Software Agents, Boundary Work and Metaphors: Challenging New Media and Technological Cultures

by
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A thesis submitted to the Faculty of Graduate Studies and Research in partial
fulfillment of the requirements for the degree of
Master of Arts

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**Software Agents, Boundary Work and Metaphors: Challenging
New Media and Technological Cultures**

submitted by Zoetanya Tomara Amoreena Sujon, B.A.

in partial fulfillment of the requirements for
the degree of Master of Arts

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Abstract

Despite claims that software agents embody the ultimate personal assistant and will soon exist in every crevice of the social landscape, there is very little sociological work on what it is that software agents do and why they are unique technologies. This work addresses these issues, and posits that software agents have a long cultural history that situates software agents firmly within the Western social and mythic imagination. Based on a critical analysis of how software agents reconfigure subject / object relations and occupy numerous interstices between boundaries, I argue that software agents reify systemic social hierarchies and functionally replace some forms of what has traditionally been labelled women's labour. Despite socio-economic and political continuities in employment patterns and the objectification of women, I argue that software agents introduce a new metaphor for understanding self / other relations, social solidarity and indicate the emergence of social relations that can be characterized by the 'subjectification' of objects: which is observed through objects interacting with other objects.

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Michael Koch (artist and designer), 2001. 'Tech-girl.' Julius Weidemann. *Digital Beauties*. Taschen: London, New York, Paris, pg. 353

Chapter 1:
Introduction: Interstices and Interfaces

'Picking someone up at that point? Out of the whole of the Universe to choose from? That's just too ... I want to work this out. Computer!'

The Sirius Cybernetics Shipboard Computer which controlled and permeated every particle of the ship switched into communication mode.

'Hi there!' it said brightly and simultaneously spewed out a tiny ribbon of ticker tape just for the record. The ticker tape said, 'Hi there!'

'Oh God,' said Zaphod. He hadn't worked with this computer for long but had already learned to loathe it.

The computer continued, brash and cheery as if it was selling detergent.

'I want you to know that whatever your problem, I am here to help you solve it.'

'Yeah, yeah,' said Zaphod. 'Look, I think I'll just use a piece of paper.'

'Sure thing,' said the computer, spilling out its message into a waste bin at the same time, 'I understand. If you ever want ...'

'Shut up!' said Zaphod, and snatching up a pencil sat down next to Trillian at the console.

'OK, OK ...' said the computer in a hurt tone of voice and closed down its speech channel again.....

Zaphod knocked his two heads together in irritation and gritted his teeth.

'OK,' he said. 'Computer!'

The voice circuits sprang to life again.

'Why hello there!' they said (ticker tape, ticker tape). 'All I want to do is make your day nicer and nicer and nicer ...'

'Yeah well shut up and work something out for me.'

'Sure thing,' chattered the computer, 'you want a probability forecast based on ...'

'Improbability data, yeah' (Adams 1979: 78-79).

Does everyday use and engagement with new technologies ultimately change not only how a person relates to their community, but also who and what constitutes their community? Are the grounds for social belonging and self-actualization becoming subject to a series of implicit behaviours based upon an increasing dependence on computers and new technologies? Younger generations, who have grown up with new ICTs as fixtures in their everyday lives find it absolutely shocking to meet someone who has never, or doesn't know how to use computers and / or

basic computer programs. For example, my class of 47 first year sociology students are convinced that information and communication technologies (ICTs), such as the internet, computers, internet service providers, cell phones and all of their related resources are not only the wave of the future, but are currently almost universal.

These students estimate that 95% of the global population must be connected, wired or somehow involved in the use of computer based systems and technologies. While realistically the scope of 'wired' technologies only reaches less than 5% of the global population.¹ Regardless, the question remains: do these incredibly inflated beliefs support claims that new forms of cultural praxis and belonging have emerged?

Technological innovation has a long history of capturing the public imagination and instilling visions of either social catastrophe or utopic deliverance from the more unsavory aspects of reality. The advent of human tools in the ice ages, marks the emergence of questions surrounding the relationship between identity, community, social patterns and technology have and continue to constitute a central problematic for social scientists (Gamble 1994, Graves 1991, Hammond 1982).² Studying the history of technology, particularly the predictions, fears and potentialities surrounding the emergence of new technologies reveals a clear continuity between old and new technologies.³

¹ However, this is a highly contestable and rapidly changing figure. For example, in the year 2000, Dwayne Winseck claimed that only 3% of the global population had access to internet technologies and services. In May of 2002, however, Manuel Castells claimed that ICTs now reached 7% of the global population.

² For example, whether *neandertalensis* and *homo erectus* should be classified as part of the *homo sapiens* phylogeny or as a distinct species constitutes a central debate between 'single origin' and 'multi-regional' evolutionary theories within physical and cultural anthropology: a debate which is largely situated around the inferred use of tools and technological practices, such as intentional burial of the dead (Graves 1991, Gamble 1994, Hammond 1982, Milo and Quiatt 1996, Bar-Yosef et al 1993, Shennan and Steele 1996).

³ For example, in 1884 the telephone was described as the 'youngest and most wonderful development of the means of communication' characterizing a 'high speed tool of civilization . . . the

Analyses of 'old' technologies, such as the telephone, the steam engine or the light bulb,⁴ illustrate that questions of technological change must be approached carefully. It is not enough to argue that social change has occurred as a result of the emergence and implementation of new 'tools'. We must challenge conceptions of technology as the unadulterated harbinger of new patterns of social interaction and new forms of sociality. As Bruno Latour reminds us, we must 'think with the 'hands and eyes' and question how new patterns of social interaction are materialized and experienced (1986: 1).

How then, can we problematize understandings of technology and culture while 'thinking with our hands and eyes'? First, it is crucial to recognize that technology and cultural understandings are not isolated entities, both are heavily imbricated within social, political, economic and cultural spheres. In fact, technology needs to be addressed as not just a predominant cultural form, but also as indicative of a distinct set of behaviours inciting implicit membership patterns.

Ideally, I would like to explore how software agents provide a basis for membership guidelines or contribute to the construction of membership codes in technological cultures; and what it is that software agents can reveal about the relationship between technology and society. However, without empirical data on

symbol of natural efficiency and co-operation' (Casson as cited in Martin 1991: 3). In 1922 predictions about the radio claimed that the radio was 'opening new vistas for democracy, education and personal enrichment [radio] will be like a gigantic school ... and have a greater student body than all our universities put together' (*Radio Broadcast* in Alexander and Pal 1998: 1). These descriptions are familiar because we have heard the same claims about computers and the transformative power of the internet.

⁴ For example, see Carolyn Marvin's (1988) work on the telephone and the electric light; John W. Bakke's (1996) exploration of how the telephone has influenced telephone users' social structures; Patrice Flichy's (1995) critique of quantitatively based telephone studies; Arwen Mohun's (1999) historical analysis of gender and the emergence of the steam laundry; Jennifer Light's (1999) analysis of women's role in the early history of computing. Although these histories provide a thorough context for understanding *technology* in an abstract and concrete sense, a worthy future project would entail a systematic comparison of the kinds of social reactions garnered by 'old' and 'new' technologies.

who uses which agents, and demographic analyses concerning the extent that software agents have been implemented in social and occupational spheres – these questions are very difficult to answer.

Nonetheless, the first question posed by my original inquiry is ‘do new technologies (as represented by software agents) constitute a culture or series of identities that warrant unique codes of belonging, subjectivities and patterns of objectifications?’ In other words, do the cultural and historical specificities of new ICTs transform not only how humans relate to each other, and to their environment but also to the self? Based upon a significant portion of the literature and popular discourses, the answers appear to be unquestionably, ‘yes’ (*Wired*, Stewart Millar 1998, Castells 2001, Alexander and Pal 1998). If these claims are correct, how exactly is the fabric of social interaction transformed? It is important to note that I am not attempting to argue that new ICTs have determined or created an entirely new set of social relationships, political institutions and all the vestiges of an independent culture. Rather, access, participation and competent knowledge (or literacy) of technology may reconfigure human relationships to information, community and identity (Merelman 2000, Turkle 1995, Castells 2001). The key question here does not address whether or not social change has been facilitated or instigated by ICTs, rather, I want to challenge how such changes occur and what such changes include.

Given the paucity of sociological work on software agents, I will explore general sociological theories about technology by using software agents as the vehicle for theoretical exploration. Contingently, I hope to unveil the potential social significance of software agents. And as I hope to illustrate, developing such an

analysis will contribute to understandings of the links between gender and technology, subjects and objects, and will address how social relationships may have been reconfigured through increasing reliance on computer mediated communication (CMC) and the emergence of ICTs. Before introducing the objectives and central problematics of the following chapters, I think it is important to situate the relationship between software agents and technology, and provide a working definition of technology.

Defining Technology: Knowledge and Techniques

Software agents are inseparable from the context of ICTs in general, particularly regarding computer scientists' claims that these entities are emblematic of future directions and embody cutting edge work on the frontiers of cyberspace, computing and artificial intelligence (Maes 1994, 1995). For example, Walter Brenner et al. claim that 'software agents are a new category of information society tools' (Brenner, Zarnekow and Wittig 1998 : 11); and Dirk Wagmer observes that "on the internet the agent paradigm prospers" and may become "dominant" in computer systems (2000 : 4). Thus, software agents are frequently presented as a symbol for new technologies, potentialities and represent the ultimate icon of new computer mediated social paradigms and navigational forms. Regardless of the validity of such claims, it is important to define what it is that technology actually connotes.

Surprisingly, the dictionary definition of technology addresses only social processes of application, methods and available knowledge:⁵

⁵ I say 'surprisingly' because a large portion of the literature on technology reflects monumental efforts to prove, illustrate and remind readers and consumers that 'technology' is inherently social and is by no means an autonomous force that determines social behaviour, events or beliefs. I find it quite shocking that in contrast to this literature, the dictionary definition privileges the social aspects of

technology *n., pl. -gies.* 1. the application of practical or mechanical sciences to industry or commerce. 2. the methods, theory, and practices governing such application. 3. the total knowledge and skills available to any human society [C17: from the Gk *tekhnologia* systematic treatment, from *tekhne* skill] (Collins 1992: 1385).

What the above definition underemphasizes is the concrete incarnations of technology. Perhaps the term 'technology' is commonly misunderstood because the everyday usage of technology generally tends to refer to mechanical and electronic tools and objects. Following feminist scholars like Michèle Martin (1991, 1996), Cheris Kramarae (1988, 1998) and Nina Lerman (1997), everyday understandings of technology refer more to sleek instruments and new gadgets like computers, rocket ships and palm pilots.⁶ However, Westrum addresses this oversight and expands on everyday connotations by defining technology as 'consisting of those material objects, techniques, and knowledge [of those objects]' (2001: 7). Thus, Westrum defines information technology as:

the branch of technology devoted to a) the study and application of data and the processing thereof; i.e. the automatic acquisition, storage, manipulation (including transformation), management, movement, control, display, switching, interchange, transmission or reception of data, and b) the development and use of the hardware, software, firmware and procedures associated with processing [information] (2001: 8).

Westrum's definition is appropriate because it synthesizes the social and material realms within technology. In other words, we must recognize technology as referring

technology and neglects the actual objects that require skills, knowledge and applications.

⁶ According to these scholars, these references mask the feminization of technologies like washing machines, telephones and sewing machines as also being technological. Feminist scholars have critiqued definitions of technology in order to identify how gender becomes embedded in understandings and applications of technology. Thus, the authors intend the distinctions between the kinds of tools listed above to convey 1) the masculinist dominance of the technological sphere and 2) how this dominance translates into common perceptions (Kramarae 1988; Lerman et al. 1997; Martin 1997). However, I would like to emphasize that tools do not need to be machinic in order to be classified as 'technological.' Technology refers to any kind of tool - including 'simple' ones, such as cooking utensils, pens and sewing needles.

to 1) objects (and the material realm) and 2) ways of thinking, referring and actively engaging or constructing those objects (through knowledge and techniques).

Situating the Agent Field and Research Limitations

As stated above, software agents are at the forefront of technological developments primarily because they are the product of a number of disciplines ranging from linguistics, philosophy, artificial intelligence, computer science to theatre.⁷ In addition to this selection, each of these disciplines contains several sub-disciplines. For example, within computer science there is end-user programming, programming by design, object oriented programming, cognitive science, human-computer interaction – to name a few of the critical disciplines.

However, this is not to say that the field is functionally “interdisciplinary” or successfully integrates a variety of intellectual, theoretical and disciplinary heritages.⁸ The multi-disciplinarity of the agent field poses significant problems. First, there is the question of appropriately covering the most relevant material. The scope of fascinating issues, including theoretical and applied social implications are too numerous to list. For example, the field of cognitive science establishes theoretical frameworks from which computer scientists can think about human-computer interactions in order to develop new programs and paradigms. However, addressing cognitive science perspectives would also entail a critical engagement of the underlying philosophical tenets utilized to construct theories of self, psychological

⁷ This list of disciplines represents the most active disciplines involved in the early history of artificial intelligence (AI).

⁸ In contrast, the MIT Media Lab, the birthplace of many software agent and other technological innovations, illustrates hands-on multi-disciplinarity, and as a result, cannot categorically be defined along traditional disciplinary boundaries (Gershenfeld 1999).⁸ This multi-disciplinarity means that seemingly similar terms and concepts are used in radically different ways and with often contradictory meanings (cf. Wooldridge and Jennings 1998: 3-5; chapter 4, table 4.1).

and biological theories of cognition and much larger questions than can be addressed by this thesis. As a result, I am excluding cognitive science, object-oriented program and agent modelling from my analysis (although these areas offer rich sources for future research).

The literature on software agents tends to be split between popular accounts, commercial expositions and highly technical or theoretical reports. There seems to be very little agreement between these spheres of the agent literature. For example, commercial projects are very rarely discussed in the technical literature, and although Patti Maes' 'Firefly' (see appendix A) may receive some attention in the news, journalistic accounts tend to be analytically limited.

These differences are further exacerbated by the classic dichotomy between the social and natural sciences. Giuseppe Mantovani claims that it is absolutely necessary to integrate social science perspectives into human-computer interaction and computer systems design in order to develop a 'suitable' model of social contexts and a "shared frame of reference" between disciplines (1996: 240).⁹ However, I will not fully explore the implications of this paradigmatic disjuncture, as this has been thoroughly documented in studies of feminist epistemology, actor-network theory and studies of science and technology (see Fox Keller 1996; Lykke 1996: 14-15).

Research Objectives: Why Look at Software Agents?

⁹ Mantovani further claims that part of the reason such disjunctures exist at all in computer related disciplines is due to "the fact that engineers and designers do not understand people – although they think they do" (1996: 240).

It is important to note that in contrast, I am interested in questions of why software agents are socially significant. Thus, although many of the mathematical and algorithmic theories are important for the development of software agents and specific software applications, such questions are not only beyond the scope of this research project, but also, do not address the social implications associated with the growth of software agents.

Figure 1.1: Clippit

When I discuss my research with people outside of computer or cognitive science, or those familiar with research in artificial intelligence – their inevitable first response goes something like this, "What on Earth is a software agent? I've never heard of one." While, I will discuss the innumerable variety of software agents more extensively in chapter 2, my usual reply entails a reference to the rather irritating MS Word office assistants such as Clippit (see figure 1.1), Ask Jeeves (one of the earlier information gathering agents) or Ananova (one of the first digital news presenters). Generally, people only recognize the MS Word agents, if they recognize them at all. The most common and basic definition of a software agent refers to an autonomous program designed to assist users. However, when, how and what this assistance includes is entirely dependent upon what kind of agent is in question.

Despite the everyday obscurity of software agents, such entities raise fascinating questions and open what can be interpreted as impressive social implications. Previous empirical research on telephone sex workers and the sex industry revealed a significant link between gender and technological development (also apparent in the history of the telephone (Martin 1991; c.f. Light 1999 for an analysis of gender and the history of computing)). This link is partially illustrated by the rapid acceptance of the VCR and the correlated growth of adult home video sales, the transformation of the Guyanese telecommunications system in order to accommodate the technical needs of burgeoning telephone sex businesses and the link between women and the history of the computer (Rose 1996, Mills 1996: A01, Kramarae 1988, Light 1999).¹⁰ The first software agents I discovered exemplified the feminization and sexualization of technology that had marked the successful introduction of earlier technologies. For example, as pictured below (figure 1.2), Ananova, Kyoko Date, Luci McBot and SANDi™ portray feminine representations that are responsible for the kinds of clerical, service and public relations labour that constitute employment fields where women tend to be overrepresented as workers.

¹⁰ Phone sex companies tend to be associated with the high tech sector, particularly in the areas of call centers, internet, and computer telephony. This suggests that phone sex tends to be either a subsidiary of high tech companies, or high tech companies are subsidiaries of phone sex companies. For example, both the national "Guyana Telephone and Telegraph" (GTT) and the "Atlantic Tele-Network" (ATN) are major communications companies that own sex lines. This relationship between phone sex companies and major communications companies indicates that telephone sex has played a key role in the development of computer telephony and communications technology. Further, Mike Mills claims that the telephone sex industry has transformed the economy in Guyana, generating \$100 million dollars in 1996 (1996, A01). How much of that money will actually go to the Guyanese is another question as an American company, the Atlantic Tele-Network Company, provides the phone sex connections (Mills 1996, A01).

As witnessed in feminist critiques of early technologies, gender and gender relations become subsumed by the apparent “natural” and autonomous nature of technology in and of itself (Martin 1991, Mohun 1999, Kramarae 1988, 1998). The continuity between the feminized presentation of gender and particular forms of work, illustrates that software agents embed traditional gender roles within technological design, applications and practices.

Following Donna Haraway's concept of ‘situated knowledges’ (1996), Lorraine Code's theory of ‘universal knowers’ (1995) and Richmond Campbell's analysis of the perpetuation of ‘systemic bias’ (1995) several of my critical questions are raised:

- What is unique about software agents?
- What kinds of knowledges are funnelled by and through software agents?
- What kind(s) of subjectivities, objectifications and identifications best respond / relate to these programs? Are these reconfigured through engagements with software agents?
- Does the relationship between software agents' functions (e.g. customer service) situate users within a ‘universal’ sphere, from which only particular forms of knowledge can be generated?
- Do software agents facilitate the development of patterns of technological inclusion and / or exclusion?
- How does this relate to subject / object relations?

- And finally, what are the implications of automating portions of the service sector, particularly in relation to the women whose labour may be replaced by such technologies?

In part, new media open an ideal point of analysis because by examining the function and purpose of such ICTs, we can also witness shifts in social paradigms and dominant ways of knowing. For example, beginning in the 13th Century, mechanistic and clockwork models were reflected in cosmological theories, military organization and patterns of social behaviour, effectively portraying the dominant forms structuring the Western zeitgeist (De Landa 1991: 65-69). As Manuel De Landa claims, even the solar system “was pictured right up until the nineteenth century as just such a clockwork mechanism, that is, as a motorless system animated by God from the outside” (1991: 3). Through the provision of mechanical models, the very ground upon which people stood became reterritorialized as a tangible human creation. Essentially, early automata reconstructed how people comprehended exterior space and local objects, arguably translating divine entities (such as the cosmos) into the graspable realm of the everyday.¹¹ I suspect that as the emergence of mechanical models reconfigured both subjectivities and objectivities,¹² the emergence and convergence of new media and artificial intelligence will reveal how social paradigms have changed and what kinds of entities, relationships and subjectivities are valued in current paradigms.

¹¹ Of course, this observation applies only to those who could ‘grasp’ the automaton’s mechanical complexities. Regardless of how small this circle was, knowledge (and applications) of the automaton introduced what had previously been amorphous and unquestionable, into public consciousness.

¹² As I hope to illustrate in chapter 2, mechanical models provided a metaphor that facilitated a transformation in how people understood themselves, their relationship to the world and everyday objects. I use the word ‘reconfigure’ here to convey that the historical and cultural specificity of mechanical technologies were rooted within a series of cultural practices that did not suddenly disappear, but were rather, simultaneously re-placed, shifted and re-formed in relation to changing understandings of the self, the social and human interactions.

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As a result, chapter 2 will first, map out agent territories, types and provide a general overview of the software agent field. Second, this chapter will situate software agents within a larger Western cultural-mythic history, through an analysis

¹¹ Of course, this observation applies only to those who could ‘grasp’ the automaton’s mechanical complexities. Regardless of how small this circle was, knowledge (and applications) of the automaton introduced what had previously been amorphous and unquestionable, into public consciousness.

¹² As I hope to illustrate in chapter 2, mechanical models provided a metaphor that facilitated a transformation in how people understood themselves, their relationship to the world and everyday objects. I use the word ‘reconfigure’ here to convey that the historical and cultural specificity of mechanical technologies were rooted within a series of cultural practices that did not suddenly disappear, but were rather, simultaneously re-placed, shifted and re-formed in relation to changing understandings of the self, the social and human interactions.

of the metaphorical implications of puppets, automatons and early artificial intelligence projects.¹³ Further, a brief exploration of the historical relationship between subjugation and the feminization of machines establishes a foundation for assessing the relationship between gender, new technologies and what Greg Downey refers to as ‘boundary’ work (2001) that will be further developed in chapter 4. My central objective for chapter 2, is to contribute to the development of a software agent genealogy in order to situate agents in a broader socio-historical context, and expose what is not ‘new’ about software agents.

In tandem with research in new areas, the few social scientists that do address software agents primarily do so descriptively (e.g. Suchman 2000; Foner 1993; Johnson 1997). This analytically limited, empirically based work is crucial for exposing how epistemological and ideological conventions are or can be socially constructed, yet also marks a need to develop critical analyses of software agents. However, because there is so little work in the social sciences that directly addresses software agents, it is important to turn to the sociological literature on computing practices and technology in general in order to explore appropriate theoretical issues.

Chapter 3, ‘Subjects, Objects and Technology: Towards a Social Theory of Software agents’ will be divided into 6 main sections. Following Rob Kling’s argument that ‘genres’ of writing about computing follow ‘utopian and anti-utopian conventions’ that are at least 350 years older than the social sciences (1997: 20-21), the first section will situate select theoretical perspectives within the sociological field. These general theoretical perspectives include technological determinism,

¹³ It is absolutely critical to note that I am concentrating solely on Western history and cultural-mythic belief systems. I am doing this primarily because this is the history reflected in and through software agents and because although comparing Eastern, Northern and Southern mythic systems would be fascinating *and* important – it is well beyond the scope of this research project.

social constructionism of technology and political economic or social stratification and power. Due to the sheer vastness of this literature, and in order to preserve software agents as the focus for this exploration, this section will primarily address tensions between technological determinism and social constructionism; as engaged through cyberfeminism, feminist epistemologies, social constructionism of technology and actor-network theory.

The comparison between technological determinism and social constructionism is important for several reasons. While thinking about how to approach the social relevance implicated by and through software agents, I realized that the frame with which software agents (and technology in general) are presented is bounded by the same polemical views apparent in debates concerning nature versus nurture, structure versus agency, utopianism versus dystopianism and the healthy / unhealthy paradigm that dominates the majority of work surrounding the sex trade and sexuality.¹⁴ Thus, the questions that emerge from analyses of technology tend to be defined by these views, which can obscure some of the more interesting implications. For example, there is a lot of work concerning the implementation of new ways of knowing and being that have been triggered and facilitated by new technologies, particularly in relation to computers and computer mediated communication (CMC).

¹⁴ Beginning with the 1980's, questions around the sex industry were highly politicized and were largely framed within a 'healthy/unhealthy' paradigm, where analyses of the sex industry targeted highly moralized conceptions of 'good' or 'bad' behavioural and/or social effects of working within the sex industry (please see Duggan and Hunter 1995, Lederer 1980, Rubin 1989, Vance 1989, Schnier 1994, Bell 1995, Sprinkle 1998, Delacoste and Alexander 1998, Pheterson 1998). This literature represents varying stages of arguments for and against pornography and the sex trade based upon dominant ideas of what constitutes healthy sexuality. One of the most interesting aspects of these debates is how issues of 'what is healthy' influences an entire discourse concerning sexuality and the sex trade. I raise this point because questions of what constitutes positive social change also dominate the literature addressing the relationship between technology, society and the individual.

a new consciousness - it just let us apply our existing consciousness to the information-space on the screen (1997: 84-85).

The dichotomous nature of these views tends to reduce the objectives of research to a question of social change. Technological determinists argue that technology is the means of and for actual and potential social change, whereas the social constructionists and political economists tend to develop reactive analyses through critiques of hegemonic discourses and the continuation of social stratification along gendered, racialized and class based hierarchies.

Nonetheless, the key questions I would like to explore in this chapter include:

1) What does a sociological analysis reveal about the software agent? 2) Do virtual agents convey a fundamentally altered metaphor for the relationship between self and other, machine and human? And 3) if this is the case, how does this new metaphor reconfigure such a relationship? The key objectives for this chapter are to explore the above questions and illustrate a critical and comprehensive engagement with the sociological literature addressing technology.

Continuing from these explorations, chapter 4 focuses on identifying central issues within the agent literature. One of the continuities between the sociological and agent literature is whether technologies (or agents) replace or augment human labour. For example, technological developments and the purpose(s) of new media (i.e. SANDi, Ananova and the McBots), suggest that new forms of mechanization are being implemented. That is, previously tacit or 'implicit knowledges' as seen in socialized labour (see Witheford 1994) are concretized through new media. For example, software agents predominantly codify women's labour and automate a new

tier of human activity characteristic of low-paid, undervalued social labour. It is this connection that I plan on exploring. This leads to questioning the distinctions between the kinds of service work characteristic of both women's and software agents' labour, and knowledge work. Thus, by synthesizing central agent themes, a brief critique of employment patterns in the KBE and 'boundary work' (Downey 2001), I hope to address the relationship between software agents and gender.

Finally, in chapter 5, I argue that one of the most interesting and critical conclusions regarding the social significance of software agents, is the emergence of relationships between objects. Building from Emile Durkheim's (1984 [1893]) models of mechanical and organic solidarity, it becomes clear that software agents are emblematic of a new, reified series of 'indirect relationships' (Calhoun 1992). Again, turning to themes identified in chapter 3, this chapter explores how software agents potentially contribute to social atomization and / or social cohesion.

In closing, I have presented a synthesis of theories, observations and analyses in this thesis that are marked by many critical absences. However, given the previously unexplored topic and the wealth of questions that still remain unanswered, I hope to have contributed a significant starting point for my own future research; and to have advanced sociological understandings of both the software agent and the agent field. Software agents may well be the cutting-edge tool of the information society and the internet, but as I hope to illustrate in the following chapters, this does not render the software agent ahistorical or apolitical.

Chapter 2

From Puppets to Programs: Software Agents, Automaton and Artificial Intelligence

These characters will be everywhere, at street kiosks, ATMs and wireless devices
(Mike Antliff, Digital Animations Group, in Heuer 2000: 4).

Smart agents are here to stay. Once unleashed, technologies do not disappear
(Donald Norman 1994: 71).

Part of the purpose of this chapter is to get a sense of the software agent field, and I make no claims of developing a comprehensive survey of the technical issues and practices; I will, however, attempt to determine what a software agent is by exploring a selection of agent examples, in addition to identifying the wide range of specialized agents. This will consist of a survey of what software agent developers say about their products, particularly in relation to the difficulty in defining agent typologies, intended functions and characteristics. Such a comparison will indicate the general shape of the agent field and facilitate a more critical discussion of why software agents are unique in relation to new technologies (see chapter 3 for a review of social theories on technology and society).

