simultaneously by the developers of *Habitat*, an early graphical chat system (Morningstar and Farmer 1990), and by Neal Stephenson, a science fiction writer whose novel *Snow Crash* features a well-described and detailed virtual environment (Stephenson 1992).

this choice is that avatar systems raise especially interesting questions both about how identity is established on-line and how new communicative strategies evolve as the technological infrastructure changes. Certainly there are interesting interface problems in video environment, the solutions to which are relevant for more abstract systems (see, for instance Isaacs and Tang 1994 on the definition of a "space" or Bellotti and Sellen 1993 on privacy), but there the identity cues are essentially those of the real world: you see and hear people as they are, albeit slightly blurred and delayed. Similarly, while CSCW is a very active research area, the focus there is primarily on the task to be accomplished and the identity of the participants is considered mainly in terms of their role in that task.

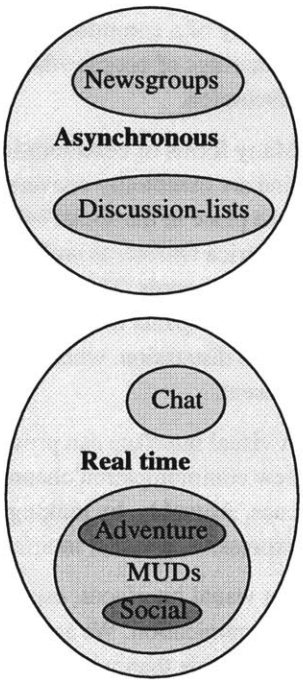
6.1 Conversational interfaces

Before designing ways to transferring text-based conversations into the graphical domain it is useful to outline a taxonomy of these discourses.

6.1.1 Types of conversational interfaces

On-line conversations[2] are either real-time (synchronous) or stored (asynchronous). In a real-time conversation, such as a chat room or MUD, one connects to a server which distributes, in real-time, the comments typed by any connected participant to the screens of all the others. Real-time conversations correspond more closely to oral speech: participants are temporally, if not spatially, co-present; utterances tend to be short, informal and highly contextualized within the surrounding discourse; and the conversation is ephemeral[3]. Stored conversations, such as mailing lists and newsgroups, are more like traditional written discourse: messages are generally longer and more formal, the discussion participants read the material on their own time, and the messages are available for perusal for at least several days, if not indefinitely.

Real-time conversations are generally more social than their asynchronous counterparts. Although substantive issues can be discussed on MUDs (Bruckman 95) the participants in MUDs and chat-spaces tend primarily concerned with establishing their persona, interacting with others, observing the group dynamics, and advancing their own status in the community. Conversely, while there is a strong social subtext to many Usenet exchanges, the contributors to newsgroups and mailing lists are, at least ostensibly, intent on exchanging ideas and information, and each posting is expected to make some contribution to the discussion. Logging into a real-time conversation and announcing "Hi! Here I am" is good manners; posting a Usenet letter with same content is not.



A taxonomy of on-line conversations.

2. By conversations I mean group discussions (i.e. not private exchanges of email) that have a reasonably interactive discourse structure (i.e. not periodical newsletters).

3. Like real world discussions, on-line chat session can be recorded (for the sake of research or nostalgia) but ordinarily are not.

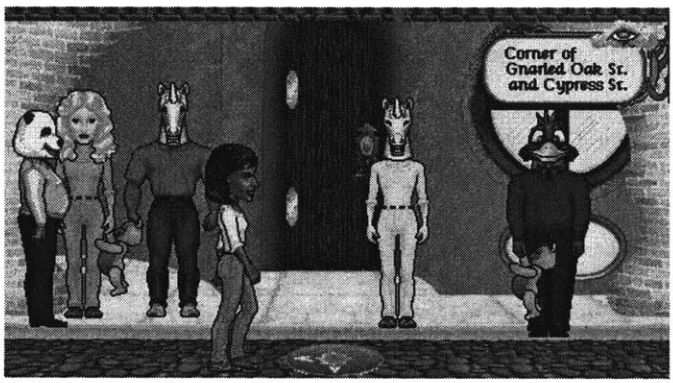
Nearly all of the avatar systems in current development (or in fiction for that matter) are graphical versions of real-time conversation systems (Rossney 1996). This is not surprising, since many social cues that are needed in a real-time conversation – such as emotional expressions, indications of attention, turn-taking signals, and awareness of presence – are problematic in a purely text-based world. Many of the distinctive vocabularies and discourse patterns (smileys, emote commands, etc.) that have evolved in these environments are attempts, given the very limited communicative channel, to introduce expression and other non-textual components of real-world speech (Cherny 1995). Graphical interfaces provide a promising new medium for conveying this information.

Thus, in this chapter I will concentrate on graphical interfaces for real-time conversations. However, it is worth keeping in mind that there are other conversational modes in the virtual city – modes which are better suited for some types of discussion and which may also benefit from a visual interface.

Even within the category of real-time conversations there are wide variation, both in the technical underpinnings and the communicative culture. Chatting (typing messages back and forth to other participants) is the main and often sole activity in sites such as Internet Relay Chat (IRC) and the chat rooms of America On-Line (AOL) and other commercial services. Chatting is an important activity on MUDs, but it is not the only one. Game playing on adventure MUDs and programming complex character and environmental behaviors on social MUDs are also an important part of MUD culture. Graphical environments can follow either model; the creative possibilities of a programmable and visible environment are endless.

6.1.2 Avatar systems

Avatar systems have recently become very popular (or rather, building them has; it remains to be seen how popular they in use). Avatar worlds, like MUDs, are shared virtual spaces: a central system keeps track of the state of the "world", including who is present and what they are doing. Each user controls his own avatar – moving it around, making it speak – and these actions are seen by the other users in the space. Today (September 1996) there are numerous avatar worlds in varying stages of development.[4] Some are two-dimensional spaces: characters exist in a flat plane and one sees one's own avatar the same way that



A frame from an avatar system called **WorldsAway** *(Fujitsu 1996)*

others do, from a third person perspective. Others are three-dimensional spaces: characters are free to move in all directions and one sees only what is in front of one's virtual eyes, from a first person perspective. In some worlds, the avatars are static images, stiff and expressionless, while in others they are endowed with a varied repetoire of gestures and actions.

