

An actor-network approach to games and virtual environments

Mark Cypher
Murdoch University
School of MCC, Div. of Arts
South Street, Murdoch, WA 6150

Ingrid Richardson
Murdoch University
School of MCC, Div. of Arts
South Street, Murdoch, WA 6150

M.Cypher@murdoch.edu.au

I.Richardson@murdoch.edu.au

ABSTRACT

In this paper we apply some of the insights of Bruno Latour and actor network theory to suggest that games and virtual spaces can be interpreted as aesthetic forms which are established and stabilised by a 'collective' of humans and technologies. The 'agents' that comprise any collective or network – whether it be a simple human-tool relation or a far more complex assemblage of actors in massively multiplayer games – are equally human and non human, social and material, corporeal and technical. Yet the combining effects of these factors rarely rate a mention in the discourses of ludology and game studies, which we suggest is for several key historical and technical reasons. The application of actor-network theory to games and virtual environments aims to facilitate a nuanced understanding that exceeds more conventional user- and viewer-centred interpretations in game studies, and is therefore more organic to the open-ended and constantly changing nature of our engagement with online games and virtual environments.

1. INTRODUCTION

According to my origin myth, it is impossible even to conceive of an artifact that does not incorporate social relations, or to define a social structure without the integration of nonhumans into it. Every human interaction is sociotechnical.

Bruno Latour (1994: 805-6).

In this paper we begin with the assumption that digital games are aesthetic forms created and sustained by the collective agencies and proclivities of both humans and technologies. We examine the conditions that allow or deny these relationships to materialize, and suggest that they are simultaneously material,

corporeal, social and technical. Yet the combining effect of these factors rarely rate a mention in the discourses of ludology and game studies, which we suggest is for several key historical and technical reasons. Using the work of Bruno Latour (and the insights of Actor Network theory more generally), we examine game-play outside the more common user-centred interpretations in ludology texts. In particular, we consider some of the material, corporeal and technical affordances relevant to digital gaming, and suggest how Massively Multiplayer Online Games (MMOGs) or Massively Multiplayer Online Role Playing Games (MMORPGs) can be considered as *sociotechnical* in Latour's terms – as multi-perspectival, generative, dynamic, embodied and open-ended networks of human and non-human agency.

Playing computer games is seriously challenging. The act of play is full of possibilities that are as much about overcoming obstacles as they are about contributing to something larger than the sum of its parts. Often governed by a small number of rules, computer games can generate relationships of surprising complexity, often building patterns and perpetual novelty far beyond the maker's intentions. These relationships multiply exponentially when environments such as massive multiplayer online games are taken into account. To say that online multiplayer computer games are simply fun belies the importance of being subjected to the ebb and flow of an emergent dynamic involving social, material and technological components. This evolving relationship made of multiple intentions, intelligences and goals often takes on a life of its own, constantly challenging assumptions about the nature of how games are played and who is playing who.

MMOGs and MMORPGs have been enabled by the internet, with varying levels of pictorial and strategic complexity. Initially only accessible by military and research organizations the internet became a public domain with game possibilities that allowed for the creation of virtual spaces that were not confined within a single user's machine. MMORPGs can evolve into persistent worlds with tens of thousands of players, and simulate expansive virtual environments that continue to exist and change with or without any one user's input. MMORPGs such as Everquest, World of Warcraft and Eve Online allow users from around the world to interact and game together, creating their own adventures, friendships and societies over the Internet. Online

multiplayer games are unique to the virtual space of media forms; although other media such as TV and cinema offer the possibility of a mass audience consumption simultaneously, the virtual space that is created online can be explored, travelled and engaged with from multiple perspectives, with each user participating in and impacting upon the virtual space in real time. As we will argue, the ‘actor-network’ model can effectively describe the complex interaction and agency emerging from multiplayer online games. Before this, however, it is useful to consider why ludology has tended towards visualist, subjectivist, user-centred and immaterialist interpretations of games.

2. VISUALISM AND BLACKBOXING

Why is it that the very material processes of human/computer interaction, transistors, CPU’s or memory, that make the collective space of computer games possible in the first place are never seen as important? There are several reasons, but perhaps the two main culprits are the strong visualism or ocularcentrism in Western culture (with the screen interface – the ‘face’ of technology – is the primary technology of vision), and the aptly named process of blackboxing.