In contrast to Donald Norman's claim that the servo-mechanism is the software agent's predecessor, I argue that the puppet, the automaton and early artificial intelligence (AI) programs have contributed significant cultural and technical elements to the development of software agents. As a result, 'Metaphors and Metamorphosis' is my attempt to construct the foundation for a genealogical (in the Foucauldian sense) analysis of software agents. Such an analysis reveals that the many attempts to create autonomous entities not only has a much longer technical history than commonly understood; but also coincides with the rich ideational and

mythical history embedded in Western symbols of technology and autonomy.

Although the materials used to express technological metaphors are widely varied, this section intends to demonstrate the metaphorical continuity found in the transitions from puppets to programs.

Additionally, the association between gender, particularly feminization, and technology crystallizes both the expression of ideological continuities through variegated technological artifacts, and the continuation of the sexual and gendered division of labour. Ultimately, this section aims to reveal what is not “new” about software agents, particularly that software agents have a long psycho-social and cultural mythic history. One of the immediate answers is that many software agents have highly feminized interfaces characteristic of stereotypical male sexual fantasies found in pornography, erotica and fantasy magazines (see figure 2.3).¹⁶

Software Agents: What are they?

The last ten years have witnessed stunning growth in the number of software agents, encompassing a wide range of incarnations, interfaces and forms. The extreme range of such entities and the interdisciplinary origins and creation of software agents means that beyond recognizing agents as autonomous and adaptive, they are notoriously difficult to define (Shoham 1999: 28-29; Pham and Karmouch 1998: 26; Papazoglou 2001: 71; Karmouch 1998:24, Bradshaw 1997: 3-12). For example, Hyacinth Nwana states:

There is as much chance of agreeing on a consensus definition for the word agent as there is of AI researchers arriving at one for artificial intelligence!

¹⁶ For example, some of the digital artists associated with Richard Glasgow, (see Figure 2.3) have contributed to *Heavy Metal*, self described as “the Mature Illustrated Fantasy Magazine” (see the web-site ‘Fantasya’: <http://www.fantasya.net/galerie.php?imgsection=4&ref=340>).

When necessary an agent is defined as referring to a component of software and/or hardware which is capable of acting exactly in order to accomplish tasks on behalf of its user. However, it would be preferable to say it is an umbrella term which covers a range of other more specific agent types ... (1997: 5).

Along much more simplistic lines, Walter Brenner compares software agents to James Bond, agent 007, because both agents and Bond autonomously and effectively follow predefined missions (Brenner et al. 1998: 1). This comment has particular significance given Bond's machismo and the hyperfeminized form of many software agents.

Despite the fantastic range of software agents, I will be primarily concentrating on interface agents, which are largely anthropomorphic interfaces ranging from Clippit (the Microsoft Office assistant) to Ananova (the green haired virtual news caster and Orange cell phone interface) to Luci McBot who is described as a 'virtual executive' for _____ (insert your company name here).¹⁷ Luci is one of many 'bots' that is designed to be a continually available (24 hours a day, 7 days a week) customer service representative, service support agent and clerical worker (by developing customer profiles and compiling database information). Interface agents are also referred to as 'personal assistants' (or 'agents') and are primarily intended to provide their user with information (through data mining and collection), provide assistance, teach and mediate information to the user. In addition to these agents, some other examples include AdEater (a program that eats advertisements before they appear on your browser) and cellular automata (autonomous software entities

¹⁷ Chin Lim, CFO of ALife (the creators of the McBots), claims that Pioneer Funds™, Eagle Star™, Berater and Castle are a few of the companies that are currently using Bots as "virtual executives" and to host company web-sites (personal communication, 07/27/2001).

simulating artificial life based on an evolutionary model) (see Appendix A for more details and a greater selection of software agents).

Conceptualizing and Defining Software Agents

One of the many analytical complexities associated with software agents includes the idea that although these programs are still in the nascent stages of development, they will one day not only be able to attend to and predict our every need, but also manage our finances, organize and pursue our consumer demands and guard our resources (Papazoglou 2001: 71-72, 77; Pham and Karmouch 1988: 26; Antliff in Heuer 2000). Bradshaw argues that the two key factors motivating developments in agent research include the need to simplify “the complexities of distributed computing” and to create better user interfaces (1997: 12). However, Bradshaw identifies software agents as providing the highest potential for delivering “an unprecedented level of functionality to people” (1997: 12). Addressing software agents means that we must also wrestle with predictions, the plausibility of those predictions and the ephemeral specter of the future and of potentiality.

Further, despite wild predictions claiming that virtual agents are the latest and greatest hybridized product of computer design and artificial intelligence; most ‘intelligent’ software agents are barely capable of interactions beyond the narrow scope of ‘pattern-matching’ programs (Heuer 2000: 2; Garnham 1988: 146).¹⁸ For example, many interface agents are capable of recognizing particular queries or statements and may react semi-convincingly, particularly when your questions or

¹⁸ A pattern-matching program or ‘parsing’ program highlights words according to ‘phrases, clauses and sentences’ (parsing) and reiterates these patterns through a response template (Garnham 1988: 146; Copeland 1993: 42-43). Although these programs may convincingly appear to intelligently respond to users (see the following discussion of ‘Eliza’ for an example), such programs can not identify or comprehend the meaning of the words, concepts or contexts within those word patterns.

interactions are in accordance with the parsing program. Yet, software agents like Luci McBot or Cybelle, heralded by their designers as adding a 'Human touch' or 'Putting some soul into' your web-site, actually incite more frustration than entertainment or information (Hueur 2000: 8,6, see 'Clippit' in chapter 1).¹⁹ As an illustration, here is a transcript of a conversation between myself and Luci McBot:

L: Hello, friend! What's your name?
 Z: Hi, my name is Zoe.
 L: Welcome to the World of Bots! How the heck are you today, Zoe?
 Z: I'm well, thank-you. And yourself?
 L: Great, Zoe, me too. What would you like to chat about today?
 Z: I would like to know more about you and Artificial Life.
 L: My name is Luci. I'm a bot developed by Artificial Life, Inc. to guide you and answer your questions on this Web site and my company.
 Z: What's a bot?
 L: Bot is short for software robot. It's another word for agent, which is a program that can perform some tasks on its own.
 Z: When did you come into existence?
 L: "When", you say? "When"?!? What about "why"? Where is "how" in all this? How come no "who"?
 Z: Ok, who?
 L: Oh boy, what pretty eyes you have! What else would you like to know about Artificial Life or our products?
 Z: How old are you?
 L: I'm 27 and every year keep getting better. This just in: Artificial Life announces first profitable quarter in its history!
 Z: How much did Artificial Life make?
 L: Please contact Chin Lim, our CFO, for pricing information.
 Z: How many bots has Artificial Life produced?
 L: We make software bots that are smart, using artificial intelligence. This is one of the best conversations I've ever had.²⁰

Regardless of 'software robot's' limited performance (compared to hyperbolic claims), it is true that software agents' – in all their incarnations – are the product of

¹⁹ This is an ironic claim, according to David Holmes, who argues that computer mediated communications (CMC) programs are anti-social because they limit the number of face-to-face interactions between workers and users. Rather than engaging in a personal encounter with colleagues, users will withdraw into their own spaces (1997: 39). Holmes' argument is not totally unfounded, but he does overlook the potential CMC programs have to extend social networks; an observation that has been widely discussed in feminist analyses of the telephone (Rakow 1988: 209-210; Flichy 1997: 152), the development of the Internet (Abbate 1999) and in discussions of chat rooms and/or 'cultures' of the Internet (Shields 1996; Argyle 1996).

²⁰ Although Luci makes some interesting comments, I have chosen to avoid a semiological or linguistic analysis because the disjointed comments (e.g. "what about 'why'" ... and "what pretty eyes you have") tend to be pre-programmed responses used when nothing else matches (see parsing in 'Humans as Soft Computers' in this chapter).

numerous disciplines (as described in the introduction). This multi-disciplinarity constitutes the second complication as the imbrications of theoretical approaches place software agents within the interstices between and across disciplinary boundaries. In addition, different software projects have different theoretical foundations, technical applications and design frameworks, which mean the grounds for agent comparability are constantly shifting.²¹

Additionally, there is a great deal of technical material on varying kinds of software agents, which largely overlook, if not blatantly dismiss epistemological, social, and ethical questions. However, it is important to note that even the nomenclature for software agents is problematic. There are a massive variety of names given to similar kinds of agents and teasing out the general continuities and differences across software agents is contingently complicated. For example some of the more common labels for software agents include: avatars, virtual humans, software robots (as illustrated by Luci McBot), bots, verbots, virtual personalities, robosapiens, cyberbabes, EVAs (electronic virtual assistants), PDAs (personal digital assistants), mobile agents, interface agents, virtual idols, tele-agents, chatterbots ... and need I go on (see Agentland for example, a popular agent guide URL: <http://www.agentland.com/>)?

The key point is that it becomes difficult to identify what is interesting and sociologically relevant about software agents amidst the mire of possibilities

²¹ Finally, software agents are a very current phenomenon, and in accordance with ICTs and computer technologies in general, they have proliferated over the past decade. The massive growth rates and constant 'new' developments within AI, computer science and the appearance of new software agents mean that there is very little sociological or empirical work on agents and that this is a difficult area to map (excluding Foner 1993). Explorations and observations of particular agents rapidly become outdated and analyses must remain fluid enough to compensate for continual fluctuations, thus risking indeterminacy and inconclusiveness.

(Shoham 1999: 28; Nwana 1997: 5; Karmouch 1998: 24; Bradshaw 1997). It is crucial to have an understanding of how far software agents reach into the social sphere. However, this becomes an especially difficult task when the proliferation of agent names and applications do not necessarily indicate that agent's (or class of agents') function, design, technical lineage, capabilities, limitations, applications or associations. In order to address these complications, the next section explores several attempts to define agent classification systems and the breadth of agent applications.

Towards an Agent Typology

"All software agents are programs, but not all programs are agents" (Franklin and Graesser 1996: 26).

Steven Johnson identifies three kinds of virtual agents: 'the personal agent, the traveling agent and the social agent' (1997: 178). Johnson proposes these categorizations as general classes of agents and should not be considered as mutually exclusive. Personal agents include the plethora of personal assistants, such as Clippit, who is responsible for helping the user negotiate word processing programs. Thus, personal agents mediate between the user and a variety of programs. In contrast, traveling agents, according to Johnson, are programs designed for information gathering and data gathering through the web, networks or other people's hard drives. Jaron Lanier predicts that this kind of agent will become difficult to regulate as the creation of users (and their agents) leave electronic trails marking user preferences and opening the floodgates of 'push' advertising and

facilitating covert data collection and user profiling (Johnson 1997: 188-189).²² Lanier's critique of such agents raises big issues associated with privacy and unsolicited surveillance, particularly through the potential these agents have to tamper with 'host computers' and the contingent development of anticipatory programs that exceed the user's control (Johnson 1997: 190; cf. Elmer 2000; Gandy 1993). Although these issues are given token acknowledgement in some of the software literature (Maes 1996; Pham and Karmouch 1998; Nwana 1996), it is generally confined to problematizing economic and legal responsibility.

Johnson's third category of agents, 'social agents', are also frequently referred to as 'interface agents' (although 'interface' would also arguably include personal and traveling agents) (Nwana 1996; Nwana and Ndumu 1997; Maes 2001; Lieberman 2001). Social or interface agents are my primary research interest and include programs that are service oriented, yet rely on 'intelligent' software capable of autonomously implementing filters and negotiating databases beyond the sphere of the agent and the user (Johnson 1997: 192-193).²³ Thus, for Johnson, social agents are primarily designed to mediate between the user and networked systems. Although Johnson's classification system includes only three categories and is by far the most straightforward agent typology I've come across, it is totally insufficient.

To further complicate matters, there have been several other somewhat contradictory attempts at developing a comprehensive typology (Wagmer 2000;

²² For example, a Dutch company named Tryllian is currently marketing a 'friendly' version of a traveling agent called Gossip (Hueur 2000: 4).

²³ Johnson uses Patti Maes' (a pioneer in the field of software agents) Firefly program as an ideal example of social agents. Firefly is designed to identify users' potential musical preferences, based upon a database compiling an aggregate of users' ratings. If someone using Firefly gave Nirvana a high rating, Firefly would recommend Pearl Jam (or bands that received high ratings from people who also gave Nirvana high scores) (1997: 196).

Shoham 1999; Pham and Karmouch 1998; Papazoglou 2001; Brenner et al. 1998; Nwana and Ndumu 1998; Franklin and Graesser 1996; Bradshaw 1997). The most comprehensive in breadth has been developed by Hyacinth Nwana (1998) and the following table (2.1) presents Nwana's eight agent categories:

Nwana's Agent Categorization (Table 2.1)	
Agent Type	Description
<u>Collaborative agents</u>	Designed to autonomously cooperate with other agents, generally through negotiation algorithms and task-specific activities. Such agents may incorporate 'learning' (adaptive and selective behaviours in order to maximize negotiating capacities) (1998: 3-5). Nwana uses the example of the 'Pleiades System,' which is an 'infosphere' composed of 'heterogeneous on-line information sources' (1998: 2-3).
<u>Interface agents</u>	A marginally 'smart' personal agent, incorporating learning algorithms in order to autonomously 'collaborate with the user' (1998: 5-6). Clippit is a classic example of Nwana's definition of interface agents, although she refers to 'calendar agents' which automatically monitor users' schedules and appointments (like VirtuaGirl). Additionally, I would argue that Nwana has provided a basis for thinking about interface agents, however, agents like Luci McBot, Ananova, AskJeeves and Cybelle 'collaborate' between the user and isolated or distributed systems. As a number of individuals have mentioned, interface agents are often responsible for data mining across or between networks, and guiding users through particular (or closed) sites – which are excluded from Nwana's classification.
<u>Mobile agents</u>	Nwana distinguishes these agents from collaborative agents because although mobile agents have the same characteristics, they are capable of autonomously negotiating with foreign hosts across open networks and public domains (1988: 11-13). Nwana uses the example of 'telescript' agents, which is a "multi-tasking interpreter;" and is capable of functioning on user-defined search parameters and autonomously collecting corroborating information (1998: 13).
<u>Information agents</u>	Essentially, these are sophisticated programs designed for information filtering, organizing and incorporating specific information from large sources (1998: 15-16). Nwana highlights the points of convergence between collaborative, interface and information agents, which she attributes to the 'explosion of the WWW and because of their applicability to this vast WAN [wide

	area network]' (1998: 16). Lastly, Nwana uses the example of a 'software robot' capable of negotiating the entire WWW, rather than a LAN like Luci McBot.
<u>Reactive agents</u>	Characterized by functionality, situatedness, task decomposition and communication between system nodes (1998: 19). Reactive agents are based on a "stimulus-response" model of behaviour. The software program animating iRobot is a prototypical example. The iRobot is a smart web-cam/toy/robot designed for mobile video-conferencing and entertainment (Davis 2000)
<u>Hybrid agents</u>	Combine one or more agent 'philosophies,' e.g. like Maes' Firefly agent: combines a "reactive and deliberative paradigm" (Nwana 1998:42. See appendix A for more details on Firefly.
<u>Heterogeneous agent systems</u>	Based on work aiming to create interoperable domains where agent participation is dependant upon the agent's capacity to communicate with other agents (Nwana 1998: 43; see Genesereth and Ketchpel 1994 for examples).
<u>Smart agents</u>	Nwana does not review this category because it represents the "aspiration of agent researchers rather than the reality" (1996: 1). However, Jennings and Wooldridge argue that the distinguishing factor between intelligent agents and autonomous agents is 'flexibility' (which infers responsiveness, proactivity and the ability to be social, 1998: 5). This is an especially confusing character, because there are so many conflicting claims regarding what constitutes an intelligent agent. Jennings and Wooldridge claim that agents built on the BDI model (see chapter 4) have intentional states (i.e. want, think, feel, believe). This means that any interface agent capable of saying something like "Great, Zoe, me too," is technically intelligent, according to BDI parameters.

One of the problems with this proposed classification system in part concerns the disjuncture between less formal (i.e. commercial and popular) communities and the more formal academic and well-established research communities. Nwana's definition of hybrid agents is, in some ways, counter-intuitive because it officially describes what technically constitutes a hybrid agent, but neglects many kinds of agents that can be classified in several categories (like Ask Jeeves for example).²⁴

Nonetheless, Nwana's earlier work (pictured in figure 2.2, below) more clearly

²⁴ Ask Jeeves has been described as belonging to a number of categories, including smart, interface and information agent.

addresses these difficulties, as it explicates the considerable overlap between agent functions and their intended design capacities.

Although Nwana's model illustrates breadth, the scope of each of Nwana's categories may be debatable and her typology is still incomplete. For example, Mike Papazoglou outlines a series of eleven 'intelligent business agents' ranging from e-commerce agents to security agents (2001).²⁵ Software architectures and agents in artificial life systems (Rucker n.d.; Adams 1998; Martinho and Paiva 1999) are similarly neglected. Lastly, the interstices between software agents and artificial intelligence programs developed in and through game theory (e.g. SimCity, Black and

²⁵ Papazoglou includes application agents, personal agents, general business agents, information brokering agents, negotiating and contracting agents, system-level support agents, planning and scheduling agents, interoperation agents, business transaction agents and two classes of security agents (authentication and authorization) (2001: 71-77).

White, cf. Wolpert, Wheeler and Tumer 1999: 77-83) seem to have no place within her classification system. However, the difficulties in classifying, organizing and keeping up-to-date on constant innovations within the agent field are daunting tasks and Nwana has provided a fair overview of the key areas within this field. Suffice to say, interface agents involve varying configurations of information and collaborative agent techniques, applications and design objectives.

Wooldridge and Jennings, on the other hand, claim that distinctions must be made between intelligent agents and less exciting agents such as software daemons,²⁶ object-oriented software or even expert systems.²⁷ According to Wooldridge and Jennings, the distinguishing factor between ‘intelligent agents’ and other agent programs is that intelligent agents are ‘flexible’ (meaning reactively, proactively and socially) (1998: 4-5). Programs such as

software daemons, which monitor a software environment and perform actions to modify the environment as conditions change – a simple example is the UNIX xbiff program, which monitors a user’s incoming e-mail and obtains their attention by displaying an icon when new, incoming mail is detected” (Wooldridge and Jennings 1998: 4)

provide an example of what is NOT an intelligent software agent, despite exercising autonomous actions on behalf of the user. Thus, the problems of categorizing agents according to Nwana’s typology is typical (for Wooldridge and Jennings) of what constitutes an intelligent agent.

Franklin and Graesser also propose an agent taxonomy, which more clearly illustrates the scope of agent applications because it includes robots, artificial life

²⁶ Software daemons are defined as a “background process that performs operations on behalf of the system software and hardware. Daemons normally start when the system software is booted and they run as long as the software is running” (Juniper Net 2002). Perhaps the most familiar kind of software daemons are the ones responsible for randomly routing e-mail messages to users’ in-boxes.

²⁷ Such as MYCIN, ELIZA, CYC or DENDRAL. Please see appendix B for further details.

and viruses, and distinguishes between software agents based on function (e.g. task-specific or entertainment). I have added the hybrid classification for those agents that occupy both categories.²⁸

The above taxonomy effectively illustrates the territory occupied by the software agent field. The one critical flaw, however, is the absence of 'intelligent' or smart agents. Franklin and Graesser appear to conflate autonomy with intelligence, because the relationship between the two elements remains unarticulated. This juxtaposition exposes the presumption that intelligence can be reduced to autonomy.

²⁸ This is also a problematic classification because how an agent meets the criteria for each category can easily be challenged.

Such a conflation effectively illustrates one of the assumptions perpetuating technologically deterministic thought: that progress is equivalent to technological developments (please see chapter 3 for more on determinism and constructionism).

The above taxonomy was intended, in part, to codify the differences between software agent and a software program. Thus, Franklin and Graesser further define an autonomous agent as “a system situated within and part of an environment that senses that environment and acts on it, over time, in pursuit of its own agenda and so as to effect what it senses in the future” (1996: 25). Drawing from Norbert Wiener, Franklin and Graesser admit that this definition is so broad that it can describe a thermostat. Yet, it must be a functional thermostat because, according to Franklin and Graesser in order to be an agent, an agent must exist within “an environment” because “a robot with only visual sensors in an environment without light is not an agent” (1996: 26). Although I will return to this point during the discussion of algorithmic and enculturated forms of knowledge at the close of this chapter, Franklin and Graesser also raise the issue of ‘situatedness’ and problematize notions of autonomy and embodiment (see chapter 3).

Despite the organizational variations applied to classifying agent characteristics, the sheer number of references to autonomy, attachment to an environment, available functionality (i.e. capacity for communication and acting in appropriate contexts) or what has been termed adaptability indicate that these are the central elements, that software agent developers are attempting to codify and automate (see chapter 4).

Metaphors and Metamorphosis: Puppets, Automaton and Software Agents

So what? Software agents may be the locus of a huge and vastly growing multi-disciplinary field that is exercising all the confusing and contradictory growing pains of a young field. But why are they significant? Why should software agents matter to me? Firstly, I'd like to remind the reader that this section aims to answer this question by identifying continuities between the puppet, automaton and early artificial intelligence projects. A significant commonality between these entities includes the powerful invocation of pervasive metaphors and the attempt to create autonomous entities.

Think for a minute of Pinocchio, the wooden puppet that was magically given the chance to become a 'real' boy, free from the constraints of human manipulation and the structural confines of a wooden, artificial body. As Petra Halkes eloquently states:

Puppets represent two contradictory desires of selfhood in our cultural history, one of connectedness and one of self-sufficiency. The puppet, moved by strings or rods ... can only come to life through the voice and movements of the puppeteer, forming a most literal, close connection to its creator. Yet it so forms an ideal, illusory image of self-sufficiency. The dialectic between the wonder of a creator bringing life to an inanimate mass – like God inspiring Adam formed out of clay – and the deceit of dead matter moving ostensibly of its own accord, is always contained within the puppet, as it is in Western metaphysical thought (1992: 15).

Like the puppet, the automaton²⁹ is more than just a singular phenomenon. It symbolizes a series of patterns reflecting and crystallizing the culmination of social,

²⁹ The conventional definition of the automaton is a usually mechanical 'self-controlled, self-governing machine' (Haraway in Gonzalez 1995: 267) or the 'often anthropomorphic mechanical curiosities' characteristic of the 17th and 18th centuries (Huhtamo 1999: 99). On the other hand, Georges Canguilhem defines the automaton as 'a mechanism that is miraculous in and of itself and does not rely on human or animal power' (1992: 47). Catherine Liu describes the faintly 'obsolescent' automaton as an 'early modern machine, and curious ancestor of the twentieth-century robot' (2000: ix).

cultural, religious, epistemic and metaphysical beliefs and practices. The simulation of moving objects, bodies and autonomy provides a 'learning machine for a new kind of self-portrait' (Stafford in Halkes 1992: 20), regardless of whether the materials of that self-portrait are constructed from wood, metal or bits and bytes.³⁰

Long before Hans Bullman created the first android in 1535, there were cabalistic and Greek myths about organic automatons. The golem, a "wooden or clay model of [a] human being" could be conjured from an amorphous mass, in order to serve its maker (Mazlish 1993: 39). Originally intended to do housework, the golem is frequently depicted as a trickster who becomes unmanageable, and like Hesiod's Pandora, acts as a vehicle for the ruin of its host (Gonzalez 1995: 270; Mazlish 1993: 39; Benjamin 2000: 696). These myths signify an attempt to embody the tensions between the liberating potential of creation, and the disastrous implications of losing control, not just of the object of creation but also of the self. The fear of what will happen as the boundaries defining the self and other and the thin lines between real and artificial, are subverted and transgressed can simultaneously stimulate and cripple the senses. The story of technological creations coming to life and overpowering the creator is a powerful mythic force, and is continually re-articulated through new characters and examples ranging from *Frankenstein* to *The Matrix*. These narratives provide an especially interesting avenue leading to the social imaginary. One of the points I will develop in Chapter 3 includes the tendency to forget this myth, and read every re-articulation as a facet of whatever the new

³⁰ The puppet lurks ephemerally within the software agent and on occasion reveals itself. For example, one of the software programs used to create agents is called 'Puppetmaster' and is used by Makoto's designer, Yamag (<http://www.asahi-net.or.jp/~gi9m-hgc/index.html>). Additionally, Henry Lieberman uses 'marionette strings' to describe the process of getting agents to use a direct manipulation interface (i.e. having to use the mouse to perform computational actions, such as opening or closing a file, nd.: 4).)

technological materials and/or details may be. However, it is in part by recognizing the re-occurring metaphors of the machinic other, that we can identify continuity and glimpse visions from the social imagination.

The Automaton

The automaton is a fascinating entity, in part because of pervasive cultural fears and the mythic projection of the other are embodied (and controlled), so to speak, in the machine. The automaton, like the software agent, is the site of numerous interstices between the automated machine and the autonomous human being, and has frequently been regarded as not just the 'screen' for human fantasy, but also as one of the loci for generating aspects of the social imaginary. The software agent is in many ways, the digitized version of the automaton.

Jacques Vaucanson, one of the most cited figures in the early history of the automaton, created one of the most famous automatons in 1735, and it clearly demonstrates the power of technological metaphors to capture the social imaginary. Vaucanson built an excreting mechanical duck with a pseudo working anatomy, intended to portray the digestive process (Huhtamo 2000: 102; Mazlish 1993: 35-39; Liu 2000: 82-105; Bedini 1964: 8-10; Benjamin 2000: 696).³¹ This duck sparked huge debates between surgeons, anatomists and doctors about the mechanical versus dissolutive nature of digestion (Liu 2000: 84). Walter Benjamin concisely sums up the importance of Vaucanson's work when he writes:

There is no doubt that in the eighteenth century the idea of applying automatic devices (moved by springs) to production was first suggested

³¹ According to Catherine Liu, Vaucanson's duck did not excrete what it swallowed. Rather, the excremental pellets had to be pre-prepared and inserted into a separate compartment (2000: 85). Thus, the designer's intentions did not need to be actualized in order to raise questions about how the digestive process worked.

by the clock. It can be proved historically that Vaucanson's experiments along these lines had a tremendous influence on the imagination of English inventors (Benjamin 2000: 695).

The intensity of the 'digestion' controversy highlights the 16th century as a time of extensive exploration and uncertainty around the workings of bodies and nature.³²

The mechanical details of automatons are not as important or as interesting as the relationship between the emergence of mechanized models of the body and the socio-cultural *zeitgeist* associated with such models. Jonathan Sawday claims that the "machine-body, an automaton of movement" came into existence at the end of the 1500s, before René Descartes wrote his famous work on the body as a machine (Sawday 1995: 28). This corresponds with Hans Bullman's and Gianello Torriano's invention of the first android (1535). In fact, Sawday claims that Descartes inherited a "half a century of voyages into the interior" through the clockwork/mechanical reconfiguration of the body and the social sphere. These voyages into the interior culminated in the Cartesian division between the body and the mind (1995: 28). Sawday also claims that:

Mechanism offered the prospect of a radically reconstituted body. Forged into a working machine, the mechanical body appeared fundamentally different from the geographic [or externally determined / divine] body whose contours expressed a landscape without dynamic interconnection. More than this, however, the body as a machine, as a clock, as an automaton ... became objectified; a focus of intense curiosity, but entirely divorced from the world of the speaking and thinking subject (1995: 29).