Are visible avatars more expressive than their text-based counterparts? Is identity conveyed better through images or verbal descriptions? The creators of graphical systems believe their worlds to be a great improvement over the textual environment. Yet the matter is not so simple. Proponents of text based worlds argue that words are more expressive, that richer, more detailed and imaginative descriptions can be made verbally, and that the graphical environments are unimaginative – all the creativity is done for you.

Often in design, the best answer to questions of the form "Which is better, A or B?" is "Yes." Much depends on the circumstances – the goals of the users, the particular implementations. In this chapter I will examine a number of the perceptual and design issues involved in making a graphical conversation interface; in particular, the advantages and difficulties of visually representing the human users. The starting point for the discussion will be a system I built called *The Illustrated Conversation.*

(For more about the sociology and linguistics of on-line conversational systems see: Sproull and Kiesler 1991 on discussion lists; Sproull and Faraj 1993, Kollock and Smith 1995 and Donath n.d. on newsgroups; Reid 1991 on IRC; Reid 1994 for a comparison of social vs. adventure MUDs; Bruckman 95, Curtis 1992, Cherny 1995, Reid 1994, Young n.d., Herring 1994, and Young n.d. on MUDs. For accounts of existing graphical systems Rossney 1996 provides an overview of the larger systems as of Spring 1996; Morningstar and Farmer 1990 and Toyoshima 1994 discuss their forerunner, *Habitat*).

6.2 *The Illustrated Conversation*

The Illustrated Conversation was designed and built in 1992-93. (A full project description is in Donath 1995a.) It was a response to interfaces that were being created for CSCW projects in which participants were represented by rows or grids of heads staring straight out of the screen. I was interested in creating a space in which the interactions among the participants, especially the changes in their attention, would be visualized. Seeing someone looking straight at you is a powerful social cue, and I wanted to use it as such, rather than have it simply be the default pose.

First I will describe the main features of the system. I will then discuss two of the features – gaze and personalized space – in depth. Representing attention via

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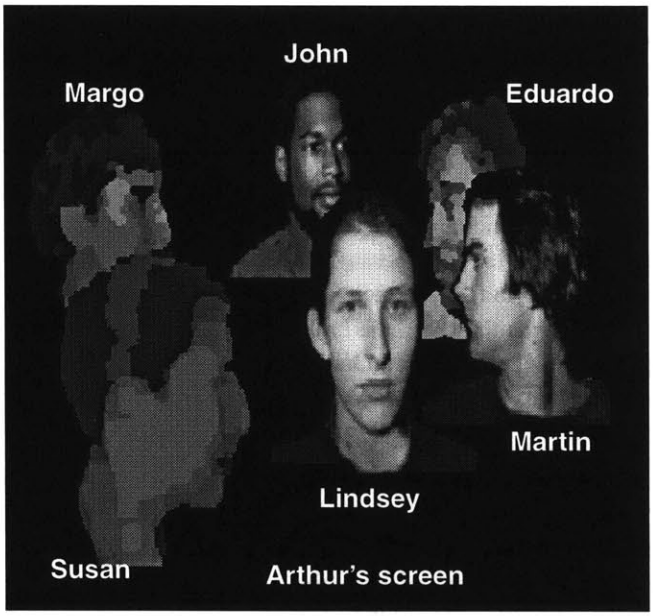
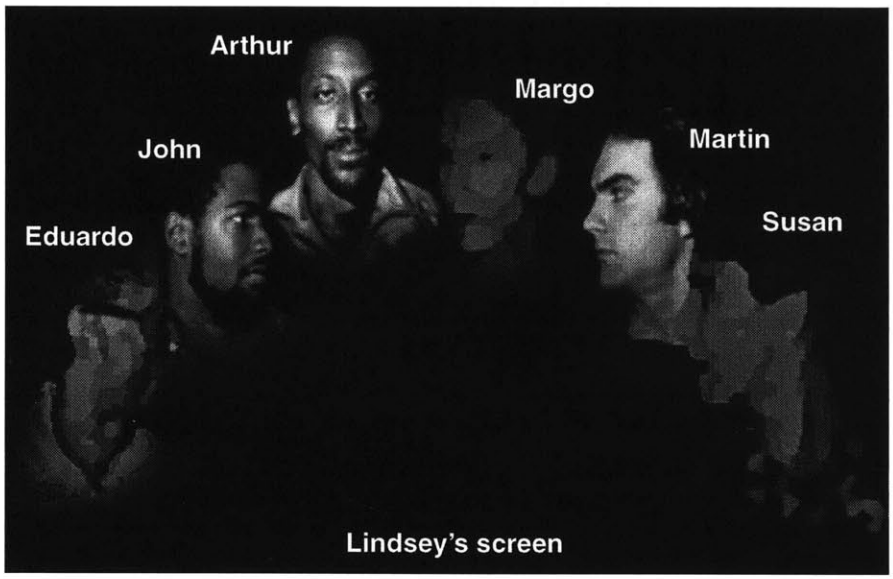
4. The *Electric Communities* page (www.communities.com) has links to about 20 systems, and this is far from a complete survey. Unlike MUDs, almost all of which are run – sometimes illegally – by students (or an occasional researcher), most avatar systems are commercial enterprises, created by corporations hoping to eventually realize a profit.

gaze can be thought of as a subset of the larger question of how to represent expression in a visual environment. Understanding the issues involved in indicating the desired gaze direction and representing it on the screen provides a foundation for addressing the more complex issues involved in representing expressions. Similarly, studying the issues involved in deciding who controls an avatar's location on the screen provides a basis for looking at the more general questions of control within a shared virtual space.





The Illustrated Conversation: Two views of the same discussion.