Contemporary western culture can be said to have a particular epistemological and perceptual bias, an ocularcentrism which works to prioritise visual and screen representations. Theorists such as Martin Jay (1993), Jonathon Crary (1992, 1999), and David Levin (1988, 1993) have suggested that this properly began with the tradition of linear perspective, a visually configured space that has become so transparent to Western sensibility that it seems the effect of a ‘natural’ vision, if not a quality of the objective world. Yet as the theorists listed above argue, linear perspectivalism is the result of a particular instrumental development in Renaissance art, a technique which enabled the translation of three-dimensional *space* onto a two dimensional *flat* canvas (Jay, 1993: 51; Harper, 2000). In Alberti’s model of perspective (see figure 1), the artist uses a grid — sometimes referred to as “the square grid of the Renaissance” (Naughton, 2003) — to illustrate a two-dimensional representation in terms of a pyramid, with its apex the vanishing point, so as to give the illusion of three dimensional depth.

This grid was ideally used by a single privileged spectator (the artist), who could step back from the scene and observe from an elevated position. In his analysis of Alberti’s window or veil, Robert Romano (1989) points to the broader *artifactual* effects of the apparatus (Harper, 2000), and suggests how it demarcated what could be counted *as* the visible. The gridded device operates as a boundary, a frame which defines the seen/scene as separate from the observer. From the viewer’s perspective, the field of vision is fixed, and begins at a point beyond the imaginary surface of the window; the viewer looks into the scene, but is not himself *in* it. This model of linear perspective underlined and popularised the Cartesian dialectic of subject and object, such that in the space of linear perspective the observer sees the world as if through a window. Significantly, the

viewer’s bodily movement is restricted by the device, in that the grid needs to remain directly between the scene and the line of sight: the body is at the service of vision, an eye-body.

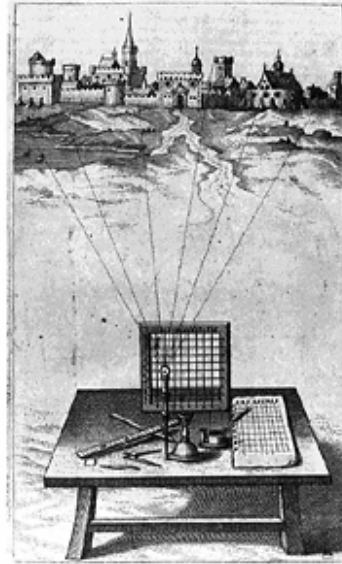


Figure 1: Alberti's Grid - c.1450 (Naughton, 2003)

As Romano argues: “Alberti’s window, which begins as an artistic device, thus becomes a style of thought, a cultural perception, a way of imagining the world... The window as membrane becomes the boundary, the place where the world is divided into exterior and interior domains” (Romano 1989: 69).

This aesthetic of window-on-the-world can thus be traced from perspectival painting to the numerous media screens (cinematic, televisual, computer) in contemporary use. Critics such as Weibel go so far as to say that:

The primacy of the eye... as the dominant sense organ of the twentieth century is a partial effect of a technical revolution that put an enormous apparatus to the service of vision. The rise of the eye is rooted in the fact that all of its aspects (creation, transmission, reception) were supported by analog and digital machines. The triumph of the visual in the twentieth century is the triumph of techno-vision (Weibel 1996: 339).

And as Manovich points out, despite numerous innovations in televisual media, the window remains as the archetypal interface:

Dynamic, real-time, interactive, a screen is still a screen. Interactivity, simulation, and telepresence: as was the case centuries ago, we are still looking at a flat, rectangular surface, existing in the space of our body and acting as a window into another space. We still have not left the era of the screen (Manovich 2001: 115).