The exceptional growth of what Sawday refers to as the 'culture of dissection'³³ in the 16th century, exemplifies a profound questioning of both the physical body and the

³² For example, theories of mechanical digestion hypothesized that "food in the stomach was simply pulverized by mechanical motion ... [by] tiny, imaginary saws and grinders that crushed food, reducing it thereby to a nourishing pulp" (Liu 2000: 84). Whereas, the dissolutive hypothesis of digestion is less clearly articulated, but basically posited that food underwent a process of "maceration, the cooking or dissolving of the grain" (Vaucanson in Liu 2000: 85).

constitution of the interior core - like the automaton, anatomy sought to reveal the mechanics of the soul (Sawday 1995: 12). The automaton concretized a conceptual reliance on the machine as a model for understanding the nature of the body, of the world, and the body / world relationship, which, in turn had a profound effect on the socio-political order. Sawday claims that “organic (and hence natural)” metaphors of the body reinforced a divine social hierarchy and belief system (1995: 20).

Mechanical metaphors meant that not only the King’s power was questioned, but the whole issue of God and the realm of God’s power came under public scrutiny, as the automaton and hence the model of the the body-as-machine, required an engineer to design - rather than a ‘father’ to care and nurture humanity (Sawday 1995: 29).³⁴

Sawday’s analysis of the social significance of anatomy indicates that we cannot attribute the rise of mechanism solely to the automaton, rather, the 16th century witnessed the realization of coalescing trends towards the identification, classification, standardization and simulation of human life.³⁵ Moreover, the automaton symbolizes a cultural merging of the body and machine, a merging that continues to pose deep questions about “freedom and servitude” (Canguilhem 1992: 49).

Part of the power of such technologies operates through the generation and /or appropriation of metaphors that are easily applied to aid understanding of the

³³ At the same time that automatons were being created in part to develop understandings of how the human body functioned, anatomists were institutionalizing human dissections as a medical and biological practice.

³⁴ Daniel Bell, however, places the automaton as an intermediary or “a token of passage from industrial to postindustrial culture” (Huhtamo 1999: 101). Therefore, Bell is claiming that the automaton was conducive to an ideational framework allowing for the dissection of labour into separate, interchangeable components, as interchangeable pulleys and wheels accommodated animation of mechanical figures and objects (Bedini 1964: 11; Marx 1999: 156-157, 1970: 341, Mazlish 1993: 61; see chapter 5 for more on social segmentation).

³⁵ See the following section on ‘Humans as Soft Computers’ for my interpretation of how artificial intelligence attempted to standardize and classify knowledge processes, along the same vein.

self, explain human nature, the cosmos and the ways each relates to each other. In Rudy Rucker's science fiction series, *Software* (1987), *Wetware* (1988), *Freeware* (1997) and *Realware* (2000), software is applied as a metaphor for thought, culture and social conventions and the body is presented as the physical, chemical and biological components of hardware.³⁶ *Does the software agent indicate the emergence of new cultural metaphors paralleling the symbolic power of the automaton to initiate cultural metamorphosis?*

Difference, Seduction and Subjugation: Femininity and the Machine

"There seemed to be a general tendency to link the 'otherness' of machines with the otherness of racial and sexual difference" (Gonzalez 1995: 275).

"Those who had access to certain machines were privileged, those who were expected to behave like certain machines were subjugated. The same is true today" (Gonzalez 1995: 269).

If the software agent metaphor is as revolutionary as that of the automaton, there are some historically consistent elements embedded within the representation of the software agent regarding gender, ethnicity and socio-economic status. For example, the automaton and the software agents embody difference in at least two imbricated forms. The first is through the feminization of the machine and the second is through the replacement of typically subordinated labour. Popular software agents typically tend to be embodied in titillating, gendered forms capable of performing a variety of services, in accordance with stereotypical notions of women's occupational and sexual roles. The former point is clearly illustrated by the following agents (see figure 2.3):

³⁶ Additionally, metaphors of 'software as thought (or language)' and hardware as 'hard-wired' biological and physical structures, has become an everyday part of at least the Western vernacular. This is an important point, because it illustrates that the Cartesian mind/body split is still powerful (see Penny 2000 for an interesting critique of distinguishing between software and hardware).

Julie Wosk implies that these manifestations of difference overlap through the mechanization of service:

The idea of automatons as useful servants and amusing toys continued in the designs of medieval and Renaissance clockmakers, whose figures, deriving their movements from clock mechanisms, struck the hours (Wosk in Gonzalez 1995: 269).

There is a long relationship between subjugation and the machine, where femininity, race and identities that threaten white, heterosexual, upper class norms (as implicitly perpetuated in elite circles of scientific inventors and innovators) are projected and intertwined within the automaton (c.f. Code 1995, see chapter 3). For example, according to Ron Eglash, African Americans have in part formulated their cultural identities from an extensive labour history as “biological automatic machines” (1995: 22). The Aristotlean declaration reducing slaves to ‘animated machines’ certainly illustrates a legacy of dehumanization that continued (and continues) to organize hierarchical thinking about people’s social positions and their biological constitutions

well into the modern era.³⁷ In the Western world, ‘lesser’ beings, such as women, the poor and those of colour were legally presented as objects of property until the early 20th Century. Hence, their social functions could more easily be conceptually and mechanically replaced.

Walter Benjamin cites Hesiod’s myth of Pandora as one of the very first instances of the automaton, which not only points to the prevalence of the dangerous “woman-machine” associated with the automaton, but highlights the automaton as a mythic symbol of control and human destruction (2000: 696). Benjamin also claims that this kind of ‘femme fatale’ indicates a mythic theme, where “the ruin of humankind, [brings] that which all shall take to their hearts with delight, an evil to love and embrace” also appears in the Indian Kṛtya (2000: 696).³⁸ The automaton (like the Cyborg and Sherry Turkle’s conception of the computer) is regarded as a mythic vehicle for the carriage of ‘new ways of knowing’, human progress and technological change (1995: 48).

Popular representations of the automaton such as Maria in Fritz Lang’s *Metropolis*, Rachel and other replicants in Ridley Scott’s *Blade Runner* and Mary Shelley’s *Frankenstein* portray the loss of control over the automaton, over the other, over the subordinate and the servant and over reproductive power. Pandora, is thus a receptacle for uncontrolled reproduction, which transforms creation into destruction as it ruins the creator/inventor and the ordered world of men. The

³⁷ In support of the ‘slave as machine,’ Catherine Liu notes that in the Czech language the root for the word robot means “forced labour” (Liu 2000: 94).

³⁸ Prometheus may have brought fire to humanity, but as punishment for his trickery, Zeus “made the beautiful evil,” Pandora, so that men “may all be glad of heart while they embrace their own destruction” (Hesiod 1996a and b: 535, 42, respectively). Disguised by seductive beauty, Pandora, the ultimate automaton who, like Eve, was constructed from mostly earth and water, invokes irrevocable change, including the destruction of Eden and the fall from paradise.

attempt to control the other backfires and annihilates the boundaries between human life and non-human life, between the self and other and threatens the carefully ordered hierarchy of power and social rank.³⁹ If life could be granted through the mixing of earth and water, what differentiates human life from (organic or) mechanical creations and other forms of life? The fundamental question became 'what is the difference between the automaton and humanity,' between the 'real and the artificial' and ultimately, between self and machine? (c. f. Liu 2000: 78-79, 84; Mazlish 1993: 26-29).

The debates sparked by Vaucanson's excreting duck trigger deep questions about the nature and limits not only of human existence, but also about how and who could create life (c.f. Mazlish 1993: 57). The feminization of the machine, as witnessed in early automatons and the abundance of 'feminine' machines / cyborgs and the hyperfeminized⁴⁰ form of software agents provides further evidence of the fascination / fear of (mostly) women's 'hidden' powers of creation.⁴¹

The key point here is that the nature of women and of seduction has been historically conceptualized as the manifestation and *a priori* symbol of the mythic other. From this perspective, the function and purpose(s) behind the development of

³⁹ Sadie Plant has an interesting analysis regarding the link between women and this myth, particularly in relation to *The Matrix*. For Plant, the 'matrix' symbolizes the womb, and the fear associated with loss of control stems directly from fear of women's power to give birth (1996: 37). The history of alchemy reveals a similar attempt, predominantly by men to create life.

⁴⁰ Following William Bogard's discussion of Baudrillard's simulacra, 'hyperfeminized' refers to the reification of simulation, and the difficulty of identifying the difference between authenticity and reproductions. Software agents' exaggerated or "hyper" simulation of feminine traits problematizes what it is that is essentially feminine (if there is such a thing) and what it is that is represented as feminine.

⁴¹ Recent developments in new technologies like 'virtual people' (e.g. SANDi, Webbie, Ananova, virtual models) clearly demonstrate the prevalence of the links between feminization and technology. However, these new technologies also encompass the second form of the automaton (the replacement of labour) as 'virtual people' are frequently designed as cost efficient means of replacing predominantly women's work (such as data entry, customer service and receptionist / telephone work; see chapter 4 for further discussion).

the mechanical automaton are irrelevant, because the automaton merely provides yet another venue for expressing elite, white men's age-old fears of the other.⁴²

Aristotle believed that the slave was "an animated machine" or an "instrument," which highlights both the reduction of human life to an existence as a 'human-machine' and the projection of 'other' onto the automaton before the advent of clockwork, the mill and mechanized automation (Canguilhem 1992: 49-50; Benjamin 2000: 697; Gonzalez 1995: 275).⁴³

This insight offers a meaningful temporal and conceptual distinction between the 'machine as human model' and the 'human as machine' associated with the Industrial Revolution. However, there seems to be little agreement regarding the automaton or the cyborg and difference. The brief history I've explored reflects a lack of colour, of cultural, racial and ethnic difference. The homogeneous surface of the automaton reflects the view from the perspective of its designers, which does not include the racialized or sexualized 'other' unless the other is presented as a *tool* or *servant*.

Many do argue that the automaton – like the cyborg and by association, the software agent – however, do symbolize a cultural merging of the body and machine;

⁴² Jennifer Gonzalez regards the *L'Horlogère* as a "woman [who] is a [biological] clock, the clock is a woman - complex, mechanical, serviceable, decorative" (1995: 269). The body of the time piece constrains and traps the woman, confining her to play "the objectification of cultural sophistication and sexuality. Her gender is consistent with the property status of an eighteenth-century decorative effect" (1995: 269). Thus, Gonzalez presents *L'Horlogère* as the ideal woman, one whose aesthetic value is immediately observable and one whose function can be regulated, repaired and easily contained. Seduction and sexuality play a key role in the feminization of the machine and technology. Although Gonzalez (1995) addresses this connection, there is much work that needs to be done in relation to software agents, and provides a rich topic for future research.

⁴³ Unfortunately, the ancient roots of the 'animal-machine' cannot be included in this project, due to space limitations. However, the ancient Greek belief in women's inferiority stemmed from an animal-like 'wandering womb' called the 'gaster' which has been widely documented (Araeatus of Cappadocia 2nd Century AD in Lefkowitz 1992: 249-256). The relationship between women, machines and the 'animal-within' is important and illustrates that the merging of life forms (as seen in the cyborg) has a long social history, despite the differences in the kinds of materials that are merged.

and continues to exist in conceptualizations of new technologies. Richard Hamilton claims that the intensity of virtual idol 'devotion' is in part caused by the 'seduction of artifice' (1997), which has several connotations. As I have argued elsewhere (Sujon 2000), the telephone sex industry incited the transformation of the Guyanese telecommunications system. Following this example, the juxtaposition of sexualized femininity and technological expansion render such technological developments irresistible. Like Eve presenting Adam with the apple of knowledge, the feminized face of technology reifies technological determinism (see chapter 3) and naturalizes embedded power relations.

Humans as 'Soft' Computers?: Eliza and the Searle Test

Thus far, I have addressed the metaphorical implications associated with some autonomous and personified technologies. Implicit within this discussion is the issue of representation. Turning to a brief history of artificial intelligence, I will briefly explore the direct intellectual and technological predecessors to software agents, which highlights questions of how to effectively represent (and codify) knowledge.

At the MIT AI labs in 1965, Joseph Weizenbaum developed Eliza, a realistic 'psychotherapist' program (Garnham 1988: 10; Copeland 1993: 12). Jack Copeland describes Eliza as a 'simple' program that can simulate human conversation to the extent that users not only became attached to Eliza, but treated the program as if it were human (1993: 14, see Appendix B for a transcript of one of Eliza's interactions).

Eliza appears to understand, perceive and comprehend the meaning of human comments. However, Eliza is based on a 'pattern matching' or 'parsing' program (Garnham 1988: 146; Copeland 1993: 42-43). Weizenbaum programmed

Eliza to identify words according to 'phrases, clauses and sentences' (parsing) and match these patterns within a response template (Garnham 1988: 146). Thus, the words and concepts invoked by Eliza do not indicate any engagement with those concepts. Rather, Eliza's use of language reflects reiteration instead of interpretation. Regardless of how Eliza simulates intelligent conversation, some users believed that Eliza was human and this belief has radical implications for assessing artificial intelligence.

Terry Winograd identifies a shift to 'knowledge engineering' in AI during the 1970s, indicating an emphasis on engineering rather than on building scientific theory (1990: 170). Thus, the emergence of expert systems and knowledge engineering signifies a shift from the first stream (understanding human intelligence) to the second stream (applying 'smart' programs). De Landa claims that expert systems are not new and are 'simply an intensification of the earlier historical project of capturing human nature in tables and lists' (1991: 175). However, Collins identifies two aspects of expert systems that are different from previous forms of 'capturing human nature':

- 1) An expert system is a computer program designed to *replace* experts in social interactions
- 2) Expert systems are largely based on the codified knowledge of human experts (1990: 77, please see chapter 3 for further discussion of this point).

De Landa supports Collins' first premise, except De Landa locates the capability of expert systems to replace humans and disembody knowledge through externalizing and codifying human practices. For example, De Landa claims that:

The removal of humans from the [military] loop acquired a new form. It was not enough to transfer control from the body to the machine, the new drive involved transferring the body's know how and expertise to a new kind of data base: the knowledge bank (1991: 169).

Expert systems are produced by creating vast databases of highly specific knowledge and explicit rules. In order to create MYCIN (a diagnostic program), knowledge engineers had to interview medical 'experts' and attempt to codify as much of their relevant diagnostic knowledge (both implicit and explicit) in a way that could be transferred to a computer database (Garnham 1988: 200-201, please see Appendix B).

Expert systems function on what Copeland refers to as 'if x, then y' logic and Francis Heylighen calls 'implication' logic (1997: 12). For example, MYCIN would gather symptoms (if fever, red, itchy spots) and produce a diagnosis based on those symptoms (then Chicken Pox). Copeland claims refers to this model of knowledge as the 'data model of knowledge' (1993: 100). Expert systems are limited to micro worlds, which Copeland interprets as a sign that AI has failed. Stored data does not equal 'intelligence' and based on the 'data' or symbol processing model this failure may be attributed to a lack of a large enough database. Doug Lenat started an AI project, 'CYC,' that will determine whether the 'data model' of knowledge is correct. CYC is a 'grand-scale project involving the hand-coding of around 100 million assertions' based on 'newspaper and magazine articles, encyclopaedia entries, advertisements etc. sentence by sentence' (1993: 103). CYC has yet to come to fruition, but the premise behind it is that after a certain knowledge base has been established, CYC should be able to initiate learning in accordance with its grand database. The hypothesis is that knowledge and learning are based upon an ontological understanding of the world, and thus far, AI applications have never had access to a large enough knowledge base. If the data model of knowledge is wrong,

this means that there is more to knowledge than the manipulation of symbols (Copeland 1993: 106).

AI is a field that is less than 60 years old, yet AI has made monumental contributions to the understanding of human knowledge and knowledge processing. Many AI advocates seem to optimistically believe that machines are capable of thought despite the failure of AI to live up to grandiose claims of producing such a machine. These failures are characterized by the differences between understanding semantic systems as holding meaning and applying semantic systems as guides for communicative action or 'labelling.'

The differences between understanding and labelling is one that John Searle, a well known critic of AI, claims clearly illustrates the impossibility of machine intelligence. In order to support his argument, Searle proposed a 'thought experiment' involving a room full of people that do not understand Chinese, but have instructions that link certain Chinese characters with a certain order. The people are sequestered in a room and baskets containing tablets (or data bits) with Chinese characters that are passed to the people in the room. If the people in the room follow the instructions, they could place the Chinese characters in a logical order and return organized characters (or data bits) without ever understanding what the symbols they manipulated mean (Copeland 1993:124). In essence, the ability to manipulate symbols has little to do with the perception and / or comprehension of meaning and has even less impact on how those people in the room modify their behaviour in relation to the world around them. If Searle's convincing hypothesis is correct, the strong symbol hypothesis is false and intelligence involves more than the capability of processing labels and / or symbols (Copeland 1993: 121-132).

For Searle, intelligence is more than just labels or decontextualized data-bits. Collins follows this by identifying two models of knowledge: algorithmic and enculturated (1990: 4). The algorithmic model is based on knowledge that is easily transferable, clearly stated and relatively explicit. The enculturation model is based on knowledge that is tacit and difficult to transfer in codifiable form (c.f. autopoiesis Maturana and Varela 1980, 1987).⁴⁴ Collins claims that these two models are not mutually exclusive, in fact, combining the tacit with the explicit provides a fuller understanding of what knowledge is and how knowledge processes work (1990: 5). It is the social world that bridges the algorithmic with the enculturated and Collins uses this example to emphasize that knowledge (scientific or otherwise) is social (1990: 5). Collins has identified a very important element of intelligence that is extremely difficult for AI researchers to reproduce. Collins claims that the only way to reproduce tacit and explicit knowledge is to live. Therefore, in order to develop machines that think, we must first develop machines that *live* (1990: 8). In order to live, machines must have bodies that activate sensorial systems, capable of providing feedback between changing environments and thus rendering symbol processing a fluid, dynamic system. Current work in artificial intelligence and agent technology is attempting to build effective human-like ‘sensorial systems.’ It is improbable that software agents will successfully achieve an integrated, highly adaptable sensorium necessary for enculturated knowledge, but they have contributed to the development of context specific feedback mechanisms.

⁴⁴ Simon Penny does fascinating work regarding “kinesthetic intelligence” that combines robotics and art. See Appendix A for more details on one of his projects named Petit-Mal or see Penny’s web-site: <http://www-art.cfa.cmu.edu/Penny/index.html>).

Although the AI programs discussed in this paper are clearly not capable of living, and have no means to access the social world, enculturated knowledge or to links between the tacit and explicit, artificial intelligence and dominant forms of technology provide maps for understanding the self and its relationship to the world.

Conculsion

Aside from direct references to software agents as puppets in computing related literature (Bickmore et al. 1998: 9; Lieberman nd.), the links between puppets, automatons, the cyborg and software agents can be summarized through two key points (c.f. Suchman 2002b). First, technology in whatever incarnation, occupies the interstices between reflections of and organizing principles for, understanding the self, the social realm and the relationship between self and other. Second, there is a strong connection between the feminization of technologies and the negotiation of the desire / fear for what Halkes describes as the tension between connectedness and autonomy. The seductive, feminized and subjugated surfaces of the interface (see figures 2.3 and 1.2) represent the drive to control not just the other (as in Said's sense), but all that that is not of the self, which also incorporates the threat of losing control of reproductive power. The feminized form of software agents, and the traditionally female kinds of work that some software agents do, mark a continuity between the patriarchal sexual division of labour and conventional power hierarchies. These two elements indicate that although software agents are a brand new form of technology, they have a long psycho-social and cultural-mythic history and call into question whether new technologies are really the icons of radical cultural metamorphosis.

Chapter 3

Subjects, Objects and Technology: Towards a Social Theory of Software Agents

The history of technology can be usefully understood as a history of fundamental questions about the nature of humankind. Thus, new technologies with purportedly human capabilities often give rise to renewed questions about what it is to be human (Grint and Woolgar 1997: 4).

In our societies, there are two systems of appeal: non-human and super-human, that is machines and gods (Latour 1988: 304).

The issues that divide or unite people in society are settled not only in the institutions and practices of politics proper, but also and less obviously, in tangible arrangements of steel and concrete, wires and transistors, nuts and bolts (Winner 1999 [1980]: 33).

There are many possible theoretical approaches that would facilitate a sociological understanding of software agents. However, in accordance with the lack of sociological analysis on software agents and the rampant technological determinism within the literature on software agents, I have chosen to base this chapter on two general theoretical paradigms: technological determinism and social constructionism. I will augment this analysis by briefly including cyberfeminist theories, feminist epistemologies and actor-network theory (ANT). The key objectives of this chapter can be summarized in two general points. Firstly, I aim to demonstrate my facility with critical sociological theories and secondly, I will interrogate what social theory can contribute to understandings of technology and software agents. At first, I had hoped to develop a theoretical corpus for thinking about software agents. However, while conducting my research, I have realized that this is an untenable goal, particularly within the confines of this paper. Instead, I will

synthesize key theoretical tenets in order to advance sociological thinking about software agents.

In part, I have chosen to look at technological determinism in order to challenge the conflation of technological innovations with linear social progress. Software agents provide the vehicle for exercising this challenge. It is not part of my objective to posit new solutions to long standing debates and theoretical inconsistencies; rather, my first intention is to situate current theoretical work within paradigmatic contexts and identify the persistence of fundamental underlying questions.

Following this general theoretical review, I turn to technological determinism, in order to identify how the software agent field and technical discourses present determinist and essentialist assumptions. Namely, problematic understandings of the social raise issues in relation to labour: particularly the technological replacement versus extension of human capacities. Finally, I critique technocentric thinking and highlight embodiment as a central, although implicit, element of deterministic and constructionist thought.

Cyberfeminism and feminist epistemologies offer interesting insights and critical points regarding issues of embodiment and situatedness. Cyberfeminism is placed as a segue way between the discussion of technological determinism and social constructionism because it is widely acknowledged as borrowing tenets from each perspective. I explore these tensions and emphasize what feminist epistemologies and the figure of the cyborg contribute to an analysis of software agents. Exploring situated knowledges and issues of embodiment facilitate a brief exploration of some of the fundamental premises of social constructionism and the

social shaping of technology. Issues of embodiment raise subject/object relations, and critically engaging actor-network theory provides several critical analytical points regarding the immutability, interactivity and mobility of software agents.

Introducing Select Theoretical Paradigms: Epistemological Envelopes

In tandem with the growth of information and communication technologies, computer mediated communications and software agents, there has been an increase in popular and academic discourses addressing the significance of technology. In sociology, such discourses are, in part, constituted from major theoretical approaches which I have positioned in the following diagram:

The above diagram provides an overall theoretical schema and situates the work of a number of different scholars along common intellectual foundations. Of course, this schema is intended to indicate general categories and does not define absolute theoretical limitations, as illustrated by the considerable overlap between theoretical approaches. In contrast to the above diagram, the bulk of this literature tends to be classified along four major theoretical traditions: technological determinism, social construction of technology (SCOT), critical theories of technology and political economic approaches to technology.⁴⁵ Unfortunately, feminist theories do not constitute a major categorical axis in standard categorizations. Although the omission of feminist approaches may reflect the subsumption of feminist approaches into other disciplines, it appears to more aptly reflect the academic ghettoization of feminist work. This may, in part, be a result of the mistaken assumption that feminism like gender or women's studies, only deals with women and / or is no longer relevant (c.f. Martin 2002: 12). Nonetheless, the diversity of approaches within feminist work places such analyses within all of the above categories, highlighting the flexibility and breadth of feminist work. The central aim of the above diagram (and of this chapter) is to illustrate key areas of social thought regarding the relationship between technology and society.

I have chosen to present these views along a triad (technological determinism, social constructionism and political economic theories), in part, to challenge the dualistic nature of the underlying philosophical tenets of these theories. These underlying dualisms have been primarily classified as free will versus

⁴⁵ This classification system is taken from Dwayne Winseck's course on *Technology, Culture and Society: 27.593* (2000) and mirrors course outlines from a variety of other university courses addressing similar topics (c.f. Keel 2000).

determinism (Woolgar and Grint 1997: 68), structure versus agency,⁴⁶ mind versus body (Suchman 2002b), hardware versus software (Penny 2000: 401) and utopianism versus dystopianism (Kling 1997).⁴⁷

Rob Kling argues that these dualisms constitute “epistemological envelopes” in the form of theoretical genres that “limit the kinds of ideas that can be readily examined” (1997: 21).⁴⁸ Randall Whittaker clarifies this point with his critique of the binarized ‘object of inquiry’ within Western philosophy, which leads to a

fetish for fixity [which] has historically led to prioritizing one of two foundations. Choosing the body (the material, the objective) leads in the extreme to a position of philosophical realism. Choosing the mind (the abstract, the subjective) leads in the extreme to the opposite position of philosophical idealism. These polar positions are twin horns of the dilemma for cognitive science – these extremes ...both take representation as their central notion: in the [realist] case representation is used to recover what is outer; in the [idealist] case it is used to project what is inner” (Whittaker 2001).

Additionally, a significant portion of feminist work has been reactive, primarily focused on disputing hegemonic, patriarchal assumptions in order to re-place women

⁴⁶ Cybernetics and autopoietic theories provide very interesting attempts to break from these kinds of underlying paradigms. For example, “Varela et al. reject Cartesian dualism because it has forced Western philosophers to postpone addressing experience until both the mind and body involved in experiencing have themselves been analyzed. Such analysis is necessarily hampered (if not prevented) by the fact that the segregation of mind from body leaves two competing starting points from which to proceed. Varela and his co-authors term the resulting malaise *Cartesian anxiety* – an overwhelming desire for some fixed ontological reference point, and a corresponding dread of the chaos presumed to be the only alternative” (Whittaker 2001). Unfortunately, I cannot incorporate a systematic or comprehensive analysis into this research project, even though an analysis of software agents in relation to both of these theoretical frameworks would certainly be relevant and thought provoking.

⁴⁷ However, Zoë Sofia critiques the “oversimplification” of human / technology relationships to the technophilic / technodystopic binary (1995: 148). This is a critical point, but this binary is continually reflected in the literature.

⁴⁸ For example, 8 months into my research, I realized that many social theories of technology revolve around identifying how technology may or may not influence social transformation. As a result, my work on software agents was substantially motivated by trying to critique the conflation of progress, technological innovations and cultural transformations. In short, the mythic and ideational continuities identified in chapter 2 appeared to significantly overshadow unsubstantiated claims that new technologies are equivalent to new cultures. However, the realization that my research objectives had been substantially influenced by technological discourses revolving around implicit notions of social change, meant that my approach had been conditioned by these discourses, rather than on direct observations.

in the territory defining what (and who) should be included in analytical contexts and how those processes of (scientific and knowledge based) inquiry are enacted.⁴⁹

Thus, Kling precisely targets why it is so important to identify the general scope of such central theoretical paradigms. Despite the power of technological innovations to fundamentally alter popular metaphors used to understand human nature, the self and social relationships, the discourses addressing the relationship between technology, society and the self follow historical and philosophical trajectories. Frequently, new technologies are bathed in hyperbole that masks the continuity and historicity of these trajectories (see chapter 2).