The top picture shows Arthur's point of view. He is conversing with Lindsey, whose point of view is shown at bottom. Although they each have arranged the images of the other participants differently, the relationship among them – who is facing whom – is the same in both screen, e.g. both show Martin and John also conversing.

6.2.1 Project Description

The Illustrated Conversation created a simple movie of an unfilmable event, a meeting among several widely separated people. The interface provided a shared virtual space for the conversation and each participant had a first person viewpoint from which to see who else was present and who was communicating with whom. The main design points of this project were

- Gaze
- Personalized space
- Presence
- Video communication

The first two points will be the focus of the more general design discussion that follows. I will briefly introduce all the features here, for they each influenced the design of the interface.

6.2.1.1 Gaze

As participants sent messages to each other, their heads turned to face the object of their attention. The interface was simple. One could send a personal message to someone by clicking on their image. Only that person saw the message contents, but on all screens the sender was seen turning to face the recipient. Since the interface was in the first person, on the recipient's screen the image of the sender faced directly out, creating the appearance of eye contact. One could also send a broadcast message, in which case everyone got the message – and all participants saw the sender looking straight at them.

6.2.1.2 Personalized space

One could arrange the layout of faces on your screen in any way preferred. The shared space of *The Illustrated Conversation* was limited to the relationships between the images – whom was each one facing. The geometry of the space – who was where – could be set by each user. The idea was that in a workspace interface the important features were to see who was present, who was part of the group and where the current activity was. People with whom one worked closely could be moved to the front, others to the periphery.

6.2.1.3 Presence

In a text-only discussion only the speaker is apparent: the listeners are invisible. In *The Illustrated Conversation* all participants are visible. It showed two levels of presence. One could be fully present, meaning logged in and participating in the discussion; or one could be absent from the immediate discussion, but still part of the group. A full color photograph represented people who were present; a monochromatic drawing was used as a placeholder for absent participants. The idea was that people could log the discussion sessions they were unable to attend; the drawing made it clear that they were part of the audience, but not actively participating.

People are involved in many on-line discussions, often simultaneously. *The Illustrated Conversation* was designed to be an awareness tool. Many windows, each representing a different discussion, could be on a single screen (the window were scalable). If not actively involved in a particular conversation, one could scale down the window and appear as a "lurker" - a non-active participant. If the activity on one seemed intriguing, the window could be scaled back to full-size and one would return as an active participant.

6.2.1.4 Video

One of our goals had been to integrate video into spatial interface. Desktop videoconferencing was becoming a reality, but here the unfortunate faces-in-a-row interface was especially hard to avoid: a coherent space needs to be made from a single camera view; with multiple cameras (one for each participant) the best that can be hoped for is that all participants look straight ahead, for if they look off camera, they are clearly observing something in another, separate space. In *The Illustrated Conversation* video links could be set up; when someone was addressing you (and such a hookup was available) the stored face (which in those circumstances would be looking at you) was replaced with a video feed of the speaker.

6.2.2 Gaze and the re-creation of expression

Gaze is a very intuitive way to represent attention.

> Human eyes are unique in that they have whites in order to signal gaze direction to their fellow humans. This is vital to follow the shifting attention of our social companions (Landau 1989)

Using gaze in the interface was a simple and easy to understand way to convey useful information. It required no additional effort from the user. And, it resulted in an interface that, although it was rather starkly abstract, had some of the dynamics of a real-world conversation.

Displaying gaze indicates what part of a scene has attracted someone's attention. Ishii and Kobayashi (Ishii and Kobayashi 1992) termed this *gaze awareness*; their observations of people working with a shared drawing space led them to conclude that gaze awareness was the key feature in such collaborations.

***Raphael*, Pope Leo X with two cardinals (detail).**

Painters use gaze to show the relationships between people in a group portrait and to indicate something of the nature of the represented individuals.

6.2.2.1 Gaze input

In *The Illustrated Conversation* gaze was used only to indicate speaker attention. It required no additional effort by the user because message sending already required indicating a recipient. In general, when the user is actively engaged, whether it is sending a message to someone or interacting with an object, showing attention via gaze can be done without added effort on the part of the user. The difficulty is with showing passive attention, such as reading a message or observing some activity; here, one must either capture the user's real world eye movements or require that the user do something to indicate attention.

One approach to using gaze to indicate attention in a shared space is to use video, finding a way to integrate images of the participants in such a way that the geometry of the space is preserved. An example of this is the shared drawing space mentioned about. Ishii and Kobayashii created a very intuitive collaborative environment – but it is limited to two participating sites (Ishii and Kobayashi 1992). Video is not suited for general use in a multiple person shared environment because of the impossibility of reconciling the multiple camera views into one coherent space.

Wearing an eye-gaze tracker and data glove (Bers et al. 1995)

For the sort of environment we are concerned with here – a synthetic space with multiple users – eyetracking is perhaps the ultimate solution (Bolt 1984), especially because it can reproduce the complexity of gaze patterns:

> In a normal two-person conversation eye behavior is predictable. As speakers, we begin a conversation by establishing mutual gaze with the listener. Then we break away. Then we look again t o check for the listener's feedback. As we engage in conversation, we use our eyes to monitor our partner's interest, understanding, and acceptance of our words. (Landau 1989)

Yet eye-tracking requires cumbersome equipment. And it can be too literal. The shared screen space is a limited window, from which the user's attention continuously wanders. Ideally, the graphical interface should show a rhythm of gaze roughly corresponding to our expectations of expressive behavior. Whether the problem is too little input (as with the mouse) or too much (as with an eye-tracker), for a representation to appear "natural" it will need to filter and augment the data. Cassell and her colleagues (Cassell et al 1994) describe a system which generates gaze (and other expressions) based on dialog; such a system could be potentially used in conjunction with live input to modify and smooth data from the participants' actions.