In contemporary life screens are often a primary focus of our attention and concern: they literally frame and display that which

is relevant or worthy of notice. Yet while it is possible to trace our bias towards windowed perception and the priority we give to that which can be seen, it could be argued that some screens depart from the visual tradition of 'objectivity' guaranteed by the distance between object (the seen) and subject (the viewer). It is thus important to trace the specific effects of screens today, in terms of their functionality as cinematic screens, computer screens and televisions, along with their many modes of content specificity – as games, video, DVD interface and so on. As theorists such as John Ellis and Chris Chesher point out, ways of seeing and 'conventions of looking' are not innate or given, but culturally, materially and corporeally contextual, such that each 'new visual technology emerges with its own conventions — its own structures of feeling' and concomitant mechanisms of attraction and counter-distraction (Chesher, 2004). In his analysis of the console game, for example, Chesher (2004) distinguishes between ways of looking specific to cinema, television and console games — characterised by the gaze, the glance and the glaze respectively. As Chesher suggests, while cinema demands constant focus, and television requires only intermittent attention, console games are 'sticky', holding the player to the screen via both a quasi-visceral immersion in depth-perspective virtual space, and a haptic attachment to the hand-controller and peripherals: 'In glazespace... players suspend their awareness of their day-to-day world to become cybernetically suspended within a virtualised sensorimotor space of the game world' (Chesher, 2004). Thus while other forms of windowed perception have been primarily visual, the game experience sets up a different relationship with the screen, and a different experience of screen space as something with virtual depth to be entered, explored and traversed. As Newman states: 'the pleasures of videogame play are not principally visual but rather kinaesthetic' (Newman, 2002).

There are many instances of the agency of embodied interactions with screens that go beyond the visualist paradigm, to do with the physicality of the body and its own motility, and the relationship between the navigation of virtual space and the body. When using a hand controller, for example, we incorporate both it and the on-screen space into our own bodily space, and utilise it as a device that extends our reach and the realm of agentic possibility in televisual space. As Pam Martin comments, without having to consciously attend to button-pressing, we are able to aim at the screen by manipulating these instruments somewhat like a second body (Martin, 2002). In a more general sense, as bodies we clearly have a frontal and gravitational ontology that impacts upon the way in which we navigate screens. For example, the standard GUI on the PC screen, such as Windows Explorer, is configured in such a way that we experience our progression through directories as forward and back, in and out, up and down, in way that is more or less familiar to us in the actual world, thus 'user-friendly'. This body-interface relation also impacts upon the way we experience space in virtual environments, as something to be explored and colonised or conquered. As James Newman suggests, in many games the space itself is often an adversary. This clearly differentiates the virtual space of computer games as something quite distinct from the spatiality of traditional screen media interfaces, which are extractive or 'lean back' rather than immersive or 'lean forward'.

While there is no doubt that we have a primarily 'frontal' relationship with the TV screen, however, this is not to say that we have no association with the 'backs' of such devices, although these interactions are for the most part brief and functional, that is, for the purpose of connection, or negotiating an effective relationship with the front. When a machine runs smoothly for extended periods of time, however, its working processes often become blackboxed. People often legitimize blackboxing by stating that they don't need to know how a computer or a machine works in order to use it successfully. In some manifestations, such as automatic backup or scheduled tasks regularly performed on a computer hard drive, this 'black-boxing' seems appropriate. Yet blackboxing represents some major disadvantages to those interested in understanding complex sociotechnical relationships. To begin with it encourages observers to concentrate on the "real" work of defining fixed inputs and outputs – which is most often rendered as visual images or visual translations of information. This is fine if you intend to measure quantifiable outcomes but not so effective if you want to uncover how these outcomes came about. By examining and understanding the process of blackboxing it is easy to see how we get fixed a-priori interpretations of the human-machine relation.

Practices such as black-boxing encourage us to 'naturally' assume the humanist stance that complex machines like computers are mere tools, separate from and without influence when it comes to human activity. The need to clearly demarcate the competencies of both humans and machines stems in part from our anxieties about what it means to be a human being. The very same notion that drives these distinctions also reifies the concepts that human thought and action are primarily influenced by social interactions. There is no doubt that social forces are powerful, but no amount of constructionist theory can do justice to the material impact of human/computer interaction, CPU's or transistors in computer games. Similar relativistic story telling is exemplified in much of ludology discourse in that the semiotic (textual) and the social become interpreted as the prime movers for most MMOG and MMORPG environments. As such, human intellect and intention (the engineers for all things social and thereby privileged by cultural determinism) is left relatively autonomous from the vast array of interactions it has with technology and machines.