For example, a substantial portion of popular and academic technological discourses revolve around what is new and includes speculations on the potential for technology to induce individual, relational and cultural transformations. Additionally, many claims relating the emergence of 'new' subjectivities, narratives and the reconfiguration of relationships related to computing practices seriously lack a substantive understanding of what, exactly, such changes would or could include. Amidst the vast plethora of sociological material addressing technology, media and communications and computers, there is next to nothing on software agents specifically and an almost unmanageable number of texts on technology in general.

It is for these reasons that software agents need to be addressed within the larger sociological context of technological discourses. Although each of the above

⁴⁹ Thomas Laqueur offers an excellent illustration of an 'epistemological envelope' in his book *Making Sex*. Laqueur argues that Galenic models positing that there was only one sex (where females were immature, not yet fully developed males) continued to exist well into the 19th century, despite the anatomical evidence refuting this belief. Laqueur argues that this belief structured medical observations, diagnoses and understandings of the body (1990). From a feminist perspective, the persistence of the 'one-sex model' reflects the systemic dismissal of women as unworthy of inclusion in the realm of knowledge production and analytic processes. Kuhn's analysis of paradigms also illustrates how epistemological envelopes may limit the scope of intellectual explorations.

theoretical approaches problematize a series of social relations that hinge upon whether technology transforms, concretizes or perpetuates social patterns, trends and actualities; it seems that with the exception of constructivism and actor-network theory (ANT), each fundamentally re-addresses one of the biggest debates in sociology, the structure versus agency debate. Like most polemical debates, the question regarding which element occupies the most influential and prevalent role in human behaviour is not only impossible to answer but can also be tiresome and intellectually distracting.⁵⁰ However, it is important to recognize that the structure versus agency / free-will versus determinism debate repeatedly appears at the foundation of new work, academic research and the “cyberbole” of industry (Featherstone and Burrows 1995: 8, c.f. Stewart Millar 1998 for an interesting analysis of *Wired* magazine). I raise this point to emphasize that discussions of technology take place within ‘epistemological envelopes’ constrained by questions of what constitutes the greater influence over subjectivities and social organization, which can more concisely be expressed as the structure (as technology) versus agency (as subjectivity) debate.⁵¹

⁵⁰ For example, feminist studies of the sex industry have largely revolved around whether the processes, systems and events within and related to the sex industry are good or bad. The structure / agency debate has many corollaries in the nature versus nurture, individual versus society, mind versus body and the micro versus macro debates. I am not attempting to argue that explorations into these questions are without merit, merely that these questions have been addressed at great length elsewhere and hold no real relevance for my work here.

⁵¹ Anthony Giddens’ theory of structuration is beyond the scope of this research project (see Layder 1994, Outhwaite 1990, Jessop 1996, Giddens 1976, 1987 for more information on structuration and the structure / agency debate). However, Giddens’ term ‘instantiation’ appears regularly in the literature on software agents. In contrast to his premise that instantiation refers to the mutually constitutive relation between structure and agency, those in the computing fields tend to use this term to convey the “carrying out” of an action by an agent or program (Mantovani 1996: 258 ff).

Understanding the Relationship Between Technology and Society: Technological Determinism, Cyberfeminism and Social Constructionism

If we go back far enough, we find that the first acts of civilization were the use of tools, the gaining of control over fire and the construction of dwellings. Among these the control over fire stands out as a quite extraordinary and unexampled achievement (Freud 1962).

Technological Determinism

The absence of social analyses in technical and computing related discourses contributes to a latent understanding of technology as the primary determinant of social organization and behaviour. This determinism is frequently rearticulated in social analyses. For example, Manuel Castells claims that new technologies have incited “new cultures” and his perspective⁵² exemplifies a broad range of academic and popular discourses claiming that we are currently undergoing social changes akin to the industrial revolution (2001: 102, 112, Haraway 1991). The notion that technology independently incites radical social change and human progress is ultimately characteristic of deterministic viewpoints. Generally, these views are classed as technologically determinist because they view technology as developing autonomously and as providing the causal factors structuring major social changes, including individual and social human behaviour.

Social and cultural organization, in this context, results from the external development of technology and is clearly visible as distinct from social, economic and cultural factors. Identifying these deterministic tendencies within computing related literature is a relatively unsophisticated task, and one I will not thoroughly pursue because the themes within social constructionist literature are far more helpful for

⁵² Castells summed up his ‘soft’ determinism during a recent conference called ‘Networked Worlds’ when he asserted that those studying technology must “leave ideology where it belongs in social battles, and out of the realm of research and analyses” (June 1st, 2002, Kingston).

interrogating the social implications and meanings of software agents.⁵³

Nonetheless, it is worthy to explore some of the determinist assumptions in computing related discourses in order to identify central problematic issues associated with agents.

For example, Patti Maes, one of the pioneers in software agent development, closes an introductory article on four agents she is working on in MIT's prestigious media lab with a series of "open questions for future research" (1996). These questions include interface design issues, whether or not agents should collaborate or work independently and if 'personification' (or anthropomorphic representations) should be applied to agent interfaces. Maes briefly explores a few "algorithmic and technical questions", which from a sociological perspective, address an array of critical concerns developing in tandem with the web, the information economy and new technologies. Some of these concerns include the implications of interoperability, infrastructural design (access and usability), privacy, surveillance, legal accountability - and by inference - the problems associated with regulation, identity, power dynamics, and potential effects on social cohesion, groups and experiences of community. Of course, from a technical perspective, as characterized by Maes' approach, these questions are focused on developing functional programs that translate into innovative technological applications (c.f. Brenner et al. 1998: 302-304).⁵⁴ If the 'social' is mentioned, there is a general tendency to do so only to

⁵³ Additionally, the implications, processes and connotations of technological determinism have been well documented through case studies (Stewart-Millar 1998; Ruhleder 1995; Berg 1999), feminist critiques of technology and science (Adam 1998; Fox-Keller 1996, Code 1995, Campbell 1998; Markussen 1995; Berg 1999; Hoffman 1999) and the social sciences.

⁵⁴ For example, Maes asks readers to consider the following questions for the future: "Should there be one or many agents? Should agents use facial expressions and other means of personification? ... Other questions are more algorithmic and technical: How can we guarantee the user's privacy,

infer some kind of exchange (e.g. “social filtering” Maes 1996)⁵⁵ and to identify the social realm as consisting almost entirely of economic and psychological obstacles blocking the way towards the mass acceptance and commercial proliferation of software agents.

The potential implications, changes to or reconfigurations of the social, ethical, political, economic, cultural and individual spheres are not only ignored in a significant proportion of the technical literature; but if they are acknowledged it is only to be most often dismissed as irrelevant or as outside the limits of the field (Pham and Karmouch 1998; Konstantas and Morin 2000; Kephart et al. 2000; Papazoglou 2001; Maes 1996). The complexities associated with this conceptualization of the social realm illustrate the importance of translating computing related work into a sociological frame. For example, echoing Michael Wooldridge and Nicholas Jennings⁵⁶, two pre-eminent authorities on software agents, “agent theories are essentially [technical] specifications” and reflect the field’s theoretical standards (c.f. Kling 1997: 42-43). As Giuseppe Mantovani argues, critical work needs to be done in order to address “the persisting gap between social and technological dimensions in computer systems design and use” (1996: 237). As Gary Marx claims, software designers, engineers and computer scientists tend to

especially if agents communicate with one another about their users? How can heterogeneous agents, built by different developers and using different techniques, collaborate? How can a system of incentives be devised, so that users are motivated to share the knowledge their experienced agents have learned? Most importantly, from a legal standpoint, should a user be held responsible for his or her agents’ actions and transactions? (1996).

⁵⁵ According to Maes, ‘social filtering’ refers to the process of exchanging user recommendations (for music preferences as seen with Firefly, or sources of preferred news content as seen in NewT) between autonomous agents (1996).

⁵⁶ Nicholas Jennings and Michael Wooldridge are computer scientists who have been responsible for organizing a number of agent based conferences, numerous publications and prestigious working groups (e.g. Agent Link, the ATAL annual conferences on autonomous agents) (see also their home pages: <http://www.ecs.soton.ac.uk/~nrj/>, <http://www.csc.liv.ac.uk/~mjw/> 2002).

focus on questions of how rather than why (1997: 49), thus highlighting an absence of critical social analysis.⁵⁷

Such problematic conceptualizations of the social lead to one of the most endemic flaws characteristic of deterministic assumptions, namely attributing social processes, changes and organizational trends to technological innovations. For example, Pascal Petit illustrates this assumption when he posits that ICTs are central to both the tacit development and actualization of the knowledge based economy (KBE):

The very essence of technological change [is] linked to ICTs. Such technologies bring together, interlink, preserve, and complement human knowledge. Doing so, they help automate old routinized tasks and develop new tasks. Some of these new tasks echo the past automation of production processes, going one step further with automated controls of production flows and breakdowns Other tasks correspond to more innovative uses, leading to new practices and elaboration of new knowledge, both tacit and codified (2000: 196-197).

The assumption here is that technology is directly linked to “new knowledges,” practices and exciting kinds of new labour, in contrast to the ‘old’ which implies boring, repetitive and in need of some kind of redeeming technological make-over. The degree to which Petit’s claim appears to simplify the complex relationship between change, technology and social relations masks the conflation of autonomous technological innovation and the emergence of ‘new knowledge.’ The

⁵⁷ However, Michèle Martin observes that a significant portion of feminist work in communications also concentrates on questions of “how gender discrimination is experienced,” unfortunately sacrificing critical analyses of why gender discrimination exists (2002: 3). Additionally, Susan Leigh Star and Geoffrey Bowker’s work on categories and standardization is of particular importance, not only in relation to differences in the analytical perspectives promulgated by each respective discipline, but also has interesting implications when thinking about how standardization relates to software agents, artificial intelligence and computerization. Unfortunately, space limitations restrict the inclusion of their work in my analysis of software agents and will have to remain a goal for future work.

connection between the implementation of ICTs and the institutionalization of a KBE remains unarticulated.

Petit indirectly argues that technology has direct and transparent effects on individuals, which culminate in political, social and economic changes. Petit ignores human agents in his discussion of the relationship between ICTs and the KBE, and does not critically address the material connection between social knowledge and the social construction of technology. The contexts leading to why particular technologies work best in relation to particular forms of work and practices are deemed irrelevant and social behaviours are portrayed as solely dependent upon technological innovations and structural forces.

The technological determinism represented in Petit's argument is emblematic of a significant portion of discourses addressing the ICTs and the emergence of the KBE:

Like electricity and steam power, ICTs are general-purpose technologies (GPTs) that are pervasive and according to Lipsey (1996), bring with them deep structural adjustments (DSAs). [These] new technologies are a catalyst of change in employment patterns (Gingras et al. 2000: 234; c.f. Lipsett 2000, Jensen et al. 2001).⁵⁸

Employment patterns are important in relation to software agents, particularly because many software developers maintain that information gathering, interface and mobile agents will replace particular kinds of mundane (or as Petit would describe it) 'old' labour (Foss 1998: 105-123; Kearney 1998: 129; Schneiderman 1997: 100-101; Maes 1996; Lieberman 2002, see chapter 4 for more on boundary

⁵⁸ Vincent Mosco counters this claim by situating recent work on cyber-education in the context of three general research findings: "First, most of it takes place in the developed world; cyberspace is empty space for most of the world's people. Second, in the West the emphasis is primarily on technical education, on teaching people how to use technology. Third, where attention is paid to content, most is directed to teaching people how to be consumers of products and services" (Mosco 2000: 377).

work). Such claims have deep resonances within long-standing debates regarding the power of machines and where exactly the boundaries between humans and non-humans can be demarcated.⁵⁹ For instance, whether technologies provide a forum for augmenting or 'extending' human capacities (McLuhan and McLuhan 1988: 94-117) or whether machines force humans to internalize machinic practices in their relationships (Marx 1970: 339-427) comprises a central question in social analyses of technology. Judy Purdom summarizes Marx's position on technology cogently when she states:

The closed system of State capitalism means enslavement to the economic and the homogenization of [wo]man as a relation of production. [Wo]Man, as a social production is thus reduced to a mechanistic component of labour; [s]he is dehumanized (1997: 118).

Regardless of what the 'correct' answer may be, it is important to note that both positions place technology at the center of social relations. The main problematic challenges whether technologies constitute us or we constitute them.

Returning to Harry Collins' claim that artificial intelligence programs or expert systems are unique technologies because they augment human nature by *replacing* experts and computerizing expert knowledge (see chapter 2; 1990: 77), we find tendrils of technological determinism. For example, Collins is claiming that expert

⁵⁹ Karl Marx, in response to the industrial revolution, argued that the individual's relationship to the means of production, structures the socio-political contexts from which society, class structure and the individual is fashioned. In other words, capitalist society is divided into two main classes (the proletariat and the bourgeoisie) based upon the ownership of private property (in the case of the means of production, such as factories, this would include the bourgeoisie). For those who don't own the means of production, the proletariat, personal labour, and thus one's life essence, must be transformed into a commodity in order to garner the means of economic support and perpetuate the profits of the upper classes. These conditions establish an oppressive system marked by the exploitation and alienation of the workers and the perpetuation of greedy bourgeois values and lifestyles; a system which would continually be manifested in the form of class struggle. Although Marx has written many prolific texts on capitalism, the most relevant point (in relation to this chapter) is the connection between the means of production (meaning the available technology and the way those technologies are organized) and economic, social and political structure (Bottomore 1994: 365). The connection Marx draws between technology (or the means of production) and socio-economic structure has led many theorists to classify Marx as a technological determinist.

systems (and by extrapolation, AI projects and software agents) are unique among industrial, computing and tool technologies because of both the embedded human knowledge and substitutive capacities built into such projects. However, Collins' point comes into question when considering how human knowledge is implicitly invested in 'simpler' technologies such as pre-historical etched tools dating from the Mousterian age,⁶⁰ or say the telephone⁶¹. Additionally, an expert is an expert by establishing socially recognized and legitimated spheres of authority within a particular knowledge community or realms of praxis.⁶²

Nonetheless, Collins' claim is representative of a broad range of the literature on software agents, artificial intelligence and computing. As I discussed in chapter 2, early artificial intelligence projects codified specific knowledge processes rendering them explicit for the first time. The articulation of those knowledge processes is certainly new, however, technologies have a long history of drawing out new metaphors for understanding the self, relationships and society. In this sense, Collins is recognizing a reincarnation of historically rooted responses to new

⁶⁰ As physical anthropology has determined, making and implementing stone tools involves sophisticated techniques that represent a whole series of behaviours, knowledges and practices, and is ultimately representative of cultural ideas and social relations (Smith 1997). However, what those practices may be and how tool technologies relate to or represent those social relations constitutes enormous debates within anthropology. For example, Melanie Wiber argues that within "origins research," tool-making practices provide the definitive yardstick for measuring evolutionary progress (1997: 178-188). Yet the anthropological definition of 'tools' mirrored modernist gender hierarchies by equating 'tool' (and thus evolutionary progress) with what was/is assumed to be essential male practices (i.e. hunting and fighting).

⁶¹ Bruce Mazlish problematizes the distinction between tools and machines when he states, "Tools are the first primitive form of machines. By a tool, we generally mean an instrument, such as a stone chip or a hammer or a saw, worked by hand. By a machine, we generally mean a more complicated apparatus, an assemblage of parts acting together for a common purpose. Karl Marx tried to distinguish between the two on moral grounds: the tool extends our personal power; the machine subjects us to its impersonal organization" (Mazlish 1993: 59).

⁶² For an elaborate critique of both human experts and the socially constituted processes of exercising and legitimating expertise see Richmond Campbell (1998), Evelyn Fox Keller (1996) and Lorraine Code (1995).

technologies, or the expression of new technologically mediated metaphors (for Collins, this would be the expert system and disembodied knowledge practices).

Although I will address boundary or 'internetworkers' and the issue of technology replacing humans through automated or technologized labour in chapter 4, it is important to point out that most computing based discussions of software agents and technology in general is presented as at least enhancing human potential; if not completely capable of replacing humans (c.f. Witheford 1994; Caffentzis 1998; Halberstam 1991). For example, the claim that software agents can affordably, effectively and conveniently replace human labour and activities, acts as major argument and justification for the development and commercialization of agents (Jennings and Wooldridge 1998: 10-18; Kephart et al 2000: 734-735; Maes 1996; SANDi 2002).

The idea that technology can substitute human labour or action betrays a latent essentialist functionalism, where human complexity can be reduced to a series of explicit performances, namely quantifiable outputs and measures of productivity.⁶³ Thus, addressing the potential for technology to provide extensions versus substitutions of human capacities fundamentally challenges the distinction between subject and object, human and non-human. However, it is important to point out that some forms of human labour have been replaced by processes of mechanization (most notably, with the emergence of industrialization and the assembly line) (see Bellec's discussion of 'virtual factories' 1998; and Caffentzis 1998; Hartmann et al.

⁶³ Early AI debates regarding knowledge representation reveal the extreme difficulty of constructing applications that can mimic basic human functions like walking, talking and learning versus the comparative ease of computerizing explicit knowledges as seen in expert systems (see chapter 2).

1986).⁶⁴ The question remains whether human labour is replaced or transformed? Automating repetitive tasks does not necessarily replace human labour, as simplifying and automating tasks also means reducing implicit aspects of that task and transforming its nature (Suchman 1999; Markussen 1995; Ruhleder 1995, see chapter 4 for further discussion of this point). Following Hartmann et al., the replacement of some forms of labour is frequently associated with the growth of new kinds of work; indicating that forms of employment are frequently transformed in tandem with the forms of communication enabled through technological developments.

In part, the argument that particular technologies lead to particular social forms and kinds of social relationships is frequently conflated with essentialist understandings of gender, class, race and culture. For example, Mantovani uses flirting to provide a model for understanding “both ambiguous environments and dubious actors” in relation to developing a viable negotiation framework in computer-supported cooperative work (CSCW) (1996: 239). This metaphor exposes assumptions about very specific gender roles (e.g. the author positions himself as both user and subject and the blonde with long hair and “charming smile” is positioned as object) (1996: 248). The “natural” metaphors, taxonomies and

⁶⁴ I suggest these references, first, because Bellec's work suggests that current research is exploring new possibilities for the computer assisted automation of factories in totality. Further, Hartmann et al. argue that “tabulating machine operator[s], mimeographer[s], and key punch operator[s]” have been rendered obsolete by technological changes and contingently both book keeping and stenography are in decline (1986: 172). Second, because Caffentzis' offers a provocative critique of Jeremy Rifkin's *The End of Work*, where he argues that Rifkin's technological determinism neglects “the dynamics of employment and technological change in the capitalist era” (1998: 4). Additionally, Caffentzis problematizes labour categorizations (agriculture, production and service) because these categories do not address un-waged work, tend to conflate overlap between job functions and further claims, that human labour can never be entirely replaceable by machines (1998). As an anecdotal example, the Dutch have created ‘restaurants’ consisting entirely of automatic vending machines, yet, these ‘restaurants’ are relatively scarce in number and in no way provide a substitute for restaurants run by human cooks and servers.

classifications invoked by a variety of software agent developers juxtapose technological innovations with scientific authority and biological certainties (Jennings and Wooldridge 1998; Bradshaw 1998; Franklin and Graessler 1996; Shen and Norrie 1999).

Nicholas Negroponte further illustrates how socially rooted subjective positionalities are embedded in the conceptual and technical design of software agents. Negroponte argues that software agents should fundamentally be able to provide subservient labour in the form of submissive “digital butlers”; however, Negroponte uses his anecdotal experience with a prospective investor’s incredibly skilled and effective personal assistant to illustrate the benefits of having a digital butler (1997: 58-59).⁶⁵ Negroponte’s metaphor reflects an obvious upper-class position, one that Cynthia Cockburn would refer to as emblematic of the “pre-existing pattern of male [and economically privileged] power” (1999: 190). Ignoring the “situated” social location of those that control the design and development of technological applications facilitates understandings of technology as a neutral, autonomous and pervasive social force (c.f. Haraway 1996; Suchman 1987).

Cyberfeminism and Feminist Theories

Women can be trained to do any job you’ve got – but remember ‘a woman is not a man;’ A woman is a substitute – like plastic instead of metal.
(From a 1943 booklet for managers entitled *You’re Going to Hire Women*, cited in Light 1999: 482).

⁶⁵ Negroponte describes how the personal assistant acted as not just a translator between himself and the potential investor, but also filled his employer’s lengthy conversational gaps. Thus, the personal assistant translated language and very minimal behavioural cues (on the part of his employer). Effectively, the personal assistant performed more labour in the interaction than did the potential investor.

One of the fundamental issues for cyberfeminists and feminist epistemologies relates to embodiment, particularly, whose bodies are positioned in what social contexts and how such positionalities reflect socio-political hierarchies. In contrast to Negroponte's privileged position, Donna Haraway eloquently critiques what she describes as the "view from nowhere":

Objectivity turns out to be about particular and specific embodiment and definitely not about the false vision promising transcendence of all limits of responsibility. The moral is simple: only partial perspective promises objective vision. All Western cultural narratives about objectivity are allegories of the ideologies governing the relations of what we call mind and body, distance and responsibility. Feminist objectivity is about limited locations and situated knowledge, not about transcendence and splitting of subject and object (1996: 254).

Haraway's argument highlights several problems regarding embodiment, and in relation to software agents, the relevant issues include whether agent technology can replace particular forms of embodied labour. The software agent literature tends to continually concentrate on agents' potential to do exactly that: effectively automating embodiment and the functional performativity of embodied practices, particularly through the replacement of labour.

Nonetheless, amongst the multiple functions of the body, it also acts as a container for the self. Some theoretical assertions situate people as relatively empty containers, devoid of agency and subject to the easy manipulation of structural forces. For example, Nicola Green accuses feminist theorist Cheris Kramarae and renowned techno-utopic, Jaron Lanier, among others, of making the mistake of analysing VR and new technologies through a "conduit metaphor" (1997: 62). Although Kramarae and Lanier argue very different positions, Green is targeting the premise that such technologies are pictured as static vehicles for 'singular

messages' and overlook the "interpretive capacities of individuals" (1997: 62-63). Green's critique is widely applicable, particularly in relation to Petit's argument (and other technological determinists), because ICTs are portrayed as the dominant vehicle inciting political, economic and social change, or what he refers to as "deep structural change," that is in part expressed through changes in employment patterns.

Green raises a fascinating yet highly controversial point. Although it seems to be widely accepted that structure and agency are recursive and precipitate a 'both/and' conceptualization, Green's question re-poses this debate along terms of each sphere's 'degree of influence.' Is the individual capacity to re-configure meaning more or less influential than pre-existing normative practices and belief systems? For social constructionists and feminists alike, the point is to situate the array of complex factors culminating in social phenomenon, rather than reducing such phenomenon to the effects of technology. Although Green criticizes Kramarae for positing that the "dominant social and cultural ideas about gendered human bodies will simply be transposed and re-enacted" (1997: 62) through new technologies, much of feminist thought critically addresses how this process occurs (Adam 1998; Hayles 1999; Balsamo 1995; Martin 1991, 1996; Code 1995; Campbell 1998; Haraway 1996).

To return to the issue of embodiment, many feminists ask where, what, how and whose bodies are involved in knowledge production, legitimation and validation (for example). Lorraine Code contributes to the discussion by arguing that scientific 'objectivity' has a layered social significance beyond scientific practice. What objectivity implies (and applies) is a condition of knowing that any knower can

achieve, that is, because knowers are objective - there is a common ground from which to know.⁶⁶ This ground means that the quality of knowing does not rest within a particular body, person or set of experiences. Rather, knowledge is extra-social and anyone following objective methods can stand in, or become what Code refers to as a “surrogate” knower. In essence, the construction of a ‘universal’ knower implicitly posits a universal ground for a universal and detached knowledge which erases the connection between ‘power and knowledge’ (1995: 16).⁶⁷

In this sense, Code problematizes the ‘neutral’ structure of the “conduit” (or what some would call a ‘black box’) – regardless of whether that conduit applies to scientific, technological or social knowledge. And the conduit argument begins to crumble when considering Code’s argument about the “invisible mechanisms” (or tacit processes) that perpetuate and continue to build the power structures / hierarchies responsible for producing and validating knowledge and everyday phenomenon (1995: 20).⁶⁸ Code claims feminists must challenge both the explicit

⁶⁶ Susan Leigh Star provides an interesting application of this argument in her discussion of the assumptions embedded in being “homed” (1995: 23-26). Star highlights how having a home ensures a degree of stability necessary for securing economic and basic living resources (e.g. food, shelter, clothes and tools); provides the necessary foundation for acquiring identification, bank account, social security numbers; and protects one from the threat of possible arrest and police persecution by enacting “bodily functions” (e.g. “sleeping, passing waste”) (1995: 25). Star’s example effectively demonstrates the pervasiveness of positionalities that are disguised (and/or ignored) by social norms, standards, expectations and assumptions. For further critiques of objectivity in science studies see Theodore M Porter’s *Trust in Numbers* (1995), Lorraine Daston’s ‘Objectivity and the Escape from Perspective’ in *Social Studies of Science*, v 22, (1992), pp. 597-618 and Phillip Prodger’s ‘Illustration as Strategy in Charles Darwin’s “The Expression of the Emotions in Man Animals,”’ Timothy Lenoir (ed.) *Inscribing Science: Scientific Texts and the Materiality of Communication*. (1998) Stanford UP: Stanford, pp. 141-181.

⁶⁷ Code claims that this ‘universal’ ground / knower / knowledge implicitly establishes a social code that places anyone or any group outside of these universals as ‘special’ interest, unique and even as abnormal (such as women, blacks, gays, poor - to name a few) (1995: 16). In order for these ‘outsider’ perspectives to come to view, they must be re-attached to political agendas that contradict the ‘objectivity’ or hidden socio-political agendas of mainstream ways of knowing (1995: 17).

⁶⁸ Code concretizes her discussion of what is tacit or invisible by looking at what (or who) is not present in objectively determined knowledge by introducing the example of medical and scientific research. Code observes that “women and other socially disadvantaged groups” are not present in medical or scientific research as exemplified in the case of ‘syndrome X’ (1995: 20 - 22). Syndrome X

(or formal and authorized) processes as well as the *latent* processes that construct explicit knowledge forms.⁶⁹ Knowledge and observation, like technology and praxis, are thus embedded within frequently invisible (or ignored) webs of authority and expertise (1995: 28).⁷⁰ Objectivity, like the myth of technological neutrality, masks the complexity of how such webs are actualized and perpetuated.⁷¹

Amidst the abundant number of feminist theorists, the unifying goal is to situate varying phenomenon within a concrete political context, frequently marked by a set of guidelines feminists must work towards in order to counter political, social and economic inequities (Arzipe 1999: xv-xvi; Haraway 1995; Code 1995: 33-36; Stewart Millar 1998). Situatedness, in this sense, can be seen through the capacity for pervasive metaphors to emerge from and perpetuate the reification of socio-economic and cultural norms. In relation to this political focus, Donna Haraway

highlights two things. 1) The importance of textbook knowledge in the diagnosis and treatment of illness and disease and 2) the androcentrism behind the construction of textbook subjects / knowledges (1995: 22). In the case of syndrome X (and the majority of medical and scientific research), the universality of both the objective subject and knowledge of that subject is based on a privileged core of generally "white, adult, usually well-fed" men.