6.2.2.2 Gaze output

Gathering the input to indicate gaze is only half the problem; the output image must also be generated. The system must be capable of showing each face looking in every possible direction. This can be done programmatically – by having a system that can generate the necessary image as needed – or by the more brute-force approach of creating a set of frames in advance showing a reasonable set of the desired gazes. For *The Illustrated Conversation* I did the latter, first with seven and later with twenty-eight frames. For photographic images this approach has several advantages: it is relatively easy to make the images, the frames clearly correspond to a particular gaze direction, and one avoids the often strangely disturbing look that comes when photographic images are modified; just as we are very acute judges of where a person is looking, we are also very sensitive to mis-renderings of eyes and expressions. However, one is subsequently limited by the frames shot: if there is no frame that comes reasonably close to showing the subject looking in a desired direction, it cannot be shown. A synthetic approach, computationally rendering the eyes and/or the head to appear to be looking in any needed direction is more extensible (Agawa et al 1990; Choi et al 1994; Morishima et al 1990; Waters and Terzopoulos 1992). However, today's techniques often still result in images that appear distorted.

Image data sets from The Illustrated Conversation.

The set of seven (above) was quite compact, but limited the layout to a single horizontal plane. Adding a range of vertical gazes (left) made a greater range of spatial layouts possible.

Furthermore, the client programs must all be able to synthesize the needed faces, Thus, even for cartoon images, if the rendering process is complex it may still be more practical to render a set of frames in advance than to expect the clients to be able to create the needed face on demand.

6.2.2.3 From gaze to expression

Gaze is but one part of the general problem of indicating expression. From the discussion above, it is clear that implementing even this relatively simple and straightforward feature can be a complex design issue. Indicating emotional expression with an avatar is a far more difficult problem. Gaze, at least in its role as an indicator of attention, is relatively unambiguous. An interface in which one clicks on an object and one's avatar turns to face it, while perhaps not the most seamless of interactions, does capture the desired activity. But what about, say, a smile? How does one indicate that it is time for the avatar to smile? By typing the word? Clicking on a graphic? Having a video capture system that sees you smile and replicates your expression on screen? Or does the system interpret the conversation and intersperse smiles at appropriate moments? Rendering the right smile is also complex. There are many smiles (Ekman 1982; Hauser 1996) and even slight muscular difference in the way the eyes participate or the speed at which the smile appears and disappears can greatly change the nature of the expression. Eisner's illustration (page 25) shows how facial expressions can transform the words they accompany. If used well, the communication channel is greatly enriched; if poorly done, the resulting exchanges will be misinterpreted and poorly understood.

6.2.3 Personalization and control in a shared space

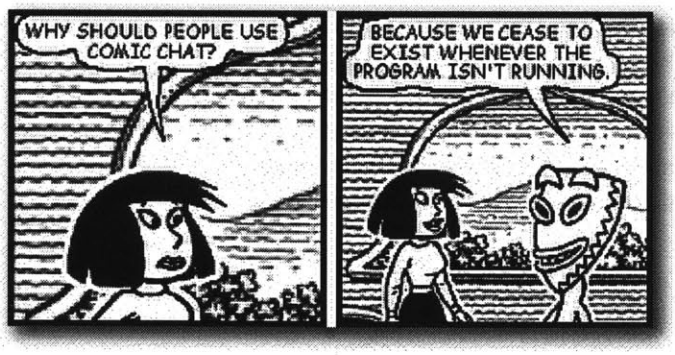
Who determines the appearance of my screen when it represents other people? It seems reasonable that I should be able to resize a window to accommodate other work I am doing - what about resizing participants in a conversation to see only those I care about? Who should determine what I am wearing - me or the person looking at me? In virtual environments these questions are often determined by the system design: one can create environments in which the user has full control, none at all, or a negotiated middle ground.

The appearance of a shared virtual space is always a compromise between the wishes of the viewer, the other participants in the space, and the designer of the environment. Does the environment limit how big (or strange) my avatar can be? Am I in full control of my avatar – or are you able to change my appearance or behavior? Here I will approach these issues by looking at the seemingly simple question: who controls where my avatar stands?

In *The Illustrated Conversation*, one was the master of the layout on one's own screen, controlling where all the avatars stood. This was done so that the presence and activities of the people with whom one worked most closely could be easily emphasized and seen. The design reflected our initial conception of the project primarily as an awareness tool.

In other systems, the designers determine where one stands. Microsoft's *Comic Chat* (Microsoft 1996) is a shared space made to look like a comic strip. As the user, you control what you say, but the system automatically places your character and makes it gesture. The intent, says the site blurb, is for the screen to "aesthetically represent the conversation".

Other systems let each user control his or her own avatar. In retrospect, I think there are compelling arguments for this approach. Having the viewers determine the location of all avatars in their personal views (as in *The Illustrated Conversation*) or turning control over to the system itself (as in *Comic Chat*) eliminates a very rich and useful means of communication. Moving one's avatar around, to join a group or walk away from a discussion, can be a very expressive act. In a 3D, first-person world (you see the environment from your avatar's perspective) you are motivated to move about in order to center an item of interest on the screen or to move to another section of a larger environment. Others see your avatar's movements, which are indications of your interest and



***Frames from* Comic Chat.**

This program automatically generates default gestures and expressions; it also controls the layout of the frame.

attention. In a third-person world (you see all avatars, but control only your own) adjusting location seems to be a more consciously expressive act, as participants place their avatars in relative to the others on the screen.[5] For instance, while observing several sessions in an 2D environment called *World Fiction* (ATG 1996), I noticed that people moved their avatars about on the screen in a manner similar to people standing around talking: the participants tended to distribute themselves around the screen, making room for new arrivals and filling in spaces when someone left. They would also often move a bit before speaking – the development, perhaps, of a turn-taking cue (Goffman 1979b; Saville-Troike 1982).

Greater control over one's representation brings greater expressiveness – and less individual control over the scene on one's screen. By giving each user control over his own avatar's location, the resulting views may not be as "aesthetically" well designed as in *Comic Chat* or as personalized to the viewer's concerns as in *The Illustrated Conversation*. In the case of location, the advantages of greater expressiveness seem worthwhile. But what of other forms of control? What if I wish to, say, make my avatar much bigger than others or brighter or otherwise overwhelmingly attention-getting? What if I want to make you, at least on my screen, invisible?