⁶⁹ Albeit, Code makes this claim couched in another disclaimer (these processes are not the result of a conspiracy that explicitly privileges men over women, queers or blacks - they are the result of complex systems of socialization and knowledge valuation) (1995: 24).

⁷⁰ David Bloor's article, 'The Strong Programme,' further explores the patriarchal language used to formally and informally discuss bombs and military technology and concisely illustrates this point. For other examples, please see Hoffman (1999: on the relation between gender and the development of the graphical user interface); Balsamo (1995: on the gendered notion of 'disembodiment' in cyberspace, particularly the primarily male tendency to escape the material confines of the body through cyberspace; cf. Adam 1998: 169 ff.); and Martin (1991: for a critical analyses of how gender was imbricated with not only the development and institutionalization of the telephone, but also in developing the telephone's primary public and private purpose).

⁷¹ For a critical analysis of the relationship between technology and science, please see Wajcman and MacKenzie (1990; c.f. Vincenti 1990; Shapin 1972). Basically, Wajcman and MacKenzie argue that technology has a greater influence upon scientific practice than vice versa. Additionally, Allison Adams points out that there is a hole in feminist work regarding technology, and this absence leads to an emphasis on the science part of 'computer science' (1998: 17). However, David Hakken argues that computer science has an 'artificial' object of knowledge, and this calls into question computer science's status as a natural science (1999: 13). Hakken's point illustrates that there is authority invested within computerscience as a discipline, even if a large proportion of that authority stems from being associated with the authority of the natural sciences. Finally, Adams asserts that because the "wider disciplines of social science studies of science and technology have developed in parallel and learned from each other," it is a good idea to incorporate feminist work on science in order to inform analyses of gender and technology.

proposed two critical concepts for feminist epistemologies, cyber studies and issues concerning embodiment. The first concept, situated knowledges, compliments Code's critique of objectivity and re-affirms the fundamental importance of linking socio-political realities with everyday praxis through an understanding of who is speaking from where. Haraway describes how situating knowledge within specific locations defined by identity, positionality and embodied perspectives develops more comprehensive knowledges than traditional 'objective' approaches:

"Situated knowledges require that the object of knowledge be pictured as an actor and an agent, not as a screen or a ground or a resource Situated knowledges are about communities, not about isolated individuals. The only way to find a larger vision is to be somewhere in particular. The science question in feminism is about objectivity as positioned rationality. Its images are not the products of escape and transcendence of limits (the view from above) but the joining of partial views and halting voices into a collective subject position that promises a vision of the means of ongoing finite embodiment, of living within limits and contradictions - of views from somewhere" (Haraway 1996: 259).

Although Haraway raises difficult questions regarding subjectivity, objectification and boundaries, the concept of "views from somewhere" is central for feminist thinking and is an emblematic current running through social studies of knowledge (SSK) and the study of science, technology and society (STS). Nonetheless, as echoed by ANT, objects must be conceptualized as sharing a realm of potential and realized actions. In other words, there is a recursivity between subject and object that must be understood via context and situatedness.

Drawing from Marxist and socialist analyses, feminist theorists almost uniformly target systemic patriarchal, socio-economic and racial inequities. Cyberfeminists build their theories within this context, yet, they also herald new technologies as a potential doorway into a technologically mediated utopia – or in

some cases – dystopia (Lykke 1996: 1-3; c.f. Balsamo 1995; Lykke and Braidotti 1996; Braidotti 1996; Plant 1996, 1997; Stone 1995). Nina Lykke situates the emergence of both ‘science/technology-as-liberating’ and ‘science/technology-as-threat’ perspectives within second wave feminism in the 1970s (1996: 1-2). Lykke attributes this to the way “fundamental metatheoretical assumptions in [science’s] strong positivist and empiricist tradition” posed feminist concerns and socio-cultural phenomenon as extraneous to scientific practices, content or interest (1996: 3-5). In contrast, Harry Braverman (1974), Juliet Webster (1995), Stephanie Stewart Millar (1998), Christa Wichterich (2000) and Heather Menzies (1996) concentrate on how new technologies are associated with the emergence of employment deskilling, devaluation and outsourcing (or off-shoring); particularly in fields of work where women significantly outnumber male workers (see chapter 4).

Haraway’s second contribution stems from her analysis of the cyborg (1990 [1985]). This work succinctly addresses the political ground upon which gendered bodies and hegemonic epistemologies battle for validation and authority. Haraway claims that the cyborg, the “cybernetic organism,” or the “hybrid of machine and organism” transgresses classic Western dualisms, such as mind – body, [hu]man – machine, male – female” (1990 [1985]: 193). For Haraway, the cyborg symbolizes the ultimate triumph over the dominance of singularities and static positions, primarily because cyborgs create a space for breaking down confining boundaries and oppressive categorizations. The cyborg is about disruption and provides an effective opening into and between the self and other, man and woman, machine and human. Haraway maintains that the cyborg “can provide a way out of the maze of dualisms” and feminists must embrace the cyborg (or the embodiment of science

and technology) in order to unleash its/our transformative and emancipatory potential (1990 [1985]: 223).

Although software agents' potential for disruption and subversion appears to be limited, the first point of comparison involves asking 'does the software agent merge body and machine'? If so, how? Like the cyborg, the software agent occupies a liminal territory, between disciplinary and self/other boundaries. However, there are some key differences. First, the cyborg is about rendering the machine interactive through the internalization of the machine; whereas the software agent is about externalizing interactivity, and directly occupies the surface of the interface. Lucy Suchman discusses applications of ubiquitous computing as the "'skin' of the migration of computing into the body" (2002b: 9). Following Suchman's argument, I propose that unlike the cyborg, the software agent represents the new 'skin' of the self and rather than a merging of machine into the body, symbolizes the externalization and extension of the self. Ultimately, *the software agent is the servo-mechanism of ubiquitous computing*.⁷² The software agent demarcates the boundaries between subjects, and the extensibility of the self into and through networks, ICTs and the ascribed power of computing technologies. In effect, the software agent embodies the computer-as-subject.

The disjuncture between the cyborg/automaton/software agent as a tool versus a mode of subjugation highlights an important controversy within discourses about machines. Yet, such questions tend to be precluded by deterministic thinking

⁷² I refer to ubiquitous computing in the same sense that Vincent Mosco describes computing as 'banal' (2002) rather than 'wearable' computing. For example, Mosco refers to the process of 'electrification' moving into the wood work, becoming embedded into the walls and the eventual mundane habituation to the stellar sense of awe, first inspired by electricity.

in computing related literature, because the relationship between technology and humanity is rarely viewed as mutually constitutive.

The response to Haraway's work has been powerful, but Steve Woolgar and Keith Grint caution social theorists to beware of the 'technicism' behind theories claiming that technology will (and does) provide salvation or create disaster (1997: 37-380).⁷³ Even aside from the deterministic foundation supporting the roots of cyberfeminist thought, it seems there has been a failure within cyberfeminism to actualize the 'transformative and emancipatory' potentialities of cyborgs and technologies. Proclaiming that liberation from oppressive systems is possible, does not change the conditions of that system. For example, Irina Aristarkhova reports on the most recent 'international' cyberfeminist conference in Hamburg. She claims that despite the 'promise of monsters' and the inclusivity incited by trespassing multiple social, cultural and disciplinary boundaries, the conference reflected a painful reiteration of traditional gendered and racialized obstacles (2002: 58-59).⁷⁴

⁷³ Technicism refers to the "enduring presumption that there is, in the end, an essence to the machine" (Woolgar and Grint 1997: 37). For example, Woolgar and Grint cite liberal feminist perspectives that claim the problem with male dominated technologies and disciplines is one of access and engagement; as soon as there are more women represented in these fields, sexism and patriarchy will subside (1997: 96). The technicism appears in the conceptualization that if people – or in this case – women, adapt to the technology, social conflicts and problems will contingently fade; thus, technology is pictured as containing a fundamental neutral essence. However, to borrow Sofia's terminology, Woolgar and Grint 'homogenize' feminist theories, and overlook a significant number of liberal feminist critiques (e.g. see Adam 1998: 19-21; Sofia 1995: 147)

⁷⁴ Another example of the cyberfeminist tendency to conflate naming with action is illustrated in Sadie Plant's article "The Future Looms: Weaving Women and Cybernetics." Plant skips between Ada Lovelace's involvement in developing the Analytic Engine and a very loose, unconvincing exploration of the historical associations between femininity and weaving (1996: 123-135; see Light 1999, for a far more critical exploration of women's role in the history of computing). In fact, Plant seems to validate and essentialize women's work (as exemplified by weaving) by claiming that because Jacquard's loom was central to the creation of the first computers, women are therefore, responsible for software programming – and by implication, their association with 'computers' redeems them from the sexist Freudian accusations of suffering from 'the void' (not having a penis) and only being capable of 'mimicry'. Plant does not convincingly illustrate the link between Jacquard, weaving and women. To further trouble her analysis, Plant unproblematically accepts the development of computer technology as a sign of social evolution, progress and is indicative of personal actualization.

Wendy Faulkner elaborates on the tension between technology-as-empowerment versus technology-as-male dominated; and although she adopts a primarily speculative and inquisitive position, ultimately argues that in order for technology to facilitate women's liberation, there must be radical transformations within science and technological practices (1996: 1-16). Additionally, Faulkner indirectly identifies the issue of control: control of the self, body, tools, space, subjectivities, objects, of time, speed and the sphere(s) within which relationships and interactions occur. The hybridized, transgressive figure of the cyborg highlights the prevalence of such boundary crises, or what Jill Marsden refers to as "cyberpsychosis," in material realms of practice and in both the individual and cultural imaginary (1999: 59-76; c.f. Shields 1996).⁷⁵ As I hope to illustrate in chapter 4, cyberpsychosis certainly appears not just in relation to the figure of the cyborg and the software agent, but also within the field of agent development.

Social Constructionism and Social Shaping of Technology

'Machines do not simply appear. People invent and shape them within a larger context, which includes visual practices and narrative strategies' (Nye 1997: 2).

In contrast to determinists, social constructionists claim that technology does not develop in a void and is influenced by the same socio-cultural, economic and political spheres that shape human behaviour (Bijker 1995, Schuler and Wajcman 1999, Callon 1988, Martin 1996, 1991, Adam 1999). As MacKenzie and Wajcman state,

⁷⁵ Jon May and Nigel Thrift refer to the material realm as the "making-living TimeSpace" and the imaginary as the "living-thinking TimeSpace" (2001: 6-37). May and Thrift conceptualize TimeSpace space as a way of re-connecting time and space beyond a one dimensional framework and break the dichotomy between spheres of temporality and geography (2001: 1-3). For further discussion on cyberpsychosis or psychanesthesia (the inability to differentiate between self and surroundings) please see Rob Shields' article *Cyberpunk Cinderella: Contextual Illness and Subjectivation* (1996).

technological change is best explained by seeing technology not as outside of society, as some versions of technological determinism would have it, but as inextricably part of society (1999: 12).

In essence, constructionists confront epistemological and practical assumptions regarding technology by examining the social relationships contributing to the development, engagement and apparent 'effects' of technology. There are three predominant theoretical streams within the genre of social constructionism: the social construction of technology (further discussed via an analysis of ANT) (Bijker and Pinch 1999 [1996]), the social shaping of technology (Wajcman and MacKenzie 1999; Wajcman 1991) and what can loosely be classified as feminist theories (Martin 1991, 1996; Haraway 1991; 1996). Social constructionists tend to position embodiment as more of a socio-material phenomenon, involving particular attention to whose bodies are involved in constructing what entities. Additionally, and by way of an introductory critique, SCOT practitioners tend to identify the 'social body' as one of the primary forces contributing to technological developments and technical artifacts. While this has significant advantages for recognizing socio-political influences, it also risks uniformly homogenizing such socio-political forces.

Both approaches target how social forces, actors and practices are imbricated within the development and social engagement with technology. The first approach (SCOT) focuses on "interpretative flexibility", namely how various groups of people will share particular understandings of a "technological artifact" that may be specific to the practices and background of the people within that group (1999 [1996]: 113). Using the bicycle as an example, Bijker and Pinch illustrate how different interpretations of the same artifact (the bicycle) influenced the development and

acceptance of that artifact.⁷⁶ While this may be a useful approach for identifying specific practices and the subtleties associated with varying engagements with technology, ‘interpretive flexibility’ faces serious limitations. One such limitation occurs if one of the specific communities under analysis is fragmented by disagreement about what ‘shared meanings’ could and should include. Thus, in order for ‘interpretive flexibility’ to be successful, these shared communities must be easily identifiable, and as a result, may perpetuate ‘differences’ across groups (e.g. women’s interpretations versus men’s interpretations). Social shaping, in contrast, names itself (according to MacKenzie and Wajcman) as such, to differentiate from ‘SCOT’ by avoiding the connotations of the social being amorphous, intangible and ephemeral. It is in this sense, that MacKenzie and Wajcman argue that social forces “shape” technological development rather than “construct”.

As the dictionary definition of technology states, technology includes social practices such as the “total knowledge and skills available to any society” (Collins 1992: 1385); yet both popular and academic conceptions of technology convey that ‘it’ is something that must be kept up with, adapted to and has powerful transformative effects on society at the local and global levels. Picturing technology as independent and autonomously developing means obfuscating how both subtle and blatant socio-cultural practices become embedded within the development and implementation of technology. Langdon Winner concisely states:

The things we call ‘technologies’ are ways of building order in our world. Many technical devices and systems important in everyday life contain possibilities

⁷⁶ For example, Bijker and Pinch argue that the first bicycle design, the ‘high-wheeler’, was considered an adventurous, racing machine by young male users, but as a dangerous, risky contraption by some women users. The different meanings ascribed to the same technological artifact influenced the bicycle’s “developmental path” and illustrates how different social groups interpret and engage technologies (1999 [1996]).

for many different ways of ordering human activity. Consciously or not, deliberately or inadvertently, societies choose structures for technologies that influence how people are going to work, communicate, travel, consume and so forth over a very long time. In the processes by which structuring decisions are made, different people are differently situated and possess unequal degrees of power as well as unequal levels of awareness Because choices tend to become strongly fixed in material equipment, economic investment, and social habit, the original flexibility vanishes for all practical purposes once the initial commitments are made (1999: 32).⁷⁷

Winner is attempting to materially illustrate the innately political situatedness of everyday technologies, with particular emphasis on how particular slices of socio-political contexts can become crystallized within technical structures. Winner is effectively targeting a central issue within the social science literature: the complexity of the relationship between technology and social relations. The key point is to deneutralize technology and critically address the complex of factors involved in socio-technical change by recognizing that social context and technology “are mutually constitutive” (MacKenzie and Wajcman 1999: 23). In other words, “some technologies are, in given social circumstances, *more compatible* with some social relations than with others” and noting such compatibilities and continuities provides a crucial basis for thinking about technology (MacKenzie and Wajcman 1999: 5).⁷⁸

It is important to note that according to Donald MacKenzie and Judy Wajcman, Winner was among the first to challenge technological determinism, and thus, his argument concerning social contexts has been elaborated upon by social

⁷⁷ Winner refers to Robert Moses, an influential architect and urban designer in New York between 1920 and 1970, who designed low bridges in Long Island in order to prevent public buses from using ‘his’ roadways. According to Winner, the low bridges reflect Moses’ racial and class biases because those using public transport could not afford automobiles and such segments of the lower socio-economic strata were not welcome in Moses’ vision of Long Island (1999: 30-31).

⁷⁸ Given space limitations, I will briefly explore what social constructionist approaches can reveal about the development of software agents in chapter 4.

constructionists, feminist and cultural theorists.⁷⁹ Although I will address actor-network theories later in this chapter, many feminist theorists have concentrated on the role of gender and 'situatedness' in the design and use of technologies, knowledge and sciences (Haraway 1996, 1991; Code 1995; Smith 1999; Suchman 1987; Adam 1998).

In order to sociologically challenge understandings of interactivity and the nature of subject / object relations, I will explore Bruno Latour's concept of 'immutable mobiles' and John Law's analysis of fluid objects.

Actor Network Theory: Software Agents as Immutable Mobiles?

By way of introduction, ANT stands out as a serious attempt to de-politicize agency in relation to technology. However, in contrast to the structure / agency envelope, one of the key tenets of ANT is the argument that the social is constituted from the 'circulation' between actors and networks (Latour 1997: 3-4). Bruno Latour describes this circulation as 'two sides of the same phenomenon, like wave and particles' (1997: 4). Bruno Latour convincingly outlines a theory of knowledge production and validation through the mobilization of conceptual representations that he refers to as 'immutable mobiles' (1986: 6). Given the apparent fluidity, impermanence and transient nature of the web, questioning how software agents are socially and technically fixed (or fluid) provides an interesting avenue for exploring the relationship between new technologies, interactivity and the potential grounds for developing "new" subjectivities. For example, if the fluidity of hypertext facilitates

⁷⁹ Although space restrictions exclude discussion of cybernetics, I would like to point out that Norbert Wiener attempted to bridge system and environment – or what Katherine Hayles refers to as the process of cybernetic 'meaning-making' during the 1950's and 60's (1999: 92). This illustrates an earlier attempt to connect context and system, regardless of whether that system is organic or machinic.

new processes of reading, learning and thus, the formation of new forms of knowledge, is this equivalent to new processes of identification?

Although I may not be able to immediately answer this question, Latour, in some ways, dismisses this line of questioning. For example, Latour argues that the form allowing for the translation of knowledge objects or concepts is in fact more important than the substance and the content of those concepts and objects (1986: 6-7). Immutable mobiles are representations of ideas (Latour uses a map as an example) that do not change over time and space. In other words, transporting an idea, or the consistent representation of an idea, over distances into decontextualized settings facilitates the concretization of both that idea and the representation of that idea within the social sphere (1986: 25, 12).⁸⁰ Additionally, the capacity to translate or transport content across disparate spaces problematizes Haraway's concept of 'situated knowledges,' as well as challenging the enculturation model of knowledge. Ultimately, exploring actor-network theory means temporarily letting-go of questions about identification, and by extension, questions of subjectification. Nonetheless, ANT will facilitate exploring the potential for software agents to be yet another incarnation of immutable mobiles, and, if they are, aid in challenging what 'it' is that software agents prescribe or inscribe.

First, we must consider how meaning becomes embedded in objects, or what Latour refers to as the process of *inscription*. Second, and also responding to Latour's call to include non-human actors in sociology, we must look at computer

⁸⁰ Although systematically recounting all of the facets within Latour's theory of immutable mobiles would detract from the purpose of this chapter, there are several points that are important to elaborate upon. Particularly, the importance of including non-human actors in analyses of social networks, processes of inscription and prescription and finally, the suasion and enrollment of allies.

technologies as a contributing factor shaping techniques of and within human behaviour, or what Latour refers to as *prescription* (1988: 301, 298).

Allies, Flat Surfaces and Simplification

Latour argues that the most persuasive author and the most convincing theory is the 'one able to muster on the spot the largest number of well aligned and faithful allies' (1986: 5). In other words, the greater the proportion of people and supporting evidence (allies) who subscribe to a particular view, the greater the power and influence of that view.⁸¹ According to Latour, one of the central elements necessary to enroll allies is the mobilization of 'presentable, readable and combinable' objects that easily represent concepts (1986: 7). The hook, so to speak, is the ease with which immutable mobiles (such as diagrams, maps and visual representations) facilitate the translation, negotiation and expression of ideas (1986: 8, 27). Is this the case with software agents? How do we recognize what is different about how software agents mobilize such 'hooks'?

Latour claims that immutable mobiles and inscriptions produce a common ground for people who rely on such immutable mobiles, thus creating a plane of convergence for multiple fields, ideas and other inscriptions (1986: 8, 27). Although this plane of convergence is reminiscent of Code's 'universal ground,' for Latour it involves creating a flat surface that integrates many forms into one plane, into one surface (Latour 1986: 21). Additionally, a flat surface is far easier to '*dominate*' than the messy real life counterpart inscribed in/onto immutable mobiles (1986: 21). The act of 'deflating' a particular set of social phenomenon into a comprehensible visual

⁸¹ However, as I hope to illustrate in my critique of the KBE (chapter 4), enrolling the largest number of allies does not always indicate accuracy. The fable of *The Emperor's New Clothes* comes to mind as an example.

tool acts as an important process in both the development and utilization of that tool's prescriptive and inscriptive associations (1986: 23, 14).⁸² Latour posits that experts rely heavily on these tools (1986: 4), and this observation provides a crucial analytic point when thinking about ICTs and software agents.

Similarly, software agents, particularly Ananova, Luci McBot, Virtuagirl, Babe's team and Makoto (see figures 1.2 and 2.3) provide a flat, integrative interface for a numerous forms of tacit and explicit information, thus, these animated interfaces are 'presentable,' easily dominated and also provide a common ground for users to interact upon.⁸³ Latour refers to this common ground as 'acctantiality' or the inscriptive / prescriptive surface allowing for potential subjectivities and actions to be realized (1999: 19). I propose that the grounds for acctantiality or 'what provides actants with their actions, with their subjectivity, [and] with their intentionality' is also becoming automated - in direct relation to the use of software agents and ICTs (Latour 1997: 7). Following my observation in chapter 2, this process of automation would include 'autonomy, attachment to an environment, available functionality (i.e. capacity for communication and acting in appropriate contexts) or what has been termed adaptability' in the grounds of software agent acctantiality.

⁸² For example, Johnson argues that the most significant thing about computers is the fact that the interface can integrate an array of 'representations' into a single mode, a single surface and unlike the printing press, according to Johnson, results in a 'symbolic system from the ground up' (1997: 15). However, Johnson does not explicate what a 'symbolic system from the ground up' actually means. Based on the context, I would argue that Johnson is claiming that the 'ground up' is equivalent to the individual use of home computers. I can see a possible connection between the interface as a symbolic system that is engaged on 'personal' or ground levels. Johnson's comparison to the printing press and other technologies is important, because 'old technologies' arguably are a complete 'symbolic system' contingent upon very specific facets of cultural belief systems(c.f. Brady 1995; Kramarae 1988; Lerman et al. 1997; Marvin 1988; Martin 1991, 1997).

⁸³ Although Latour is addressing expert knowledge in the field of science and technology, I believe that the general tenets of immutable mobiles are also applicable to everyday knowledge. For example, understanding a diagram depicting DNA and a newspaper map of the protective fence around the anti-FTAA protest in Quebec City both engage the same inscriptive and cognitive processes. As Latour claims, immutable mobiles are tools, regardless of their content, form or of the level of knowledge required to contribute to the mobilization of the ways of seeing such tools carry (1986: 16, 29).

Another fascinating element of Latour's theory involves a simplification or 'extraction' process (1986: 17). Essentially, Latour maintains that translating any kind of phenomenon into a flat, two-dimensional representation involves extracting specific points of information and rendering these points visible, understandable and mobile (1986: 16-17). As Bradshaw argued (see chapter 2), one of the driving forces for the development of software agent technology includes the need to *simplify 'the complexities of distributed computing'*. Again, the automation of particular forms of extracts and simplifies specific kinds of labour from labourers and renders boundary workers and boundary work invisible, a subject I will explore more fully in chapter 4.

For the remainder of my discussion of ANT, I will problematize the conception of software agents as objects, particularly because of their interactive nature; which, in turn also means questioning what ANT will reveal about the fluidity generally accompanying perceptions of interactivity.

Interactivity and Fluid Objects

Interactivity is another name for shopping, and hyper-real gender identity is what it sells

(Tamblyn as cited in Braidotti 1996: 3).

Web technologies are frequently described as fluid, malleable and capable of facilitating the re-creation of users according to their desires rather than their material conditions and social situations. Although there has been considerable growth in the literature dispelling the former perspectives as hyperbolic (Agar et al. 1999; Balsamo 2000; Stewart 1998; Woolgar 2000), the dominant view still appears to be that the internet provides a forum to transcend the limits of time, space and identity (Johnson 1997; Holmes 1997; Castells 1996; Bogard 1996; Turkle 1995).

In other words, ICTs have been unquestionably portrayed as fluid, as linking decentralized networks that mark the emergence and actualization of post-modern 'oppositional subjectivities' (Holmes 1997: 33). I do not want to argue that such perspectives are wrong, but rather, as Star claims, immutable mobiles are adaptable to specific contexts and become 'instantiated in' particular situations and thus, are not 'completely immutable' (Star 1995c: 91; c.f. Law 2000: 11). What is interesting about this is that negotiating web-sites and utilizing software agents call into question traditional notions of mobility. For example, despite claims that such technologies are immediately interactive, and are representative of mobilizing the self into new vistas, we must utilize a great number of technological artifacts in order to access the web and software agents. From the perspective of someone who is entirely unfamiliar with these ICTs, it would seem that users are rendered immobile. The rather intriguing observation is that underneath all this mobility, users must conform to the positionalities of the technological artifacts (excluding of course, cell phones, laptops and other mobile devices).⁸⁴

As Johnson reminded us in the introduction, multi-tasking and fragmentation have existed as long as childcare and domestic labour.⁸⁵ One of the key differences between the postmodernist experience of multiplicity (and/through ICTs) is the codification of multiplicity. John Law addresses this through a discussion of fluidity,

⁸⁴ Of course, even these technologies require particular forms of 'habitus' from users, yet such practices occur in variable environments and contexts.

⁸⁵ Other examples include Michael Lynch and Steve Woolgar's observation that scientific communities build knowledge from 'tissue cultures' or multi-layered extracts from the socio-cultural milieu (1990: 5). Additionally, the emergence of Memex in 1945 foreshadowed the multiplicity and multivocality of layered windows interfaces commonly associated with computer programs of today (Jones and Spiro 1995: 150-151; c.f. Elmer 2001: 5-6). Florian Brady claims that the computer is the post-modern incarnation of the book, because like the written word, ICTs extend human capacity for memory; like print, software programs (like e-mail) render representations immutable and mobile (2000: 135-140). To re-iterate the key point here, multiplicity has existed long before Windows™ and internet programs, thus such 'fragmentations' of identity and experience are not strictly linked to ICTs.

beginning with a definition of the traditional actor network theory (ANT) definition of an object:

An object is in effect of an array of relations, the effect, in short, of a network. And that it holds together, it is an object, while those relations hold together and don't change their shape (2000: 2).

Ignoring strains of structural functionalism, Law claims that objects are networks of component parts, each with a specific place within the contextual system, and each component part is a configuration of parts within the network (2000: 3-5). Before understanding fluidity, we must understand Law's proposition that objects (as and in networks) exist in Euclidean (roughly equivalent to socio-psychological or navigational space) and Cartesian (or material) space (2000: 5-6). Further, the synchronized movement of objects through both of these spaces defines and creates the *topos* or territory. Essentially, objects only exist in relation to other objects, and as the object-network expands, so does the territory it occupies (Law 2000: 7; c.f. Jones and Spiro 1995: 152).

In other words, the relational position of objects within Cartesian and Euclidean space instantiates the surrounding *topos*. First, both Law and Latour emphasize the contrast between 'networks' in ANT and in a cyber sense,⁸⁶ the web provides a clear example of how objects (i.e. hyperlinks) visibilize and instantiate space. For example, Greg Elmer argues that thinking about web browsing as a random, non-linear process is misleading because 'user customization' is largely defined by corporate giants like Nortel Networks (2001: 3-4). User customization highlights one of the main functional purposes of software agents; however, this

⁸⁶ In 'On Recalling ANT,' Latour claims that networks are not just 'double click information,' but 'like Deleuze and Guattari's term rhizome, clearly mean a series of *transformations* - translations, transductions - which could not be captured by any of the traditional terms of social theory' (1999: 15).

tends to occur only on the level of the interface, and thus masks the limits of customization. Unbeknownst to most users, there is an architecture of 'path-ology' designed according to search parameters automatically recognized by web browsers (2001: 5). However, the territory of cyberspace can not be viewed by users until they instantiate that space through their arrival at particular points in cyberspace.⁸⁷ Thus, users' movement through cyberspace defines and creates the ground (or Cartesian and Euclidean space) upon which their movements take place.

Law repeatedly accentuates that although networks are dependent on a series of external forces, they are fixed and immutable:

A shape, an object, is stable and singular if it is configured within a stable set of links with other entities. Within a stable grammar or syntax of those links. Hulls, spars, sails, stays, stores, rudder, crew, water, winds, all of these entities (and many others) have to be held in place, so to speak functionally, if we are able to point to [that] object and call it a ship A working ship is, yes, a continuous Cartesian object, a constant set of Cartesian co-ordinates . . . they perform in a way which contributes to the coherence of the vessel (2000: 5).

In order to exist in Cartesian space, say as a desk, the component parts (legs, top, bolts) must remain constant both individually and in relation to other component parts, otherwise the nature of the network as object changes into a different object in both Cartesian and Euclidean space. And as seen in Elmer's example, cyberspace is built upon a highly orchestrated and fixed structure.

However, because 'cyberspace is fundamentally concerned with links and motion [hypertext] users create their own paths and their own stories through cyberspace' (Brady 2000: 152; Shields forthcoming) - does this call the fixity of the

⁸⁷ Additionally, users' navigations and movements through cyberspace are recorded and logged into memory banks that can and may be regulated by bots like Luci. 'Computers are less windows to the mind than memory spaces where the user deposits icons for later use' (Brady 2000: 145). This interactivity and 'memory space' mean that users leave traces of themselves, of their presence in computer networks and http 'history' files.

network into question? Lev Manovich claims that “digital representation makes every image inherently mutable - creating signs which are no longer just mobile, but also forever modifiable” (2000: 3). Additionally, e-texts, web-architectures and software designs are easier to modify than the printed word and thus, challenge boundaries between public and private texts (Markussen 1995: 176). However, building on Law’s above comment, it is important to note that it is the ‘pattern,’ the configuration of objects that remains stable, apparently irregardless of the substitution of one object for another.

Interestingly, the possibility of changing the content, places a break in the network and contingently, change (or breaks) become part of that network. Even if software agents are designed to interact with users based on simple parsing programs, the series of textual inter/reactions will be different, albeit limited to the programs’ parameters of possible inter/reactions.

So, while computers mobilize masses of inscriptions, individualized hyperlink paths and web browsing appear to render these network-objects mutable (Latour 1986: 12; c.f. Moody 1996: 75). Nonetheless, the movement or relational configuration of component parts in the network-object of a software agent is still dependent upon the context, not only upon the user’s subjective text-based inquiries, but also in relation to the agent’s fixed position within its environment.⁸⁸

Law uses the Zimbabwe bush pump as an example of a ‘fluid object’ because it is so frequently built from impromptu, ready-made materials (or component parts), and serves radically different social functions (2000: 7-8). However, there is some

⁸⁸ The same claims about the mutability of books have been made based upon how subjective interpretation renders each reading, each engagement with the text a different component part (Rorty in Jones and Spiro 1995: 149; Star 1995c: 96; Brady 2000).

difficulty applying Law's concept of the fixity between Euclidean and Cartesian space. For example, is the nature of the bush pump fundamentally changed in both Euclidean and Cartesian space because a rubber band is used as a spring rather than string? Because Luci McBot answers, 'I'm available for \$250 000' rather than, 'my price ranges from \$150 000 - 500 000'? Pragmatically, and following Latour (among others) the answer is yes /no or both /and (1999: 19; Star 1995c: 95). A string used to replace a spring instead of an elastic could translate into a much slower bush pump, which could potentially subject all of the hands, and eyes dependent upon that pump to a longer wait, and that extra time would have a series of effects altering the pump's prescriptive influence. Luci McBot's different answers could potentially have radically different influences on Cartesian space if a user intended to act upon that information. However, as Star asserts when she claims that representational processes themselves are mobile, this is not always the case (1995c: 98).

Fluidity, then, is not just a characteristic of some objects, some of the time. In support of the seeming arbitrariness of fluidity, Law claims that it "is not possible to draw a line in the sand . . . and say that beyond this point continuity is lost" (2000: 9). Yet, Law also proposes that fluidity is introduced into a network when the network breaks down or 'when an object in the network fails' and the rigidity of the ground starts to shift (2000: 11). Thus, fluidity is the bridge between Euclidean and Cartesian space, the lubrication neatly explaining the connection between the hands and the eyes and socio-cultural paradigms. The disjunctures between nodal inscriptions expose new paths, and previously invisible inscriptions and prescriptions. Thus, fluidity provides the essence of continuity between the metaform of immutable

mobiles and the acctantiality built from their planes of convergence. However, to briefly return to my conversation with Luci McBot (chapter 2), pre-programmed responses are automatically invoked to compensate for conversational lags, disjunctures and a gap (or malfunction) within the parsing program. Does this mean that automation cancels out the potential for fluidity?

Software agents are not unquestionably immutable mobiles. For example, the fact that they can only be agents within a specific environment in order to be functional means that software agents are not necessarily mobile. Their interactive nature calls into question whether they are immutable, although the fact that they have fixed architectures and parsing programs does mean that their mutability is perhaps merely an interface or user illusion. Software agents could be immutable mobiles marked by a surface of fluidity covering a rigid structure of architectural foundations. The ideological continuity found in software agent's representational form and their function as the loci for the automation of social labour, highlight starting points for understanding software agents (see chapter 4 for further developments). The plane of convergence is undoubtedly the interface, and easily enrolls users into allies through the strength of the interfaces inscriptions and prescriptions. Thus, it is arguable that software agents are immutable mobiles only because of the metaform [ICTs] they embody. However, this further illustrates my point about the immutability of their underlying structure.

The growth of interactivity provides the illusion of user control, however, as seen in the case of software agents and increasingly friendly GUIs (graphical user interfaces), the depth of user influence/control becomes truncated. Through entities

like software agents, the processes of documentation are placed within automatic information systems.

Conclusion

Although this chapter covers a wide range of material, there are still critical absences (such as a critical engagement with the implications of the ‘network’), and ultimately opens more questions than answers. Following the second purpose of this chapter (outlined in the beginning) this analysis has revealed several interesting critical points regarding software agents. First, my analyses of technologically deterministic thinking in the agent field, in conjunction with social constructionist perspectives reveal, that for the next chapter, it is important to situate gender in relation to the development of software agents. In accordance with feminist epistemologies, it is no accident that software agents illustrate the continued existence of a feminized interface, and I hope to challenge how this relates to the feminization (and automation) of particular kinds of labour.

Second, the cyborg offered several analytically rich interpretations of the software agent. In fact, it was only by comparing how the cyborg internalizes the machine that it became apparent that the software agent externalizes embodiment. This line of thinking reveals what I think is one of my most interesting observations: the software agent is the servo-mechanism of ubiquitous computing. Additionally, this exploration indicates that the software agent acts as the metaphorical incarnation of the skin, simultaneously acting as a sensorial system between humans and machines, facilitating inter-computational communication and embodying boundaries between the self, subject and object. Although this observation takes us

no further in answering one of the significant questions from chapter 2 (*Does the software agent indicate the emergence of new cultural metaphors paralleling the symbolic power of the automaton to initiate cultural metamorphosis?*); it does succeed in identifying what the software agent may metaphorically symbolize.

Lastly, ANT enriched understandings of the software agent as an object. If the software agent is an immutable object, it is only because it reinforces the user illusion of customization and surface interactivity. Although the relation between fluidity and the software agent is still open for questioning, it appears that software agents actually reify fixity. This has serious implications regarding Lorraine Code's concept of a 'universal ground' which effectively conditions who can know, how they know and from where they may know. In other words, software agents appear to automate knowledge processes, and fix particular passages and or social negotiations within the machine. One of the ways this can be explored further is by assessing how software agents relate to work and the replacement versus extension of labour.

Chapter 4:
Identifying Agent Implications: Interoperability, Invisibility and “Internetworkers”

*But possibly, just possibly, all this heated debate is excessive, and agents will merely become the Pet Rock of the 1990s – everyone knows they’re just for fun
 (Schneiderman 1997: 106).*

*The real problem is not whether machines think but whether [women and] men do
 (B. F. Skinner).*

Aside from the challenges incurred by exploring a field that cannot decide on a standard definition of what constitutes an agent, nor implement a general typology of agent applications – one of the more interesting things about the field of software agents – is the obvious attempt to digitize communication and for demarcating boundaries between self and subject-as-object. For example, a recent article proposes that software agent designers need to implement idioms, or what they term a ‘basic reactive plan,’ in order to outline an accessible means of communication between designers (Bryson and Stein 2000: 73-88). Ironically, part way through this proposal, it becomes difficult to discern if the authors are referring to communication in the research community or to agent societies and projects. Bryson and Stein have effectively written a manifesto for developing a shared language; yet struggle with making their objectives clear. Nonetheless, the common presumption that engineers and computer scientists cannot talk to other people comes to mind. Are software agents merely an attempt by experts in computing related fields, to avoid communication with real people? Or to augment what is generally understood to be poor people and communication skills?

Although this question may be interesting on some levels, it detracts from the focus of this chapter, which has two primary goals. First, I would like to review a

selection of the literature on software agents in order to identify dominant themes and their social implications. Second, I will elaborate on these themes in relation to what Greg Downey refers to as “Internetworkers” or the boundary workers that have historically maintained information and communications networks in order to make them functional (2001: 209-235).

Despite the humorous implications of people working on ICTs struggling with communication, this is quite a serious issue. For instance, there is a marked disjuncture in agent researchers’ confidence in their work and in their field. The opening quotations provide a brief illustration of this lack of confidence; Franklin and Graesser represent the optimists in the field, whereas Shneiderman is clearly more pessimistic about the future of software agents. Scott DeLoach presents the field of multi-agent systems as if it is in a state of crisis, claiming that software agents and intelligent systems “cry out for [shared] methodologies, techniques and tools” (my emphasis, 2000: 335).⁸⁹ This indicates that the software agent field suffers from psychoanesthesia, the inability to recognize boundaries between self and other; a state that may lead to interesting, and perhaps, transgressive possibilities. Nonetheless, such oppositional views regarding the fate of agent technology occur within the field as well. Wooldridge observes that the computing field is expanding and encompassing “more and more agent features” (2000: 333). Joanna Bryson, on the other hand, comments on a number of “mainstream software engineering” companies that are threatening bankruptcy (e.g. Center Line, PARC Place SmallTalk VisualWorks 80, Nextstep and XANALYS, 2000: 334).

⁸⁹ Yet, in contrast, Richard Murch and Tony Johnson claim: “One of the valuable mainstream tools will be computer agents. These are software programs that are, in many respects, alive; and as part of living in this extraordinary network environment, they have begun to manifest many features and actions that were until recently the domain of human beings (1999: 2).”

Although the field tends to be overwhelmingly technocentric and equivocates agent innovations with socio-cultural progress, doubts about the security of agents and the agent field repeatedly appear within the literature. In part, these tensions arise from basic communication problems within and between the multiple disciplines involved in designing agents. This translates into diverse research communities marked by fragmented, isolated projects characterized by the perpetual process of having to build software agents, their architectures and methodologies virtually “from scratch” (Bryson and Stein 2000: 84-85; Decker 2000: 337; Wooldridge and Jennings 1998: 19). All in all, such communication and application difficulties point to a rather different reality from the one painted by claims stating that software agents will “lead to a high speed ubiquitous information superhighway” (Decina and Trecordi as cited in Hayzelden et al. 1997: 1).⁹⁰

However, the opening point on communication relates to several other themes that have emerged from the literature on software agents. Overall, the communications issue relates to the lack of a shared language, which is clearly a point of contention within agent related fields, and certainly causes confusion from a social science perspective. For example, words that have very specific meanings in sociology are used in radically different ways in software agent literature. Please refer to table 4.1 for a brief selection:

⁹⁰ Unless, of course, that superhighway is composed of hundreds of one way dirt roads, constant detours, and no navigational road signs to guide users to their destinations!

Table 4.1: Contrasting Definitions		
Word	Definition	
	Computing Related Fields	Sociology
Ontology	"Specification of a domain of discourse among agents" (Chorafas 1998: 27)	The philosophically rooted exploration of the nature of being.
Instantiation	"carrying out (i.e., instantiate) that function" (Mantovani 1996: 258).	The mutually recursive construction of two phenomenon (e.g. structure is instantiated in and through agency)
Sociological	Sociological is used as a verb to connote agents "who can model their social environment and agent relationships" (Luck and D'Inverno 2000: 182-197).	Classically used as a noun to refer to "the study [and analysis] of companionship ... and the bases of social membership, interaction and social relationships" (Abercrombie et al. 1994: 396)

Identifying Agent Issues

Despite the conflicts within computing related fields regarding what exactly constitutes a software agent and pervasive communication issues, the key issues that explicitly emerge from the field include:

- need for 'interoperability' between agents, operating systems, languages (e.g. KQML, XML, KIF, SQL or LOOM, see Finin et al. 1997)
- balance between agent autonomy and intentionality - and appropriately serving the user's needs
- importance of user familiarity with agent
- personification, personalization and customization

These issues highlight a larger tension between attempts to create a standardized computing system, while simultaneously accommodating a forum for users to express their individuality. Ultimately, the debates about what the ideal programming language should and could be, in conjunction with the repeated calls for 'interoperability' illustrate that the process of digitization is one of standardization (c.f. Collins 1990: 23). As Harry Collins argues, digitization transforms intentionality into routine upon which users determine meaning and substance (1990: 60). Rendering a simplified, interoperable framework to not only think about computing related practices, but also to engage personal environments, organize one's private

and professional lives, facilitates what Latour refers to an increase in the “enrollment” of potential allies. Implementing an easily acceptable universal framework for agent architectures, methodologies and designs means providing a platform for automating autonomy and investing (or as Latour would say, ‘inscribing’) autonomy and intentionality into objects.

In other words, software agents represent a re-configuration of subject-object relations, where the object becomes more than just a vehicle for anthropomorphic tendencies, and more than just a metaphor for human agency, rather the object becomes its own subject. There are a couple of phenomenon that concretize this point, namely the ‘mentalist’ language used to describe agents utilizing the BDI (Belief-Desire-Intentionality) model and MIT’s ‘Things That Think’ research paradigm.⁹¹

However, before exploring the BDI model, I think it is important to point out that agent ‘autonomy’ is a problematic concept, particularly in consideration of how agents need to be situated within a specific environment in order to be functional. Software agents juxtapose autonomy and situatedness, and despite the seeming contradictory relation between these two elements – it is exactly this combination which allows the automation of agent functions. It is with this in mind, that I hope to question how particular forms of gendered labour become invisibilized.

⁹¹ See Gershenfeld (1999) and the ‘Things that Think’ (TTT) home page (<http://ttd.media.mit.edu/>) for more information. Although it is beyond the scope of this essay to explore the implications of this research, it is important to note that the TTT group is responsible for many innovations driving “computing off of the desktop and into the world” (<http://ttd.media.mit.edu/>). Some aspects of ubiquitous computing are innately tied to the development of software agents and personalized, interactive interfaces mediating between ‘smart’ products and the user. The point that ‘things that think’ illustrates is that objects are being technically re-inscribed with ‘agency,’ intentionality and responsiveness. As an aside, Dmitris Chorafas discusses one of TTT’s current and seemingly ridiculous and unnecessary projects, the “intelligent diaper” designed to “provide precious feedback” (1998: 8).

The BDI Model and Mentalist Language

To ascribe certain beliefs, knowledge, free will, intentions, consciousness, abilities or wants to a machine or computer program is legitimate when such an ascription expresses the same information about the machine that it expresses about a person. It is useful when the ascription helps us understand the structure of the machine, its past or future behavior, or how to repair or improve it (John McCarthy 1979: 1).

Michael Wooldridge describes the computer science rationale behind the BDI model as an attempt to develop “theories and formalisms” about representations of mental states in a “structured, well-defined artificial language” through mathematical logic (2000: 12). Further, Wooldridge claims that the BDI model incorporates three analytical levels: philosophical, software architecture and logics (2000: 23).

Essentially, the BDI model provides a basis for defining, codifying and programming potential agent behaviour by formally representing “rational” action (see Bratman 1987).

From a non-technical perspective, it is difficult to identify the number of software agents modeled after the BDI architecture. For example, Nwana and Ndumu claim that “reactive agents represent a special category of agents that do *not* possess internal, symbolic models of their environment” (1998: 39). However, the BDI model is frequently portrayed as a unique system that is only occasionally implemented (Wooldridge 2000: 8-10). In contrast, Yoav Shoham dismisses such inconsistencies and contradictions, claiming that regardless of the various incarnations of BDI architectures, composing a complete list of mental properties and internal states is practically impossible (1995: 276-278). Thus, following Shoham’s argument, mapping out agent applications of BDI is a useless endeavor,

particularly without shared definitions of the contingent factors (such as “goals and plans”) associated with BDI (1995: 277). Nonetheless, as McCarthy claims above, for computer scientists applying anthropomorphic metaphors to agents, machines and computers is useful when these metaphors facilitate human comprehension of mechanized objects.

McCarthy’s claim has had profound influence within communities of software agent developers and designers. In fact, the pervasive occurrence of ‘mentalist language’ (e.g. having beliefs, desires, intentions, agency, thoughts or feelings) within the software agent literature is overwhelming, particularly to those who are skeptical of deterministic perspectives. Social constructionists would argue that such embedded metaphors naturalize technology and obscure the relationship between human agency, socio-cultural contexts and technological development. Lucy Suchman eloquently summarizes the implications of this point, when she states:

My concern, in sum, is that far from recognizing the deep interrelations of humans and artifacts, contemporary discourses of machine agency simply shift the site of agency from people to their machine progeny. This does not mean that human power is lost. Rather, as in claims for the independent voice of nature in the practice of positivist science, the assertion of autonomy for technology depends upon the obscuring of human authorship. And just as claims for nature’s autonomy ensure the power of the scientist, it is precisely in the obscuring of authorship that the power of the technologist is renewed. The history of the materialization of machines is intimately and intricately tied to the history of “regulatory (power/knowledge) practices and their participatory role in the production of bodies” (Barad 1998, p. 23 as cited in Suchman 2000).

Although I will return to “regulatory power / knowledge” in the following section on ‘Internetworkers,’ it is important to note that the erasure of personal responsibility in favour of technological autonomy is situated within complex discourses of embeddedness and personalization. I am referring to personalization in two senses

here: primarily, regarding the process of individualizing and customizing interfaces in order to instigate a sense of ownership and identification with and over technologies. Second, the latter connotation is quite literal, meaning that software agents embody the attempt to technically (re)construct person-hood and 'person'-ality, effectively marking the commodification of subjectivity, and in the process, invests technologies with autonomous power.

Software agent designers and engineers intend for software agents to actualize an extension of the self to provide individual clones that can be segmented from one's 'important' realm of activities and sent off to perform mundane tasks (such as price comparisons and sifting and organizing large amounts of data). At this point, a social constructionist perspective provides interesting insights regarding the relationship between software agents and the automation of gendered forms of labour. Many agent developers repeatedly emphasize the importance of user familiarity with their software agent. Familiarity allows the agent to 'learn' user habits and accordingly adapt its behaviour to user preferences in order to eventually predict that users' preferences. However, Patti Maes and Tomoko Koda conducted a small experiment, in order to determine "the effects of agent personification" (nd.: 1-6). Koda and Maes conclude that users respond most positively to 'realistic' and 'feminine' personified interfaces. Of course, the experimental subjects were 10 graduate students from the MIT media lab – which in all likelihood means that they were privileged male users, accustomed to membership within an elite intellectual community. Koda and Maes neglect to identify the gender of the participants and refer to the feminine personification as 'human.' Thus, power inequities in gender and socio-economic relationships are perceived as part of the everyday landscape

and, in Koda and Maes' work, becomes embedded within software agent design practices.⁹²

In contrast to William Bogard's claim that the attempt to digitize embodiment suggests a 'hyper-realization' of the body, and thus incites the ultimate disappearance of identity, the body and subject-ivity (1996), Koda and Maes' project indicates that new ICTs are tangibly grounded in the socio-material realm.

Nonetheless, Bogard raises a critical point and represents a significant portion of social theorists that question the potential for new ICTs to extend (or fragment and isolate) communities, communications and self perceptions. In tandem with these questions, another theme that emerges from social analyses of technology concerns the liminality of virtual embodiment and the cyborg. Marisa Ruis observes that a central problem inherent within discussions of cyborgs is that anyone using any kind of ICT becomes a cyborg (1999: 27). Thus, is human touch, thought and experience extended through ICTs across ideational and physical territories of time and space? Many theorists argue that movement through cyberspace, via direct surfing or through agents,⁹³ is equivalent to the conquest of spatial and temporal limitations while also marking the transcendence of the body's limitations (Bogard 1996; Biocca 1997; Benschop 1997; Hillis 1999; Stone 1995).

⁹² Current interface and web-based design work tends to concentrate on designing a 'psychic landscape' that highlights how developing 'user friendliness' is an active process, and designers expend great efforts to embed 'natural' interfaces in order to facilitate users' comfort with their computers (*E-design*, 2002).

⁹³ Or as Sandy Stone argues, via technologies in general. Stone uses the example of Stephen Hawking's wheel chair and voice augmentation system (1995: 395) in order to question the limits and scopes of Hawking's body. Stone claims that Stephen is as much a part of the "silicon and plastic assemblage" that facilitates his speech and movement. Self-referentially, Stone claims that while building a "primitive radio" and upon receiving a signal, experienced a visceral link between "a couple of coils of wire" and "send[ing] a whole part of myself out into the ether. An extension of my own will, of my instrumentality" (1995: 394).

Previous work on telephone sex workers and cybersex studies reveal that in contrast to such claims, embodied experience is still at the center of such phenomenon (Sujon 2000).⁹⁴ Erasing the connection between ‘human authorship’ and the practical limits of technological function(s) effectively partitions the body (and embodied experience) from a sense of self. As Collins posits, computers and calculators do not, in actuality, perform arithmetic (1990: 69). Machines cannot perform a specific act, they can only carry out the “behavioural coordinates of the act” (1990: 71). It is humans that *do* arithmetic and through the internalization of metaphors, interpretively attribute the execution of such behavioural performances to machines, agents and ICTs. As Greg Downey states, “the Web, this image [of a scene from *The Matrix*] seems to say, is nothing but pure data, and any illusion of humanity is merely an advertising gimmick” (2001: 210). Thus, the interpretative work performed by users is perceived as an internal component of ICTs.

Nonetheless, the hybridity of software agents place technologically mediated identifications of the self between and across boundaries demarcating self and other, isolation and connectedness, machinic and human. In order to address these issues, I will turn to Downey’s (2001) concept of ‘internetworkers’ and to Nick Witheford’s (1994) idea of the ‘socialized worker’ in relation to both ‘women’s’ work and marginalized forms of labour.

⁹⁴ For example, David Schnarch argues that engagement with cyber sex has real behavioural and psychological effects (1997). Further, Collins illustrates that ‘users’ provide a significant proportion of the basis for their understanding of mediated interactions. In other words, understanding is based upon situated social and physical contexts which is then projected onto current phenomenon (1990: 97-99).

Internetworkers and Invisibilization

“As the robot was to the industrial imaginary, so the software agent is to the desires and fantasies of the service economy (Suchman 2002b: 2).

Manuel Castells positions ‘networked business models’ as emblematic of emergent new ‘e-business’ inspired economies (2001). Castells states that “for all the hype surrounding the dot.com firms, they only represent a small entrepreneurial vanguard of the *new economic world*” (2002: 65). Castells claims that the ‘networked business model’ is unique because companies have removed the intermediary between production and distribution, and as a result, can immediately react to customer demands (e.g. Zara clothing, 2001: 74). Whether this is merely the result of what happens when faster communication tools contribute to the continued growth of advanced capitalism, or if this is really the sign of a vast and pervasive social transformation, as Castells claims, is open for debate. In support of the former argument, Michèle Martin claims that communication systems (ranging from the telephone to the latest and greatest ICTs) are about the “circulation and accumulation of capital” (2002; c.f. Witheford 1994).

Following Martin and contrary to techno-utopic claims, new technologies are not transforming social inequities and hierarchies; rather new technologies are “merely a thin disguise for methods of social domination and control” (Eglash 1995: 18; c.f. Millar 1998).⁹⁵ Stephanie Stewart Millar cites the overrepresentation of women and people of colour in technological displacement, the ‘deskilling’ of

⁹⁵ For example, Millar traces the roots of technoculture to the 10th Century marriage of science to a misogynistic and male dominated “Christian clerical tradition” (1998: 30). Millar claims that this marriage not only began the exclusion of women from both technology and technological practices but also instigated the apotheosization of technology in Western cultures. Millar further posits that online research reveals that far from ending inequity, the digital world reflects traditional gendered and racialized divisions.

employment, exploitative labour, part-time and contract telework as concrete examples of how this 'thin disguise' attempts to hide sexist and racist ideologies of the wired world (1998: 73, 79; Nakamura 2000; c.f. Menzies 1996; please see Appendix D on Internet Demographics).⁹⁶ In accordance with Code's theory of 'universal knowers,' the hyperfeminization of software agents indicate that the dominant cyber subject is standing upon a 'universal ground' defined by white male experiences and expectations. Following Code's discussion of universality (cf. Callon's notion of "obligatory passage points"), the dominant signpoints or "psychic landscape" become invisibilized within technical design. The implementation of 'user friendliness' conflates and naturalizes social and computational practices (Berger 2002; Ward 2002; Maes 1996).

Additionally, Ms. Chinery-Hesse, the International Labour Organization's (ILO) Deputy Director General outlined women's current employment status:

They constituted 50 per cent of the world's population but had not achieved equality in any country of the world. They made up 70 per cent of the world's poor yet only 5 per cent of the rural credit made available by multilateral banks reached them. Although they represented over 40% of the global workforce, only 25 women in this century had become Heads of State ... women's access to top management posts was still severely limited ... Indeed, it was in the world of corporate business that the glass ceiling had proved most impenetrable, with a mere 2-3 per cent of top jobs in large corporations held by women (1998: 4).⁹⁷

⁹⁶ Anne-Jorunn Berg provides an excellent example of how technology 'thinly disguises' racist and sexist ideologies. Berg conducted research into three 'smart houses,' or the technologically run "innovative home of the future" (1999: 301). Despite the sponsor's glorifications of these houses as 'providing every modern convenience' resulting in the reduction of household maintenance tasks, Berg found the design of these houses did not "initiate any developments that would substitute or save time in housework . . . [which] reflects a male idea of the home and responds to male activities in it. It [the integrative technology running the smart houses] is gendered in what it leaves out - its lack of support for changes in the domestic sexual division of labour" (1999: 312). Berg's research emphasizes the importance of looking behind the sheen of new technologies and challenging utopic claims of simply finding (or receiving) salvation through technologically inspired developments.