This invisibility issue come up frequently in today's MUDs (Dibbell 1993; Reid 1994) and newsgroups (Donath n.d.; Kollock and Smith 1995). "@gagging" on MUDs and "killfiles" in Usenet are ways of individually screening out anything coming from a disliked participant. Criticism of their use is generally not about whether they are ethical (those who demand that everyone must listen to a harasser or other virtual pest are almost invariably the ones who are being screened) but whether they are socially effective. Unlike walking away from someone in real-life, shutting out someone in a text-based virtual world is inherently invisible: it saves the screener from encountering the problem, but it is not an effective social sanction. In Usenet, where killfiles are highly recommended (they limit the escalation of angry, off-topic threads), people often announce when they've added someone to a killfile – a way of visibly and publicly ignoring them.

@gagging and killfiles make the shared space a bit less shared. Participants using these tools still see the words of others responding to screened person, but missing half the content can make the discussion unintelligible. Furthermore, other people, unaware that A has screen out B, may wonder why A does not respond to various overt or subtle provocations, in a worst case they may assume

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5. Environments with a third-person perspective make it much easier for a user to see how he appears to others. This is important for the development of an expressive vocabulary because the way we learn and modify expression in the real world – through imitation, physical sensation and the mirror of our effect on others – does not exist in the virtual world. On-line, we need to see what others are seeing. (Of course, in real life people are often quite surprised to see how they appear when captured on film or video – hence the image consulting firms that help one make the right gestures and expressions).

that B has A's tacit approval. The choice of whether to personalize of one's view of the space is a trade-off between comfort and coherency.

This is where institutional rules come in. Enforcing some code of behavior, whether it be banning virtual sexual harassment on a MUD (Dibbell 1993), setting height limits on avatars (Stephenson 1992) or creating community-wide killfiles in Usenet (Kollock and Smith 1995) in theory means the users will have a more unified experience as fewer feel compelled to modify their version of the shared virtual reality. The trade-off is between personal autonomy and the creation of a collective and wholly shared space.

Creating a shared experience are fundamental issue in the design of virtual social environments. What part of the space will be common ground and what will be personalized? Personalization – a system that adapts to you – is one of the benefits of a synthetic world, yet in a shared environment personalization is at odds with community and communication; at the extreme, personalizations creates a solipsistic mirror world from which little of the outside can be seen. In order to have the virtual city that can provide a symbolic basis for a community, a shared space and common ground is needed.

7 Inhabitants of the virtual city

This chapter is about inhabiting the virtual city. The concepts developed in earlier sections – the role of visual representations and the creation of a cultural context in an information space – are brought together in a discussion of a multi-scale environment.

Imagine you are at a party, in the real world. You look around the room, seeing how the guests have gathered in various conversational groups, some lively and loud, others privately intimate discussions. You see who is a center of attention, who is wandering about restlessly. An acquaintance notices you and sits down to talk for a bit. While conversing, you notice little things - perhaps the style of his shirt or a slight Southern accent. Nothing remarkable, though in the course of the conversation your perception of this acquaintance grows deeper.

In real life, one moves seamlessly from taking in the patterns of a large group, to observing an individual close up, to participating in a conversation. Understanding of an individual is helped by one's knowledge of the setting; comprehension of the setting deepens as one learn more about its inhabitants.

Filmmakers are aware of the importance of providing views of their subject from various perspective. The *long shot* tells about the environment and its social patterns: is it crowded or empty, a hangout for college students or a businessman's establishment? The *medium shot* follows the conversation, listening to what is being said and watching reactions of the participants. The *close-up* shows the details of clothing style and facial expression, the features of self-presentation both deliberate and subconscious.

In the on-line world, these views are too often isolated.

The focus of this section is the *A Day in the Life of Cyberspace* web site(ATG and Media Lab 1995).[1] It incorporates, in a simple way, several features discussed in previous sections. It provides for large scale visualizations of the community of attendees (the long shot), it provides the means for interpersonal

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[1] This web site was designed in conjunction with Art Technology Group and was implemented by them. ATG's Dynamo environment provided the dynamic page creation, session tracking and database server that made the capsules, Web-o-grams, people watching, comment rating, etc. possible. See *http://www.atg.com* for more technical details.

communication (the medium shot), and it introduces home pages that evolve through actions (the close up). Its structure embodies the concept of seamlessly providing views of the inhabitants from various perspectives.

7.1 *A Day in the Life of Cyberspace*

A Day in the Life of Cyberspace was designed to be an on-line festival - a virtual event that people from all over the world could attend and participate in. The goal was to encourage people to think about how cyberspace is developing and its impact on their own lives and to send in writings and pictures about their experience with this new world. With these contributions we would create a "Portrait of Cyberspace" – a global snapshot of the on-line world, circa autumn of 1995. The challenge was a) to get people to come to the site; b) to make it intriguing and enjoyable enough so that they would not only explore it, but actively participate in it; and c) to create an atmosphere that fostered thoughtful contributions.

The event was structured as a ten day countdown, in order to build interest and word of mouth referrals. The countdown gave people a chance to see the site, participate in it and to link to it. Each day had a different theme. The site was cumulative: the first days theme was "Privacy" and that was the only material available. The second day was "Expression" and one could visit both the new area and the Privacy area. The site thus grew every day and people were encouraged to return daily to see what was new. The tenth day was a summary of the previous days, including survey results, live feeds from the Lab, and the opening of the *Portraits in Cyberspace* exhibit.

The nine countdown days all shared a common structure. There was a daily discussion ("Expound"), a survey ("Reveal"), and a short summary piece filled with links to the rest of the Web ("Review"). In addition, one could wander among the internal home-pages (called "Capsules") of the other people on the site.

7.1.1 Expound: rated discussion

Each Expound section began with a short essay about the day's topic followed by the discussion section. Here you would see a set of three user comments on the topic. Each one could be rated on a scale of 1 ("low quality or unoriginal") to 5 ("a real gem"). Next to each comment was its current rating and how many people had rated it so far. You could rate the visible comments or press a button to see a new set. The algorithm for selecting comments to show gave precedence to highly rated comments and to new ones with few ratings. The low-rated ones would slowly disappear - but not so quickly that a couple of early negatives would consign a remark to oblivion.