⁹⁷ Katherine Scott and Clarence Lochhead state that "by 1995, [Canadian] women earned, on average 65 cents for every dollar earned by men - up from 54 cents in 1981. For every full-time full year workers, the wage gap narrowed slightly from 64 cents to 73 cents earned by women for every dollar

Additionally, women continue to significantly occupy female-dominated kinds of work, characterized by “lower pay, lower status and fewer advancement opportunities than male occupation” (World Employment Report, 1998-99). Swasti Mitter reports that in relation to textiles production and manufacturing, “computer-aided technologies has likewise been a contributing factor to the dramatic decline of women’s employment” (1993: 19).

Additionally, Castells neglects the effects of changing business models on workers. In the case of Zara Clothing, this company’s success is reduced to technological advances allowing direct market response which facilitates ‘just-in-time’ fashion design and production (2001: 74-75, 102; c.f. Mitter 1993). The sales people, factory workers, delivery people and technical support staff are left out of the discussion. Moreover, software agents represent new frontiers of automation in office, secretarial and human resources labour. Although it may be too early to tell how effective software agents will be at replacing these kinds of work, the feminized interface certainly re-asserts the juxtaposition of the kinds of work women are predominant in, with the increasing feminization of these occupational areas.

In an innovative and critically refreshing article, Greg Downey historically situates the telegraph, postal and telephone systems as ‘internetworks’ that are similar in form to what we know as the internet (2001). Downey refers to these communications systems as internetworks for two reasons: first, because these systems combine at least three other communication systems⁹⁸ and indicate

earned by men” (1997).

⁹⁸ In the case of the internet or “global digital information internetwork,” Downey identifies “point-to-point telephone networks,” “packet-switching computer networks” and “broadcast radio and television networks” (2001: 212).

communication between and across these systems; second because each of these 'internetworks' are built upon material infrastructures requiring regular maintenance and active construction (2001: 218). Downey proposes that network 'support' workers are instrumental in actualizing information networks, and are frequently overlooked in technological discussions because such labour occurs at the boundaries; and are hidden by what Bowker and Star refer to as being placed "between a thing and an action" (1999: 285).

Lucy Suchman connects Downey's observations with software agents when she states:

[As] the just-visible-enough worker [the traditional subservient butler also referred to by Negroponte], he directs his considerable skills to maintaining the comfort and respectability of his employer, the upper class, good-natured, but slightly dim-witted Bertie Wooster. While created close to a century ago, it is evident that Jeeves pre-figures a central object of contemporary projects in computing and interface design; that is, the interactive software agent (Suchman 2002b: 2).

Suchman has articulated a central point concerning the social implications of software agents. While the surface or interface issues are about personalization and customization, the intent of task-specific and hybrid software agents is to automate the kinds of boundary and internetwork labour that Downey identifies (c.f. Bowker and Star 1999; Suchman 2002b). This leads to two key questions. First, who maintains the maintenance crew, particularly when that crew is (potentially) composed of automated workers? Following Randi Markussen's (1995) critique of labour saving technologies, is the effort involved in maintaining software agents worthwhile?⁹⁹ The second question concerns which communities will be most

⁹⁹ Markussen opens with a discussion of how the washing machine creates more labour, in part by increasing cleanliness expectations, much to the chagrin of the audience. Her point here, is to challenge the implicit assumption that technologies achieve what designers intend for them to achieve

effected by the implementation of software agents; and does the contingent automation of their labour constitute what Braverman (1974) would term the 'degradation' or dehumanization of work?

Nick Witheford introduces the concept of 'the socialized worker' which includes the "white-coated, educated and content 'knowledge-workers' of the information age" (1994: 97) and somewhat contradictorily, also the "bank clerk, health care worker, teaching assistant" (1994: 95). Witheford's point introduces some of the complications and difficulties associated with thinking about knowledge work and the knowledge based economy. Based on this point, it is important to problematize the distinctions between knowledge and service work, particularly in relation to the KBE.

Challenging the KBE: Knowledge or Service?

Lives are at stake in curious quasi-objects like databases; they structure the informatics of possible worlds, as well as of all-too-real ones (Haraway 1995: xix).

In *The Changing Skill Structure of Employment in Canada*, Yves Gingras et al. outline examples of what kinds of work constitute knowledge work and the average annual rate of growth in a variety of employment sectors ranging from 'knowledge' to 'goods' (2000 238-239). For example, Gingras et al. Define 'management work' as 'science and technology' work including health, engineering and sales managers and bankers. 'Data work' includes technicians like dental hygienists, engineering technicians, secretaries and office clerks. 'Services' include barbers, police officers and tourist guides (2001: 238). The employment sector of 'goods' workers includes

and that technological developments are innately 'liberating' and progressive (1995; see also the 'intelligent diaper' Chorafas 1998). Empirical analysis focusing on evaluating the usefulness and quantitative distribution of software agents (e.g. do they replace labour, if so, how much and to what extent?).

farmers, box packers and machine tool operators, whereas 'knowledge' workers include pure scientists, applied scientists, engineers, computer workers (analysts and programmers) and social services (economists, accountants, lawyers and artists) (Yves et al. 2000: 238). These classifications reflect arbitrary categorizations, and the distinctions between data and knowledge work reflect class boundaries that arguably, break down when the actual work performed by such workers is questioned.¹⁰⁰ Clearly, these are problematic classifications, which ultimately highlights the difficulties surrounding determining what constitutes knowledge, information and data work.¹⁰¹

Lastly, Gingras et al. note that in 1996 knowledge occupations constituted 1,172,000 workers or 8.5% of the 'total employment in Canada,' whereas the goods and services sector employs 6,140,000 workers - just under six times the amount of the total number of 'knowledge workers' (2000: 239). Do these figures reflect an economy based upon the actions and profits of knowledge workers? Although further substantiation is required, it seems highly improbable that this is the case. Additionally, it is important to note that there is an influential conflation between work involving computers and new technologies and the emergence of both knowledge work and the KBE. To use Latour's language, knowledge associations are *inscribed* into ICTs and in turn, reify behavioural *prescriptions* that effect social actions and understandings.

¹⁰⁰ Take for example, any of the secretaries at Carleton University's department of sociology and anthropology. These people have detailed knowledge of the official workings of the department, they know who to refer to for specific information and what kinds of processes must be engaged to get a wide variety of essential functions started - from delivering mail to organizing committees and maintaining a working university department. Why are the fundamental forms of work they do classified as 'data work' rather than 'knowledge' management or knowledge work?

¹⁰¹ Please refer to Frank Webster's 1994 article entitled 'What Information Society?' in *Information Society*, v. 10, pp. 1-23, for a further critique of how the knowledge based economy and information society are measured.

Why is this critique of the KBE relevant to software agents? First, challenging the classifications used to determine what constitutes the actualization of a KBE reveals that ICTs may not have altered the social sphere as radically as the hype would have us believe. Second, some of the equivalent positions that ‘boundary workers’ occupied in the postal, telephone and telegraph internetworks would be customer service representatives, technical support workers, administrators and their assistants. Software agents like Luci McBot indicate that some of these spheres of work are becoming automated. Determining the degree of this automation, of course, requires empirical study. However, it is conceivable that the computer science approach to software agents-as-objects has prescriptive effects on living boundary workers.

At this point, it is important to ask ‘what is the relationship between the automation of parts of the service industry and the automation of production witnessed at the turn of the century?’ Do software agents indicate a transition towards not just the agent-as-object, but also the service worker-as-object? Do software agents automate critical elements of the knowledge production process?¹⁰²

¹⁰² Read Mercer Schuchardt proposes an interesting link between the emergence of road rage, the personal computer and remote control (including the mouse). Essentially, Schuchardt argues that the inability to exercise remote power while stuck in traffic leads to road rage (2000: 44-45). For example, the body’s position while driving is similar to the position one occupies while surfing the net and watching television. The two latter activities reinforce the users’ ability to negotiate and influence the web or television environment by changing the scenery, changing the channels and jumping back and forth between multiple windows. Driving in traffic, on the other hand, limits the power and control users have over their immediate surroundings, and provides a visceral connotation reminiscent of both channel changing and web surfing. In essence, the remote control translates a particular relationship between self and object into a particular object, that when obstructed, contributes to the development of road rage. Schuchardt has thus proposed a further link between particular forms of technology and cultural trends in everyday praxis and behavioural forms, or one of the incarnations of technological *prescription*. Although Schuchardt’s argument is highly speculative, particularly because he neglects other socio-cultural conditions also contributing to the emergence of road rage, it is an interesting theory and warrants further research. Schuchardt’s point highlights what can be referred to as ‘social atomization’ perspectives on technology, a point I will explore more fully in the following chapter.

The above questions require further research; however, I propose that software agents automate not just particular kinds of work, but also prescriptive and inscriptive processes. Software agents-as-objects include digital autonomy and because of this, they highlight how non-human actors (whether that refers to a door-closer, paper clip or system of integrated technologies) act as a screen for the projection of pre-existing social conditions, environments and relationships on to seemingly 'neutral' objects (c.f. Turkle 1995: 44; Penny 2002).

In other words, software agents act as inscribed objects reflecting both a designer's perceptions of social conditions and social constructs employed by the user's perceptions of social conditions. Geoffrey Bowker and Susan Leigh Star provide further support of these prescription and inscription processes when they state:

Information scientists work every day on the design, delegation, and choice of classification systems and standards, yet few see them as artifacts embodying moral and aesthetic choices that in turn craft people's identities, aspirations and dignity (1999: 4).

Software agents automate mundane forms of labour, traditionally associated with women's work (Hartmann et al. 1986), and gender is materially and ideationally embedded within the automation of prescriptive and inscriptive processes. The hyperfeminization of the software agent reflects a technological crystallization of women's socio-economic and occupational status. In part, the mentalist language implemented in the design of software agents obscures the connection between technology and function. Thus, the fluid negotiation of ICTs, knowledge work and social organizations is subsumed into the technical 'hardware,' perpetuating the technocentric and gendered segmentation of object from context. Rather than

opening opportunities for political, economic and cultural metamorphosis, women's existent employment patterns indicate a continuation of inequitable socio-material conditions.

Chapter 5: Things to Things: From Bits and Bytes to Social Cohesion?

One of the ways they survived was by forming themselves into groups of tribes, gathering around flags and books and laws ... a shared ideal is one of the best ways to hold a tribe together in the face of chaos.

*But now the tribes are all sharing the same tent, and we can all be guilty of sometimes mistaking our ideas for **things** (Grant Morrison, 2002).*

What held us together was not a discipline, but a belief that computers would spectacularly modify and transform the quality of life by their ubiquity, not only in the sciences, but in all aspects of everyday life (Negroponte 1995).

Amidst discussions of what kinds of social effects are incurred by the institutionalization of a knowledge-based economy and new ICTs, a long-standing issue remains unresolved. Since at least the emergence of the electric light and the telephone, technology has been construed as a vehicle for increasing social atomization and isolation. However, in the same vein, new technologies have also been presented as bringing disparate groups and geographically distant individuals together, thus, facilitating community development and not only extending social networks, but creating new ones. One of the ways social cohesion is highlighted in the agent literature is by repeated attempts to raise the importance of trust between users and agents. Even if trust was the only barrier blocking the perfect implementation of software agents, what, if anything, do software agents actually do?

Based on the discussion thus far, software agents provide faster ways of negotiating increasingly complex informational territories. However, manipulating information over larger geographic regions through shorter units of time is a quantitative observation. These increases and decreases do not indicate what is unique about software agents or that a new culture has (or is) emerging. The same social practices occur, even if they are actualized with new tools, improved

techniques and glossy materials. Craig Calhoun critiques the notion that faster, better ICTs are equivalent to substantive social differences when he states:

Visions of a new and different age derive substantially from the anticipated effects of new technology, most prominently computers and related information technologies. Although this technology is indeed powerful, such accounts of a qualitative break with the previous two hundred years of modernity are misleading. New technologies have extended the most basic trends in social integration more often than they have countered them (1992: 218).

In addition, Calhoun also argues that writing marked the first occurrence of “invisible linkages” between social actors and actualizes the capacity for what he refers to as “indirect relationships” (1992: 216, 220).¹⁰³ Calhoun is effectively referring to the use of immutable mobiles and the replacement of co-presence with objects in human communication, which he argues have two qualitatively different forms: tertiary and quaternary. For Calhoun, the primary difference between these relationships is that in tertiary relationships, the social actors are fully aware that their interactions are being mediated by machines, texts or other parties; whereas in quaternary relationships, people are not active participants (1992: 218-219). Calhoun describes such hidden relationships as taking place

Outside of the attention and, generally, the awareness of at least one of the parties to them [quaternary relationships]. They are the products of surveillance and exist wherever a sociotechnical system allows the monitoring of people’s actions and turns these actions into communication, regardless of the actor’s intentions (...[e.g] the tapping of telephones, the theft of computerized data or even the analysis of stored data) (1992: 219).

What is particularly interesting about Calhoun’s perspective is that it not only exposes the potential abuses of ICTs, but also suggests that social cohesion can occur without actually involving human actors.

¹⁰³ For Calhoun, indirect relationships are mediated through entities that are “distanced both in time and space” (1992: 216).

Jeffrey Kephart (et al. 1998) substantiate this suggestion when they predict “a free-market information economy in which billions of software agents exchange a rich variety of information goods and services.” Of course, software agents may be programmed to act autonomously on their user’s behalf, but the BDI model accommodates a certain (and ill defined) degree of adaptive behaviour based on ‘learning’ user preferences and habits. These processes of adaptive and learning behaviours mean that the user embeds traces of themselves into the agents’ memory, exponentially expanding the potential for Calhoun’s ‘quaternary relationships.’ Again, Patti Maes’ social filtering program ensures that these user traces are not only communicated with other agents but are reified throughout agent societies, and may become embedded within numerous agent systems.

So in order to interrogate what it is about software agents that is unique in relation to old technologies and patterns of social cohesion, I propose a return to Emile Durkheim’s theory of mechanical and organic social solidarity.

Briefly, Durkheim proposed that there were two forms of social solidarity. The first form, mechanical solidarity, took place in pre-industrial societies and “links the individual directly to society without any intermediary” (1984 [1893]: 83). According to Durkheim, mechanical solidarity was marked by people working towards shared ideals and like his conception of the machine, created organized parts working together as a whole. Durkheim argues that this form of social solidarity is predominantly marked by relationships between people and people. In contrast, organic solidarity is marked by the increase of specialization, differentiation and individualization. Capitalism and industrialization meant an increase in segmented labour, which could effectively function outside of the collective and independently

from other forms of labour. Durkheim claims that the dominance of relationships between 'people and things' is an essential characteristic of organic solidarity (1984 [1893]: 85). However, Durkheim also claims that as the division of labour became increasingly specialized, the social integration of differentiated parts also grew. Durkheim conceptualized society as a living organism, where the marked division of labour represented the organism's organs (1984 [1893]: 85).

Building from Durkheim's model of what he terms "social solidarity" (also inferring social cohesion or integration), software agents indicate the emergence of relationships between objects, even if on the behalf of human users. In contrast to claims that the reality of cyber experience is constituted through cyberspace users (rather than in the ICT network), software agents mark interactions not only *with* the network, but between objects in the network. Software agents highlight the emergence of social relationships that remain 'within networks' rather than being mediated through networks. Ultimately, software agents mediate 'indirect relationships,' reifying interactivity through a number of inter-mediated layers.

The transformation from predominantly people-to-people relationships, to people-to-objects relationships provides a convincing model suggesting that new technologies, despite all the continuities, have instantiated a significant social and cultural shift. A shift that is marked by the object-to-object, or thing-to-thing relationships embodied through software agents. Like the alchemical attempt to transmute metals to gold, software agents illustrate attempts to create the transmutation of the machinic into the living.

Returning for a moment to the enculturation model of knowledge and briefly addressing Manuel De Landa's idea of 'computational societies;' I would like to

explore an interesting, although speculative, insight into one of the possible implications of objects relating to objects. In *War in the Age of Intelligent Machines*, Manuel De Landa has written a fascinating and complex account of technology and AI in relation to military initiatives, strategies and events. De Landa outlines a history of human relationships with machinic social models, claiming that one of the most important shifts occurred from 'clockwork' frameworks (where each part of a social system functioned as cogs in a larger system) to that of the steam engine (1991: 179-183). The central change in De Landa's account is marked by the emergence of the production of movement from within (as found in the steam engine), rather than the transference of energy from part to part (as found in clockwork) (1991: 141; cf. chapter 2). De Landa claims that this shift is reflected within social theory (e.g. Darwin, Marx and Freud each have their own 'theoretical reservoirs') and military practices (1991: 141-142). For example, De Landa cites radical improvements in information gathering systems (e.g. satellite photoanalysis and expert systems) as indicators of a shift from 'armies' (or computer systems) that could transmit information to 'armies' (or computer systems) that could produce information (1991: 6-7, 103, 143).

De Landa links the emergence of 'packet switching' or 'independent software agents' or 'daemons' with 'local intelligence' which challenged the idea of central control by providing the means for "collective decision making" (1991: 120).

However, De Landa posits that the most important aspect of daemons¹⁰⁴ is that they are in essence self organizing, and as a result are "beginning to form computational

¹⁰⁴ As discussed in chapter 2, Wooldridge and Jennings claim that software daemons do not meet the necessary criteria for defining an 'intelligent agent.' However, they do not preclude thinking of software daemons as another kind of agent.

societies that resemble ecological systems that resemble insect colonies” (1991: 121). For example, an e-mail message is encoded into ‘bits’ that are randomly sent across a world-wide network, headers provide addresses to direct bits (or packets or what De Landa would call daemons) to their final destination. However, because daemons are sent on random paths before arriving in the recipient’s inbox, De Landa claims that software daemons constitute part of a self-organizing system and on their way to their final destination, they form ‘computational societies’ (1991: 121, 177). Applying the idea of computational societies to packets may seem to be more appropriately considered via science fiction, however, De Landa situates this claim within the concept of ‘thresholds’ (1991: 7). In other words, De Landa argues that ‘behind self-organization,’ behind the emergence of ‘order out of chaos’ a critical point must be reached and a threshold must be crossed. De Landa uses the example that at:

a critical point in the concentration of a chemical . . . the termite colony becomes a nest building machine; when available food reaches a (minimum critical value, the amoebas self-assemble into an organism; when critical points in the rate of reaction and diffusion are reached, molecules spontaneously come together to form a chemical clock . . . (1992: 7).

In this context, software daemons are capable of ‘producing’ energy or information that is completely independent of their purpose or their content. As such, the capacity for software agents to generate their own energy/information clearly illustrates the emergence of object-to-object relationships. Nonetheless, De Landa is not arguing that this kind of ‘artificial life’ actually exists. Rather, De Landa is suggesting that given an inevitably arriving ‘critical period,’ the future could bring the emergence of a self-organizing, artificially intelligent force. Contingently, self-organizing and emergent systems (particularly as characterized by and through insect

colonies or 'swarm intelligence') have begun to dominate theories of artificial intelligence and have even ventured into 'sociology of knowledge' discourses. De Landa has identified the cusp of socio-cultural thought regarding the generative power of 'things,' technologies and objects-as-subjects.

Regardless of the efficacy of the daemons-as-computational-societies concept, the fact that De Landa places the capability of AI outside of the technology and within technological *system* reinforces the object-to-object relationships discussed above. In a sense, this shift reflects epistemological arguments that *knowledge is social* and has potentially frightening implications in relation to the enculturation model of knowledge. De Landa is proposing that object-to-object relations could provide spaces for software agents to become enculturated, and thus, self-organizing, intelligent entities.

Despite the problems embedded in conceptualizing social transformation in terms of 'critical periods,' De Landa's argument strengthens observations that software provides a powerful cultural-mythic and psycho-social metaphor for relations between the self and the other. In effect, De Landa is positing that software agents are so powerful, they are about to emerge from the primordial soup of bits and bytes, break through an evolutionary hurdle and emerge as new computational life forms. In some senses, the software agent already embodies this power, this new 'energy.' Ultimately, the surface or the skin of the interface demarcates not just the limits of self, but also contains the other. In the case of the computer, the software agent gives a face to the 'new energy' De Landa refers to; even if that skin will reflect the socio-material and cultural contexts from which it has emerged.

Conclusion

The body is [woman and] man's most natural instrument. Or more accurately, not to speak of instrument, [woman and] man's first technical object.

(Marcel Mauss 1992 [1934]: 461)

In our societies, there are two systems of appeal: non-human and super-human, that is machines and gods.

(Bruno Latour 1988: 304).

Although I have explored a significant number of theoretical viewpoints, a lot of work remains to be done on software agents. In some senses, this thesis provides a basic platform for introducing and developing thinking about software agents as a social entity. In summation, I would like to evaluate what this thesis contributes to sociological understandings about software agents and technology in general.

One of the motivations inspiring this project involved questions of how technology can contribute to extended practices of inclusion, and alternatively exclusion. Ultimately, I wanted to interrogate how socio-technical systems have influenced notions of cultural belonging. Implementing software agents as an analytical vehicle facilitates observations of the continued embeddedness of social and material practices. These practices become especially apparent when the relationship between gender and technology is observed in the hyperfeminized form of many software agents. In this sense, the metaphorical power of the puppet and the automaton to organize understandings of the self, the other, the world and their contingent inter-relationships highlight several of the software agents' historical continuities. As the enculturated model of knowledge posits, embeddedness is a fundamental element for creating artificial intelligence. Even if attempts to create artificial intelligence (or even codify what intelligence is) fail, as could easily be

argued with software agents, technologies are deeply rooted in the social realm. Social constructionists point to many indications of how socio-cultural practices become fixed within technical designs and artefacts.

In the case of software agents, stereotypical notions of femininity and women's work have clearly influenced software agent designs and functions. However, on a cultural mythic level, software agents do suggest that they embody new metaphors for understanding self / other relations. As I proposed in chapter three, this metaphor appears to indicate a process of enselfment, of the continual attempt to re-define shifting boundaries by the development of a 'hyper-skin' – simultaneously enclosing the self and inscribing the 'other' (particularly the computer) with a subjectivity that must be contained. The cyborg, in contrast, symbolizes the internalization of the machine in order to achieve interactivity. The software agent, on the other hand, is an attempt to limit interactivity – to close off incoming information, interaction – or whatever it is that demands the users' attention.

The agent field appears to be paralleling the agent's metaphorical content, particularly by such pervasive attempts to define, categorize and demarcate agent territory from potentially threatening impostors. I find the connection between psychoanesthesia's crises of boundaries very provocative, and it is a connection that calls for further development.

So as a preliminary answer to the question, 'do new technologies (as represented by software agents) constitute a series of identifications that warrant unique codes of belonging?' The answer appears to be 'no.' Rather, software agents enable the construction of a series of identifications that enact codes of exclusion.

However, in relation to the latter part of the original question (does the software agent warrant a unique code of objectifications?) the answer appears to be 'yes.' Building upon Emile Durkheim's models of social solidarity, software agents mark the emergence of new forms of social cohesion containing object-to-object relationships. Following ANT, objects are becoming inscribed with subjectivity, and the software agent provides a face for objects to realize inscriptions of subjectivity.

However, given Downey's argument about boundary work and the invisible labour needed to perpetuate and maintain digital and analog 'internetworks,' empirical analyses must be conducted in order to determine the degree to which invisible work is required to maintain software agents and their intended functions. From another perspective, software agents contribute to the invisibilization of what constitutes predominantly women's labour; which primarily occurs by automating and replacing low status and underpaid forms of labour. Again, further work needs to be conducted in this area, particularly because internetworkers are so fundamentally connected to the ubiquity of information infrastructures.

In relation to one of the questions introduced in chapter one, 'Does the relationship between software agents' functions (e.g. customer service) situate users within a 'universal' sphere, from which only particular forms of knowledge can be generated?' several chapters provide relevant insights. For example, feminist epistemologists would definitely claim that software agents do situate users within a 'universal' sphere, however, this is a universal sphere defined and designed by men. The hyperfeminized software agent indicates that the primary cyber subject is male, which is clearly reflected in current internet demographics (see Appendix D). This raises another absence, not just in the body of this research, but also in the agent

literature: namely, where and how are fantasy software agents being applied and constructed?

Although I have only opened the doors for exploring how software agents incur social atomization or aid social cohesion, I have succeeded in providing a solid platform for the sociological analysis of software agents and technology. Building on Durkheim's concepts of organic and mechanical solidarity situates Durkheim as the intellectual predecessor to Calhoun's concept of 'indirect relationships.' Synthesizing Durkheim and Calhoun's ideas provides an interesting insight into some of software agent's more significant social implications. In tandem, De Landa's hypothesis that 'computational societies' provide a rich feeding ground that ultimately nourishes software agents' potential to evolve into new life forms appears almost possible from within a social paradigm that recognizes that objects have relationships. De Landa's argument transforms Calhoun's notion of 'indirect relationships' into a layered version of interaction.

Both the exponential growth of agents and the agent field, in conjunction with the diverse array of disciplines involved in agent development, constitute serious limitations on the scope and applicability of this research project. Given the conditions of extreme change, constant expansion and the disparate disciplinary languages engaged by agent developers, software agents comprise a rich and remarkably problematic research area. For example, even within sociology there are many analytical paradigms that would greatly inform an understanding of software agents, of which, I have addressed only a minute selection.¹⁰⁵ However, rendering

¹⁰⁵ For example, Baudrillard's concept of 'simulacra,' Deleuze and Guattari's theory of 'concrete' and 'abstract machines,' Goffman's dramaturgical approach and symbolic interactionism (to name a few), all provide potentially profound analytical routes into a much broader sociology of software agents.

the complex multi-disciplinarity of the agent field decipherable is, of itself, a challenging and significant contribution to the sociology of technology. Particularly, because the paucity of social science research in this area means that the first goal of this project has been to identify and sociologically introduce software agents; unfortunately, at the expense of excluding the application of a vast number of potential social and cultural theories. Further, the lack of empirical research in this dynamic area impedes the degree to which it is possible to precisely concentrate on individual agents or compare the differential subtleties between agent paradigms and programs. As a result, this research is not confined to any one software agent that may quickly become obsolete.

In closing, there are numerous areas calling for further work. Primarily, I think it is absolutely necessary to develop a critical engagement with the software agent's environment or the network. For example, Michel Callon claims that the network that needs to be examined is, "not a network connecting entities which are already there, but a network which configures ontologies" (as cited in Suchman 2002a). Whether one regards 'ontology' to convey the nature of being (as in the sociological sense) or the particular agent domain (as in the agent developer sense), networks need to be historically situated, and their relation to subjectivity – and subject-ification – calls for interrogation. I plan to continue this line of questioning through future work on technological citizenship (or what can loosely be defined as informal and formal practices of belonging and exclusion) and the relationship between new ICTs, such as software agents, and globalization.