The author's name accompanied each comment and was a link to his or her capsule page. Any comments one had contributed showed up on this page - the process of taking part in the discussions thus was part of what created one's own portrait in this site. At the bottom of the Expound page was a form for

contributing your own remarks (with the fact that this contribution would be part of your capsule page prominently noted).

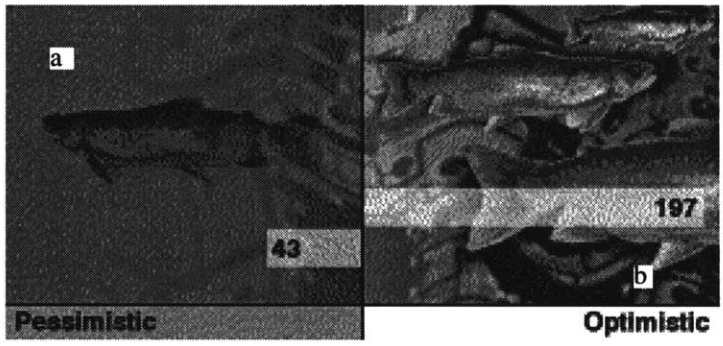
We decided to experiment with a rated discussion model instead of the usual threaded discussion for several reasons. One of our goals was to gather people's opinions and reactions as part of a "Portrait of the Net, 1995". Thus, we wanted the comments to be stand-alone remarks, whereas letters in a threaded discussion are often too heavily interwoven with the ongoing conversation to stand on their own. Similarly, for the comments to be included in the capsule pages they needed to be readable as independent remarks. Furthermore, we wanted to encourage people to write something outstanding (or coherent, at least). Too often, threaded discussions and on-line chats veer off-topic or devolve into nonsense and name-calling. The rated discussion seems to have succeeded in getting people to try to write something that others would rate highly - compared to many Usenet letters, and certainly to on-line chats, the statements in the Expound section are lucid, well-written, and often thought provoking.

7.1.2 Reveal: surveys and visualizations

The Reveal section consisted of a series of mini-surveys, each linked to the day's topic. They were designed to be short, simple and entertaining: an easy way to participate in the site. Most of them were multiple choice questions, where you checked applicable answers. On "Expression" day, for instance, we asked people what activities they participated in on the Net - build home pages, chat, access databases, send email, etc. On "Faith" day we asked about adherence to various belief systems, both religious and nontraditional. Part of the "Place" day survey asked participants to point out where you are on a map of the world. On "Body" day, we included a "physical fitness" test - a mouse-clicking race.

One's answers to the survey, like the contributions to the discussions, showed up on one's capsule page, but in an abstracted, graphical form. The idea was to provide some feedback without generating misleading pseudo-scientific results. The graphic also served to decorate the capsule pages - to make those of the active participants colorful and compelling.

On the 10th we featured visualizations of how everyone had answered the surveys. For the Place survey, for example, we showed the world map with a dot



The results of the Environment survey.

Clicking on any region of this image brings you to the capsule of someone whose views were in that part of the pessimism-optimism range.

For example, clicking where the label a is brought up the capsule of rmarks, from Michigan. On environment, he said

> *"While more people seem to be more aware of environmental issues and problems, few seem willing to make lifestyle changes that would really make any difference. The power is still in the hands of corporate America and if care for the environment is not putting cash in their pockets, then it is not their top priority. "*

Clicking on spot b brought up typhoto. His comment was:

> *"Any technological advancement that makes this world a little smaller and brings people from all corners of the globe together in the same place is a great step towards peace among nations."*

From his capsule, one could go to his home page - which revels in the wonders of enhanced Netscape features and VRML.

marking the physical location of each participant. One could click on any spot on the map and be taken the capsule page of someone who was at or near that location. For the Environment survey, we showed the continuum from "pessimistic" to "optimistic" - clicking on a spot in the graph took you to someone who fell in that region

These visualizations were more simplistic than we liked, due both to the limitations of the Web and the small amount of data that could be gathered in the course of such an event. An interactive visualization, like *Visual Who*, with which the users could explore the community space would have been preferred, but was not possible within the existing Web environment. Perhaps the most missed feature was the ability to find a particular user in the data: you could click on a dot and find out who it was, but you could not request that a specific person be highlighted.

7.1.3 Capsules & web-o-grams: persona & presence

Wandering the web is usually a solitary experience - one has little sense of the presence of others. The 1010 site had a number of features that made visiting it a far more sociable experience.

You entered the site by signing in - your real name was not required, but you needed to provide an identifying name and password. A home page, called your "Capsule", was created for each participant. If you chose to, you could include your real name, email address, home page, or other text and pictures in this capsule. And, as described above, your contributions to the discussion and your answers to the surveys were also recorded in the capsule. Ordinary home pages are designed once and then updated infrequently. These capsule pages had the interesting characteristic that they were updated continuously through your participation in the site - they are not the wholly self-conscious creations that home-pages usually are.

You could get a sense of the "crowd" on the page you were viewing: the top of each page listed the recent visitors to the page and told you how many people had visited the page in the last few minutes. It was thus possible (and not uncommon) to "run in" to people you knew - either from the on-site discussions or elsewhere.

Any mention of someone's name was a link to their capsule. If you saw a comment you thought intriguing, or were just curious about the other people on the same page as you, you could click on the name and see what they had been saying.

When visiting someone's capsule you could send them a message. These messages, called "web-o-grams", were a simple messaging system integrated with the site. Web-o-gram's appeared as notes on the top of the recipient's page. Each web-o-gram automatically came with a link to the sender.

A Capsule

There are some web-o-grams at the time; then comes optional personal information such as your home page. The pictures are tokens from the surveys. The text at the bottom is entries from the Expound section.

7.2 The virtual (self) portrait

The home pages (capsules) that were automatically created in the *A Day in the Life of Cyberspace* site were much simpler and more constrained than ordinary Web home pages. Yet they had one very interesting feature: they were built as a by-product of ones actions, rather than as a deliberate design initiative.

> There's no art to find the mind's construction in the face.
>
> - Shakespeare, *Macbeth*

There is a deep-seated belief that one's actions and character are written, unwittingly, on one's face. Even a still photograph – a moment abstracted out of time – can seem to yield clues about the subject's character. Whether or not there is an objective truth to this – and certainly many of its methods, such as phrenology, have been discounted – it remains a powerful social force. Psychological studies have shown that people read numerous character traits into facial features (Synnott 1993). On-line, seeing a photograph of someone can vastly alter one's impression of them.

The idea of a virtual self-portrait that evolves over time is quite interesting – and controversial. The *Day in the Life* pages were a first stab at the problem and they were very simplistic. Yet they showed that even just recording one's actions in a suitable environment could easily make for compelling portrayals; they are less self-conscious than ordinary home pages - expression is given off, more than given. Furthermore, such self-portraits could grow to be quite complex, becoming items of great value to their subject. As we discussed earlier, the lack of commitment to one's virtual self was a basic problem in the on-line world. A self that carries history, that cannot be easily reproduced or substituted for, is a grounding mechanism, making the subject more aware of the consequences of actions.

Yet, the self-revelatory portrait is also disturbing. Most of us are already in the process of creating a vibrant and involuntary self-portrait in credit card receipts and medical records. Here we return to the questions about privacy and control of information about ourselves.

Brilliant's *Portraiture* ends on a rather despondent note:

> Indeed, before long, one may expect that instead of an artist's profile portrait the future will preserve only complete actuarial files, stored in some omniscient computer, ready to spew forth a different kind of personal profile, beginning with one's Social Security number. Then and only then, will portraiture as a distinctive genre of art disappear. (Brilliant 1991)

Will portraiture disappear? Or will it be transformed? Gombrich described the idealized role of the portrait artist as the "Neo-Platonic idea of the genius whose eyes can penetrate through the veil of mere appearances and reveal the truth". (Gombrich 1972) The on-line world, with its central and problematic concern with identity, will be the source of immense invention and creativity in portraiture. There will be other forms beside painted canvas that can "reveal the truth" – portraits that interact, that have behaviors, portraits that exist within a communicative context.

The Picture of Dorian Gray

Then he drew the screen aside and saw himself face to face. It was perfectly true. The portrait had altered.

- Oscar Wilde

8 Conclusion: Inhabiting the virtual city

This thesis began with two quotes, one from an urban designer, the other from sociologists studying on-line communities. Whyte, the urban designer, urged city developers to remember that the presence of others is the key to a successful urban environment. Sproull and Faraj, the sociologists of the virtual, urged system designers to keep in mind that the net is a social as well as informational technology. In this thesis I have taken these ideas about the importance of the presence of others and about the sociable nature of the network as fundamental precepts and used them as the basis for developing an approach to the design of on-line environments.

The metaphor of the virtual city was used throughout the thesis, both to think about what an on-line environment can be like and to clarify the designer's role in creating such an environment. I discussed some of the key parallels between the virtual world and the urban space, such as its vast and heterogeneous population, and showed how knowledge of cultural responses to city life can be applied to designing environments for virtual populaces.

I also discussed some of the key differences between designing a physical and a virtual city. The virtual city is wholly mediated and synthetic: not only must the environment be created, but also the means of expression, the appearance of the inhabitants, etc. For such an ephemeral environment to be legible it must be given some structure. Metaphor is a powerful design tool in this structuring for it allows us to apply the qualities of the definite and familiar to the a novel and amorphous world. The caveat is that the metaphor not be taken too literally – the goal is to achieve a balance between recreating the familiar and exploring what unprecedented possibilites exist in this new world. One of the most notable differences between the two worlds is the body, which plays a central role in real-world society and which is absent from the virtual.

The discussion of the social role of the body raised the issue of identity – how is identity established in a disembodied environment? What are the ramifications of a society in which identity is ephemeral and easily reconfigured? I looked at several contemporary on-line environments and at how the design of each environment's infrastructures influenced the way that identity was established it it and how the participants learned about each other.

These ideas are the basis for a series of projects which were reviewed in the second part of the thesis. Created over a period of 4 years they have been both influential to and influenced by the notions of the virtual city and virtual identity

discussed above. They were discussed in thematic chapters that highlighted particular design issues.

The first theme was "sociable information spaces" and encompassed three projects that explored communication within the context of an information environment. The designs reviewed included an example of a participatory sociable information space (*Portraits in Cyberspace*), a widely used communications application (*The Electric Postcard*) and a set of technological tools for expanding the communicative capabilities of the Web (*WebTalk*). Here the city metaphor was applied in terms of infrastructure, with published information acting as the built environment. In these designs the information infrastructure has several social roles: it brings people together based on common interests, it provides a common cultural environment, and it delineates specific "places". These projects work within the constraints of today's primary information space, the Web; their purpose is to explore and expand its role as a sociable environment.

The second theme was social visualization and featured two projects that used interactive graphical interfaces to represent social structures and activities. *Visual Who* is a visualization of a community's social structures and its temporal patterns. It is an awareness tool, designed in response to one of the effects of disembodiment, that action and patterns leave no trace unless deliberately constructed to do so. The second project, *The Illustrated Conversation*, also provides awareness of activity and presence, though at the scale of a small group discussion, rather than a whole community. In both of these projects the visual design not only to provides information, but also makes the environment memorable, recognizable, and legible.

Identity was a central part of this discussion. *Visual Who* shows group affiliation, its various configurations demonstrating the multiple roles and relationships individual have within a community. Although the visual representation of each person is kept quite simple (just the text of their login name) their identity within the group is revealed through their place in the patterns. Here we see the beginnings of a new form of portraiture: representation through visualization of relevant statistics. *The Illustrated Conversation* featured a more traditional representation – the photographic image – but in an interactive environement. The discussion of this work focussed on the challenges presented in translating gestures and other non-verbal conversational nuances from the physical domain to the screen.