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Appendix A: Select Autonomous Agents

Hybrid Software Agents (Entertainment and Task-Specific Agents): Ananova, VirtuaGirl and Virtual Models

Ananova: News and Information Mediator

Ananova is virtual green haired 'head only' news anchor designed to disseminate news to users. Her face is composed of the best features from ten of the top supermodels. In the year 2000, Ananova was purchased by *Orange* (a British

Figure 1

telecommunications and mobile phone company) for between \$142 - \$144 million US dollars (Muehlbauer 2000). Speculations about Ananova's fate at *Orange* include the possibility of becoming a talking interface for *Orange* mobile telephone users. Ananova will thus act as a friendly mediator for company information and client services and may appear on the liquid display window of each *Orange* mobile telephone. Currently, Ananova can respond to text-based questions via her web-site www.ananova.com. Ananova's designers, *Digital Animation Group (DAG)*, have produced a second-generation virtual agent named TMmy. Both agents rely on pre-programmed responses and behaviours, although, DAG hopes that both interfaces will soon be able to automatically detect and spontaneously exhibit appropriate situation specific responses and interactions (Heuer 2000).

VirtuaGirl:

"Imagine having a beautiful girl who says hi in the morning, reminds you of your appointments, dances and strips for you whenever you ask? VirtuaGirl can be whoever and whatever you want, whenever you feel like right on your desktop. VirtuaGirl is entirely yours to customize: you will never be late for your

appointments again, she will be your lovely reminder" (Agentland, URL: <http://www.agentland.com/pages/common/news/2001/sept01/week4.html>)

"Want a sexy beauty living and stripping on your desktop?

So download the VirtuaGirl software now and a whole bunch of horny chicks will be yours for ever ! It's easy and fast, 100% free. Imagine a beautiful girl saying hi in the morning, reminding you of your appointments, dancing and stripping for you whenever you ask?" (URL: <http://www.virtuagirl.com/>)

Virtual Models:

NoDNA is another virtual modelling agency, and unlike Elite, they have approximately 9 other models, two of which are male.

NoDNA's virtual models also have 'personalities,' hobbies and other forms of 'virtual' employment. There are many other virtual models emerging, such as Webbie Tookay (no picture available) who is one of *Elite Modelling Agency's* first 'Super Virtual Models' (SVA) intended to provide an always 'work ready' model designed to model clothing, products and services for subscribing companies.

Task-Specific Software Agents: Luci McBot and SANDi™

Luci McBot: Virtual Executive and Customer Information

Portrayed as a red-headed 'Scottish' lass who is also an expert on *Artificial Life* (the designers), Luci is an animated 'virtual executive' who can respond to limited text based inquiries, such as "Tell me about your products?" Luci is one of three different

'bots,' each with their own areas of expertise and interests. Bots are designed as commercial web hosts and are capable of providing 24-hour customer access to company products and services. Bots engage in 'natural conversation' including animated smiles, winks, and friendly gestural behaviour with the client in order to collect information for customer profiles. Figure 3 depicts Luci's standard line of greeting. The customer profiles that Luci creates are accessible by sales representatives and allow for "the next generation of profiling and direct marketing" (Artificial Life Inc. 2000). Prices range from \$150 000 - \$500 000 (Heuer: 2000).

SANDi™: Digital Secretary (Sound Advantage Natural Dialog Interface)

The company, *Sound Advantage* claims that this product is a speech activated “perfect receptionist” capable of handling all the voice mail needs for small to mid-sized companies. SANDi™ is one of the latest developments in voice recognition software program, and is designed to connect Windows NT with your telephone system. She will answer your telephone calls and direct them to the appropriate place. Available for lease at US \$92 a month, SANDi™ will screen calls, forward callers or messages, return calls and handle all of your telephone needs. *Sound Advantage* claims that “in many ways, SANDi™ is the mouse for the communications industry. But instead of point and click it's pick up and speak. Never before has communication been so simple. Never before has communication been so fast” (Sound Advantage 2000). According to her designers, SANDi's™ best selling points include that she will work for 24 hours a day, is not in a union and thus, the cost of employing her works out to \$0.49 per hour. SANDi™, like Ananova and Luci McBot is one of many “electronic virtual assistants” (EVAs) which signals the automation of socialized labour, particularly customer service, clerical, secretarial and administrative work.

Task-specific Agents Without Faces: CiteSeer, Firefly and Letizia

CiteSeer (1998, Bollacker, Lawrence and Giles):

“Research papers available on the World Wide Web (WWW or Web) are often poorly organized, often exist in forms opaque to search engines (e.g. Postscript), and increase in quantity daily. Significant amounts of time and effort are typically needed in order to find interesting and relevant publications on the Web. We have developed a Web based information agent that assists the user in the process of performing a scientific literature search. Given a set of key-words, the agents uses Web search engines and heuristics to locate and download papers. The papers are parsed in order to extract information features such as the abstract and individually identified citations. The agent’s Web interface can be used to find relevant papers in the database using keyword searches, or by navigating the links between papers formed by the citations. Links to both ‘citing’ and ‘cited’ publications can be followed. In addition to simple browsing and keyword searches, the agent can find papers which are similar to a given paper using word information and by analyzing common citations made by the papers” (Bollacker et al. 1998: 116).

Firefly (≠ 1996, from MIT's 'Software Agents Group):

Patti "Maes, along with [graduate student, Max] Metral and some other students, next set about making agents that could apply collaborative filtering to compare the musical tastes of different users. If someone liked Suzanne Vega and Shawn Colvin, for instance, they could be linked to a user whose preferences included Vega, Colvin, and Natalie Merchant.

Why start with a musical agent? "All the projects we do are personally motivated," Maes happily admits. Ringo, as the prototype was dubbed, solved her music problem: she couldn't find an interesting mix of artists on Boston radio, nothing like the eclectic selection in Brussels.

What Maes liked especially was the possibility of collaborative filtering fostering community

To date, the company has generated an impressive \$18 million from venture capital sugar daddies, including Esther Dyson, Merrill Lynch, Softbank, Trident, and Dun & Bradstreet. One of the earliest financiers was Atlas Venture's Christopher Spray, a man who, coincidentally, had previously bankrolled Maes's sister Kathleen and her electronic publishing operation, SoftCore Inc., in Belgium.

The company built a Web site, rechristened the Ringo prototype [developed circa 1994] Firefly, and created an area where visitors could set up a personal profile that described their musical interests (it also managed to include their ZIP code, age, and gender). They then could step back and just let the algorithm do its thing, hooking them up with music they might enjoy. They also had the option of chatting with people who showed similar musical tastes, a feature that made the site very popular, Maes explains. (And the demographic and psychographic information in the Firefly profile - which is called Passport - in turn allows the marketers to crisply target their advertisements to, say, a 20-year-old woman living in Manhattan's Upper West Side, or a 55-year-old man in Miami.) The company changed its name to Firefly Network Inc. in August 1996."

(Excerpted from Maguerite Holloway's 'Pattie,' *Wired*. Vol. 5, no. 12, December 1997. URL: http://www.wired.com/wired/archive/5.12/maes.html?person=jaron_lanier&topic_set=wiredpeople. Firefly was purchased by Microsoft in 1998.)

Letizia:

Henry Lieberman describes Letizia as "a user interface agent that assists a user browsing the World Wide Web. As the user operates a conventional Web browser such as Netscape, the agent tracks user behavior and attempts to anticipate items of interest by doing concurrent, autonomous exploration of links from the user's current position. The agent automates a browsing strategy consisting of a best-first search augmented by heuristics inferring user interest from browsing behavior" (nd. <http://lieber.www.media.mit.edu/people/lieber/Lieberary/Letizia/Letizia-Intro.html>).

"The model adopted by Letizia is that the search for information is a cooperative venture between the human user and an intelligent software agent. Letizia and the user both browse the same search space of linked Web documents, looking for "interesting" ones. No goals are predefined in advance. The difference between the user's search and Letizia's is that the user's search has a reliable static evaluation function, but that Letizia can explore search alternatives faster than the user can. Letizia uses the past behavior of the user to anticipate a rough approximation of the user's interests.

Critical to Letizia's design is its control structure, in which the user can manually browse documents and conduct searches, without interruption from Letizia. Letizia's role during user interaction is merely to observe and make inferences from observation of the user's actions that will be relevant to future requests.

In parallel with the user's browsing, Letizia conducts a resource-limited search to anticipate the possible future needs of the user. At any time, the user may request a set of recommendations from Letizia based on the current state of the user's browsing and Letizia's search. Such recommendations are dynamically recomputed when anything changes or at the user's request.

Letizia is in the tradition of *behavior-based* interface agents [Maes 94], [Lashkari, Metral, and Maes 94]. Rather than rely on a preprogrammed knowledge representation structure to make decisions, the knowledge about the domain is incrementally acquired as a result of inferences from the user's concrete actions.

Letizia adopts a strategy that is midway between the conventional perspectives of *information retrieval* and *information filtering* [Sheth and Maes 93]. Information retrieval suggests the image of a user actively querying a base of [mostly irrelevant] knowledge in the hopes of extracting a small amount of relevant

Figure 6

material. Information filtering paints the user as the passive target of a stream of [mostly relevant] material, where the task is to remove or de-emphasize less relevant material. Letizia can interleave both retrieval and filtering behavior initiated either by the user or by the agent."

(Descriptive excerpt from Henry Lieberman's web-based article, *Letizia, An Agent that Assists Web Browsing*, [URL: <http://lieber.www.media.mit.edu/people/lieber/Lieberary/Letizia/Letizia-AAAI/Letizia.html>])

Entertainment Software Agents: Kyoko Date, Rachel, Thani

Figure 8

Kyoko Date: One of the First - Virtual Idol

Created in 1996, Kyoko is referred to as an idoru or a virtual idol (an ideal 'idol' or young pop stars) with an extensive personal profile.

Kyoko released an album in 1996 and planned to release another one in 1998. The voice behind the imagery is provided by a 'seiyuu' (a flesh and blood singer / performer) and another 'real' person provided a body from which Kyoko's image was designed (Totally Useless 1997). According to Robert Hamilton, virtual idols are a stronger market than flesh and blood idols in Japan (1997: 9). Horipro, the company responsible for Kyoko's design, is

working on developing new virtual idols and are currently working on 'Pink Lady X,' an acrobatic duo capable of inhuman gymnastic feats intended to 'pick up where Kyoko left off' (Hamilton 1997: 12).

Figure 7:

Preliminary design for Kyoko without virtual flesh.

Figure 9

Figures 10 and 11

Tahni (Figure 12):

"Tahni is a sexy supermodel who lives and plays on your desktop. She reacts if you touch her or move her around the screen with your mouse. If you leave her alone, she will amuse herself and entertain you in the process" (Agentland, <http://www.agentland.com/pages/common/news/2001/sept01/week4.html>)

Artificial Life Agents: Cellular Automata and DALi

Figure 13: An example of cellular automata - Rucker and Walker describe this CA as an applications of 'The TimeTun rule after 195 generations' (n.d.).

Cellular Automata (CAs):

Rudy Rucker and John Walker define cellular automata as "self-generating computer graphics movies. The most important near-term application of cellular automata will be to commercial computer graphics; in five years you won't be able to watch television for an hour without seeing some kind of CA. Three other key applications of cellular automata will be to simulation of biological systems (artificial life), to simulation of physical

phenomena (heat-flow and turbulence), and to the design of massively parallel computers" (n.d.).

Rucker and Walker identify the most significant thing about CAs as "their ability to produce interesting and logically deep patterns on the basis of very simply stated preconditions.... A good CA is like an acorn which grows an oaktree, or more accurately, a good CA is like the DNA inside the acorn, busily orchestrating the protein nanotechnology that builds the tree" (n.d.).

Autonomous Robotic Agents: Petit-Mal

Petit-Mal (1989-1993, Simon Penny, Carnegie Mellon University):

"Although much work has been done in the field of screen-based interactive art, the mode of interaction in these works is confined by the very existence of image material on a screen, the so called "graphical user interface". I am particularly interested in interaction which takes place in the space of the body, in which kinesthetic intelligences, rather than "literary-imagistic" intelligences play a major part.

The goal of Petit Mal is to produce a robotic artwork which is truly autonomous; which is nimble and has "charm"; that senses and explores architectural space and that pursues and reacts to people; that gives the impression of intelligence and has behavior which is neither anthropomorphic nor zoomorphic, but which is unique to its physical and electronic nature.

Figure 14: Petit-Mal with a member of the public

The formulation "an autonomous robotic artwork" marks out a territory quite novel with respect to traditional artistic endeavours as we have no canon of autonomous interactive esthetics. Petit Mal is an attempt to explore the esthetics of machine behavior and interactive behavior in a real world setting. Its public function is to present visitors with the embodiment of a machine "intelligence" which is substantially itself, not an automaton or simulation of some biological system. More generally, Petit Mal seeks to raise as issues the social and cultural implications of "Artificial Life". The reflexive nature of interactivity is a focal issue: interactive behavior is defined by the cultural experience of the human visitor. As in the Turing Test, evaluation of interactivity is subjective.

Figure 15:
Petit-eiffel-mal.

Petit Mal is in some sense an anti-robot. Most conventional robots are elaborations of von Neumanns~ notion of the universal machine, in which the physical machine is simply a formless form to be filled with software "content". This attitude is an application of the Cartesian idea of the mind-body split. Petit Mal is an attempt to build a robot which opposes this attitude. Hardware and software were considered as a seamless continuity, its behavior arises from the dynamics of its "body".

Petit Mal is not a tool in the sense that an industrial robot is a tool, it does not execute a predefined task in an optimized way. In robotics terminology it is a reactive robot, it is on its own little voyage of discovery. Although the principle of Brooksonian subsumption architecture was influential, the software architecture of Petit Mal is a hybrid of various techniques devised with respect to its particular form and dynamics.

In neurological terminology, a Petit Mal is a momentary loss off consciousness. It is important that Petit Mal is just a little out of control, it is a reaction to oppressive {sic} theories of control so ubiquitous in computer science. It is an engineer's nightmare, although the mechanical structure is inherently stable it has a chaotic motion generator at its heart, the double pendulum, an emblem of unpredictability.

Petit Mal was produced on a tiny budget and a conceptual efficiency or compactness was desired. The aim was to under-engineer as far as possible; to choose simple solutions over complex, even if they were statistically less reliable; to produce a robot which has seemingly intelligent relation to both objects and people, with the minimum of hardware, sensors and code. The design process of Petit Mal sought not to ~design out~ unreliable behavior, but to capitalize on mechanical or electronic quirks, such as the dynamics of the double pendulum structure or the limitations of a sensor, as generators of emergent behavior, of "personality".

Its mechanical structure is a pair of nested pendulums of welded aluminium suspended from a pair of bicycle wheels on a common axis (a dicycle). This design is lightweight, economical (a full range of motion and control is achieved via only two motors) and self stabilising. The upper pendulum houses processor, sensors and logic power supply. The lower pendulum houses motors and motor power supply. The inner pendulum functions to keep the sensors (more or less) vertical while the under frame swings due to acceleration. Batteries in both frames function both as power

source and counterweight. It has three ultrasonics sensors paired with three pyroelectric (bodyheat) sensors in the front and a fourth ultrasonic at the back. There is an accelerometer and two motors with optical encoders for motor feedback. These are coordinated by a single Motorola 68hc11 microprocessor. A second processor will be added to allow Petit Mal to learn. Petit Mal will function autonomously in a public space for several hours before requiring battery {sic} replacement.

Having designed the basic geometry of the work, the material aspects of the work were proscribed by the necessity that it be lightweight, durable and mechanically efficient. This led to a physical appearance {sic} which had a "laboratory prototype" esthetic which visually coded the work in a very specific way. An attempt to defuse or confuse that particular reading, while avoiding anthropomorphic/zoomorphic readings has been made by the addition of coverings of domestic printed vinyl tablecloth on some of the parts.

Petit Mal was first designed in 1989, building was begun in 1993. Assistants in the project have included Mark Needelman, Kurt Jurgen Schafer, Gabe Brisson and Jamieson Schulte."

(Excerpt from Simon Penny's website: [nd.http://www-art.cfa.cmu.edu/Penny/works/petitmal/petitcode.html](http://www-art.cfa.cmu.edu/Penny/works/petitmal/petitcode.html)).

Appendix B: Artificial Intelligence Projects

Time Line: Historical Developments in Artificial Intelligence

1936: Alan Turing designs an abstract design for a computer that becomes to be called the 'Universal Turing Machine'

1941: Konrad Zuse creates the **first general purpose computer**

1943: Bletchley Park's '**Colossus**' (Code cracking computer)

1945: John Mauchly and J. Presper Eckert's (Moore School of the University of Pennsylvania) **ENIAC** (Electronic Numerical Integrator and Computer)

1948: F. C. Williams and Tom Kilburn built the first general purpose Manchester University Computer (Mark 1 or **Ferranti Mark 1**).

Early 1950s: Albert Samuel - **chess and checker playing program** that had an inbuilt 'learning mechanism'

1956: Alan Newell and Herbert Simon's **Logic Theorist** (built on the Eric von Neumann's JOHNNIAC)

1956: Dartmouth Conference on 'Artificial Intelligence' - organized by John McCarthy

1957: Alan Newell, Herbert Simon and Cliff Shaw's **General Problem Solver**

1965: Joseph Weizenbaum created '**ELIZA**'

1965: Edward Feigenbaum: developed 'expert systems' (**DENDRAL**)

Mid 1960s: Knowledge Engineers

1970: Emergence of semantic models of information processing

1971: Terry Winograd's '**Shrdlu**'

1972-1975: Edward Shortliffe's '**MYCIN**'

1975: Gerard Sussman's '**Hacker**'

1984: Beginning of Doug Lenat's '**CYC**' project

Eliza: One of the First Artificial Intelligence Projects:

Joseph Weizenbaum developed Eliza, a realistic 'psychotherapist' program (Garnham 1988: 10; Copeland 1993: 12). Jack Copeland describes Eliza as a 'simple' program that can simulate human conversation to the extent that users not only became attached to Eliza, but treated the program as if it were human (1993: 14). For example, here is a segment of a conversation between Eliza and a teenager:

Teenager: Men are all alike.

Eliza: In what way?

Teenager: They're always bugging us about something or other.

Eliza: Can you think of a specific example?

Teenager: Well, my boyfriend made me come here.

Eliza: Your boyfriend made you come here?

Teenager: He says I am depressed much of the time.

Eliza: I am sorry to hear that you are depressed.

Teenager: It's true that I am unhappy.

Eliza: Do you think coming here will help you not to be unhappy?

Teenager: I need some help, that much seems certain.

Eliza: What would it mean to you if you got some help?

Teenager: Perhaps I could learn to get along with my mother' (cited in Copeland 1993: 14).

Eliza: Tell me more about your family.

Teenager: My mother takes care of me.

Eliza: Who else in your family takes care of you?

Teenager: My father.

Eliza: Your father?

Teenager: You are like my father in some ways.

Eliza appears to understand, perceive and comprehend the meaning of the teenager's comments, however, Eliza is based on a 'pattern matching' or 'parsing' program (Garnham 1988: 146; Copeland 1993: 42-43). Weizenbaum programmed Eliza to identify words according to 'phrases, clauses and sentences' (parsing) and match these patterns within a response template (Garnham 1988: 146). Although, Eliza appears to be convincingly 'intelligent' this program does not understand or comprehend the meaning of 'boyfriend,' 'depressed' or 'help.' Eliza's use of these terms is dependent upon 'matching' the user's input. Regardless of how Eliza simulates intelligent conversation, some users believed that Eliza was human and this belief has radical implications for assessing artificial intelligence.

Influential Historical Expert Systems:

DENDRAL (1965-1983*, DENDRitic ALgorithm) and CONGEN (CONstrained GENerator):

"The DENDRAL Project was an application of computer science to the problem of molecular structure elucidation in organic chemistry: the determination of the topological structure of organic compounds from indirect observations of these compounds with the empirical procedures of modern chemistry such as mass spectrometry. This problem is important because the chemical and physical properties of compounds are determined not just by their constituent atoms, but by the arrangement of these atoms as well. "DENDRAL" is the name of the research project, which was conducted at Stanford University ... under Joshua Lederberg,

Edward Feigenbaum, Bruce Buchanan, and Carl Djerassi as principal investigators. "DENDRAL" is also the name of the programs produced by the project...

The CONGEN program ... is one of the most important programs resulting from this research and embodies the general (acyclic and cyclic) generation algorithm in a system that allows a chemist to constrain its enumeration in a variety of ways. CONGEN is written in BCPL and is being made available to interested researchers as is, without any warranty or support" (Kantrowitz 1994).

MYCIN (1972-1983*):

"Mycin was an expert system developed at Stanford in the 1970s. Its job was to diagnose and recommend treatment for certain blood infections. To do the diagnosis "properly" involves growing cultures of the infecting organism. Unfortunately this takes around 48 hours, and if doctors waited until this was complete their patient might be dead! So, doctors have to come up with quick guesses about likely problems from the available data, and use these guesses to provide a "covering" treatment where drugs are given which should deal with any possible problem.

Mycin was developed partly in order to explore how human experts make these rough (but important) guesses based on partial information. However, the problem is also a potentially important one in practical terms - there are lots of junior or non-specialised doctors who sometimes have to make such a rough diagnosis, and if there is an expert tool available to help them then this might allow more effective treatment to be given. In fact, Mycin was never actually used in practice. This wasn't because of any weakness in its performance - in tests it outperformed members of the Stanford medical school. It was as much because of ethical and legal issues related to the use of computers in medicine - if it gives the wrong diagnosis, who do you sue?" (Cawsey 1994).

PUFF (1977-1979,* for interpreting Pulmonary Function Data):

"The PUFF system was the first program built using EMYCIN. PUFF's domain is the interpretation of pulmonary function tests for patients with lung disease. The program can diagnose the presence and severity of lung disease and produce reports for the patient's file. Once the rule set for this domain had been developed and debugged, PUFF was transferred to a minicomputer at Pacific Medical Center in San Francisco, where it is used routinely to aid with interpretation of pulmonary function tests. A version of PUFF has been licensed for commercial use" (Shortcliffe n.d.).

PROSPECTOR (1980s*):

PROSPECTOR was designed to “aid geologists in their search for ore deposits. Given field data about a geological region, it can determine the propability {sic} of discovering a range of ore deposits, including sandstone uranium, massive sulfide, carbonate lead/zinc, etc. Its expertise is based on geological rules which form models of ore deposits, and a database of known rocks and minerals. In 1980, PROSPECTOR analyzed geological data from a site near Mount Tolman in eastern Washington and predicted the existence of molybdenum (an ore) in a particular location. Subsequent drilling by a mining company confirmed PROSPECTOR's prediction” (ALIVE n.d.).

*Dates compiled from Shortcliffe, Darlington, Cawsey, Kantrowitz, ALIVE and many other sources. The largest range of dates is applied when discrepancies appear. See Ted Shortcliffe's web-site for an overview of other influential expert systems (URL: <http://smi-web.stanford.edu/projects/history.html#MYCIN>).

Time-line of Major Automaton Developments*

The emergence of clockwork (1270)

Emergence of Stage 1:
Mythical Automaton (relation to the cosmos)

Hans Bullman (circa 1535) constructed the first ANDROID
Gianello Torriano (1560): believed to have invented the dancing lady with lute (please see fig. 2 and 3)

Rene Descartes: 1637
(1596-1650)

Cornelius Drebbel (1666)
automatic furnace or athanor which utilized a thermostat

Jacques Vaucanson (1735-1737):
constructed several mechanical devices, including a duck with a visibly moving mechanical anatomy and several androids

Pierre and Henry Louis Jacquet-Droz (late 1700s):
Designed three androids: the writer, the artist and the musician

James Watt (1765):
Invented the steam engine which sparked the 'industrial revolution'

Ancient Chinese mechanical toys, devices and flying machines

Giovanni de Dondi (1364):
The 'astrarium,' a very complex astronomical clock designed to map the movement of the sun, moon, universe and rising tides

Emergence of Stage 2:
Mechanistic Automaton (dissect and copy the body)

Saloman De Caus (1615): Pleasure Gardens: automated waterworks, clocks and "hydraulic displays" (Bedini 1964: 2)

Emergence of Stage 3: Mechanical Automation (concentrations of machines, workshops and factories)

Tomasso Francini (circa 1698):
extravagant elaboration of De Caus' waterworks, involving three 'grottoes' depicting mythic figures**

Friedrich von Knauss (between 1753-1760):
Created the writing machine - a figure of autonomously Writing "a lengthy passage of 107 words" (Bedini 1964: 10)

18th Century: proliferation of mini-automatons - mechanical toys and amusing devices

Stage 4 and 5

4) links with neomechanisms endowed with at least a semiautonomous intelligence; and 5) synthetic live

*Data collected from Bedini 1964; Bedini and Maddison 1966; Mazlish 1993; and Liu 2000.

**Demonstrates a further link between the social imaginary and the automaton

Beaune's Model of Automata and Social Stages

Jean-Claude Beaune has proposed a useful cognitive schema outlining both the developmental stages that automata have undergone and, by inference, also applies to the above mentioned developmental stages of the automaton:

Stage	Description	Corresponding Dimension
1) Mythical Automaton	'maintains a relationship with the cosmos, with the totality of things'	Space and objects
2) Mechanistic Automaton	'an attempt to dissect and copy the human body and the body of other living creatures'	Objects and bodies
3) Mechanical Automation	'groups together concentrations of machines, workshops and factories, in accordance with very inflexible rules;'	Space and bodies
4) Cybernetics and Computing	'links with neomechanisms endowed with at least a semiautonomous intelligence or the ability to adapt, making it equivalent to a new kind of living creature;'	Bodies, space and objects (e.g.) artificial intelligence
5) Synthetic Live Matter	Tomas does not offer a description, but I understand this stage to incorporate human flesh or a facsimile of flesh (such as 'Onco-Mouse' or Rucker's 'cellular automata') (Beaune in Tomas 1995: 260).	Bodies

Despite the ease with which we can look at the history of the automaton through Beaune's phases, it is important to emphasize the permeability of these stages; they are not isolated to a specific time (or category) and as the timeline (on following page) indicates, all of the developmental stages considerably overlap. It is important to note that stage 2 has strong historical roots that predate the emergence of stage 1. Additionally, automata do not incite a mechanical view of the world, rather, automata mirror the emergence of an increasingly mechanized social paradigm. Finally, the fourth and fifth automaton stages incorporate the cyborg and the software agent as one of the most recent incarnations of the automaton. These stages are beyond the scope of this thesis, but critically examining models of social cohesion and stages of social development in relation to technology are an excellent topic for future research.

Appendix B: Internet Demographics

Figure 1: *Percent of population over 15 years of age that used the internet in the previous 12 months. Source: General Social Survey, Cycle 14, 2000, compiled by Philip Robinson.

Figure 2: Source: Household Internet Use Survey, 2000, compiled by Philip Robinson.

Internet Use By Education of Household Head

Figure 3: Source: Household Internet Use Survey, 2000, compiled by Philip Robinson.

Typical Internet Users and Non-Users

Figure 4 summarizes the differences between 'typical' internet users and non-users.

Figure 4: *Demographic trends in internet use.*

The Typical Internet User:	The Typical Internet Non-User:
Urban	Rural
English-speaking	French-speaking
Male	Female
Younger	Older
Higher Income	Lower Income
Higher Level of Education	Lower Level of Education

Source: Robinson, Phillip. Unpublished paper, 'Canadian Internet Use and Online Research: A Feasibility Study.' (2002, Carleton University).