The final chapter brought together many of the above conceptual threads. *A Day in the Life of Cyberspace* is an information space that includes experimentation with discussion design, awareness of presence, and the development of self-representation through accumulated action. It unifies many aspects of design that had hitherto been separate. In the real world, one goes seamlessly from inside to outside, from looking at a crowd of people to focussing on an individual. In the virtual world, the counterparts to these activities are still often distinct functions; bringing them together is essential in order to truly inhabit the virtual city.

The key ideas that have emerged from this thesis are the importance of identity and of history in building a social environment. The two are intertwined, for the ephemerality of identity has to do with its ahistoricism: the claim to a particular name is easy, the claim to an entire history is hard. It is history that gives an identity value - a long history is costly to acquire. And it is history – the accumulation of experiences and decisions – that makes one unique.

History also brings individuality to an environment : Alexander's call for city designs that are evolved rather than wholly planned is a call for an architecture shaped by its history. A participatory virtual space, such as the *Portraits* gallery, is such an architecture: it is a space that grows and changes daily. The *Day in the Life* site was also designed to evolve as users added material; its capsules were an abbreviated version of the self-representation that evolves over time. *Visual Who* is also about history, for the complex interweavings of memberships is woven over a period of time; its lists of groups include the recent and the long defunct.

One of the alternate titles I had considered for this thesis was "Building the virtual city". I decided in favor of "Inhabiting the virtual city", for my emphasis is on the social aspect of the design, on the experience of being a participant in the virtual world. Yet there is a close relationship between building and inhabiting, for inhabiting the virtual city is a process of adapting it and adding to it, of building the connections between places and people t hat make the on-line world a vibrant and vital environment.

Appendix: *Visual Who* algorithms

This section introduces the algorithms that were used to implement *Visual Who*'s spring system. A more detailed discussion can be found in (Donath 1995b).

When a mailing list is chosen as an anchor, its profile is calculated. The profile, or prototypical member, reflects the interests of the members of the list, i.e. what other lists they are (or are not) on. It is this profile that is compared to the individual users to compute their similarity to a given list. This, in turn, is used to set the spring constant of the spring connecting the person to the anchor, which is used in the physical modelling of the spring system.

The profile of an list is built from the membership patterns of its subscribers. If there are a total of n lists, then the profile of list i is described by a vector $\boldsymbol{P}_i$ which has n entries, one for every list. The profile vector of an list is:

$$\boldsymbol{P}_i^j\Big|_{j=0}^{n-1} = \frac{(N(i \cap j))^2}{N(i)N(j)}$$

where $N(i)$ is the number of people subscribing to list i and $N(i \cap j)$ is the number of people who subscribe to both list i and list j, $0 \le i, j < n$,

For example, say we are creating the profile of a bicycling list with 20 members. If 15 of them are also on a skiing list which has 18 members, then the value of the skiing entry in the bicycling profile vector is calculated as:

$$\boldsymbol{P}_{\text{bicycling}}^{\text{skiing}} = \frac{15}{20} \times \frac{15}{18} = 0.625$$

If 15 members of the bicycling list were also on the movie-goers list, but that list had a total subscription of 40, the value of the movie-goers entry would be much smaller:

$$\boldsymbol{P}_{\text{bicycling}}^{\text{movie-going}} = \frac{15}{20} \times \frac{15}{40} = 0.2812.$$

The lists that will have the highest value in the bicycling profile are those in which a high percentage of the bicyclists are subscribers and whose members comprise a high percentage of the bicyclists. The profile of an list shows the areas which distinguish its subscribers – the discussion groups in which they play the greatest part.

When the viewer places a mailing list on the screen as an anchor, the program calculates each person's resemblance to that list's profile. The calculation is simple. Since the profile of a list is a vector with a value for every list, the strength of a person's resemblance to the list is the sum of the values given in the profile for each list of which he or she is a member. If $\boldsymbol{M}(k, i)$ is a membership function that returns 1 if person k is a member of list i and 0 otherwise, then the strength of person k's resemblance to the profile of list i is:

$$(k, i) = \sum_{j=0}^{n} \boldsymbol{M}(k, j)\boldsymbol{I}$$

In calculating $\boldsymbol{P}$, the number of common members was divided by the total number of members, which prevents membership in the larger lists from overwhelming and obscuring the impact of the smaller lists on the overall shape of the profile. In calculating individual resemblances to a list, no such allowance was made, and the popular lists exert a strong pull on nearly everyone, while the smaller lists have less strength, even in the attachment of their own members. Dividing $\boldsymbol{R}(k, i)$ by the total possible resemblance,

$$\sum_{j=0}^{n} \boldsymbol{P}_i^j$$

eliminates this imbalance; however, the visualization no longer shows the relative predominance of particular discussion groups. We have chosen to show the stronger pull of the larger lists; clearly, there are many ways to display this data, each of which will highlight different features.

The core of the visualization is a numerical simulation of a system of springs. Each name has springs attaching it to all the anchors with the spring constants determined by $\boldsymbol{R}$. The spring forces are the main forces acting on each name. There is also friction, so that the system will stabilize.

A list has a location when it is chosen to be one of the anchors; this location is determined by the user. A person's location is determined by the forces acting upon it. $\mathbf{Loc}(obj)$ is an object's location in the *Visual Who* space. $\mathbf{List}(\boldsymbol{a}_x)$ is a function that returns the mailing list that anchor a_x represents. In a composition with m anchors the spring forces ($\mathbf{SF}_k$) pulling on person k in a given location are:

$$\sum_{x=0}^{m} (\mathbf{Loc}(a_x) - \mathbf{Loc}(k)) \times \boldsymbol{R}(k, \mathbf{List}(a_x))$$

The velocity of k at time t is

$$v_t = \mathrm{SF}_k - (v_{t-1}^2 - fric)$$

where $fric$ is a constant of friction.

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