In what follows we will appraise the perspectives and concepts of several theorists that allow us to think about the relational ontology or imbrication of the social, the corporeal, the material and the technical in collective rather than discrete or autonomous terms, and outside the visualist and human-centred interpretations of agency and interface. We are not suggesting that technology (instead of society) is the primary influence on humans when engaging with contemporary media screens and playing computer games. Rather, we are arguing that a broader set of relationships must be taken into account when we consider an assemblage of computers, computer games, players, bodies, devices and all manner of other agents.

3. ACTORS, AGENTS, NETWORKS

Actor-network theory considers humans and artefacts as negotiations of both the social and the technical, irreducibly and non-hierarchically agents or actors within sociotechnical networks. Bruno Latour conceptualizes the human-technology relation as a heterogeneous network of human and non humans (technologies/machines/materials) that work together to make things possible that neither could achieve without the other. Just think how much of so called human advancement would not have been possible were it not for 'non humans' such as books, combustion engines or laboratory apparatuses. Likewise, consider the amount of work, in all its ethical, political, technical or material forms that is delegated to the simplest of non-humans (machines). The point is that technical objects define a general framework of actions together with the actors and spaces in which they are supposed to act (Akrich, 1992). In this way Latour's project is to consider the infinite networks of technological, social and material mediations that actively contribute to the evolution of the collective.

Mediated relationships that we have with non humans are all around us, and influence almost everything we do; none more so than when interacting with tools. Latour explains the complex nature of mediation in relation to how humans and guns interact and how through their interactions they become a collective:

If I define you by what you have (the gun), and by the series of associations that you enter into when you use what you have (when you fire the gun), then you are modified by the gun - more or less so, depending on the weight of the other associations that you carry...You are another subject because you hold the gun; the gun is another object because it has entered into a relationship with you (Latour 1999: 179).

In another words a certain level of influence is distributed throughout the relationship, irretrievably altering each of their associated goals and objectives. The gun for example is designed and inscribed with multifarious untold historical, political and ergonomic goals that aid in its main mechanical purpose of moving projectiles. Similarly the human's goals are bound up with all manner of social and psychological narratives that aid in the personal belief that a gun is required for protection. This can be represented in diagrammatic form in figure 2 (see appendix).

When the two agents join, any number of unintended goals can emerge which are made possible only by their association in the collective. So much so, that when you originally wanted the gun, you only wanted to protect yourself, but now with the gun in your hand, you want to kill (Latour 1999: 179).

The key point is that the prime mover of an action becomes a new, distributed, and nested series of practices that is only made visible if we respect the mediating role of all manner of heterogeneous agents. This leads Latour to redefine action as:

not a property of humans, but of an association of actants [human or nonhuman agents]...Provisional 'actorial' roles may be attributed to actants only because actants are in the process of exchanging competencies, offering one another new possibilities, new goals, new functions (Latour 1999: 182)

Questions about the nature of action force us to ask questions about who constructs what and where the impetus for that action comes from. If actions are recast as a collective force then the implications of such associations are rooted far deeper than mere physical action. Just as all designed objects are prescribed in advance with the users' perceptions in mind; so must our associations with non humans alter our thoughts and beliefs. As Latour surmises:

I do not deny that people have minds - but the mind is not a world creating despot that makes up facts to suit its fancy. Thought is seized, modified, altered, possessed by non humans, who in their turn, given this opportunity by the scientists work; alter their trajectories, destinies and histories. (Latour 1999: 282)

Whenever we make something we are often overtaken and surprised by the twists and turns of that construction coming into being. Even for a situation seemingly as simple as acquiring and holding a gun, the relations and possible implications become much more complex when the collective is taken into account. This is somewhat similar to what Don Ihde (1991) refers to as the unintentional effects, latent inclinations or trajectories of technologies, tools and interfaces, and in the game context could be recognised as the 'non-trivial' or unpredictable effects or results of gameplay (Kucklich. 2003). To this point, then, via Latour's non-humanist notion of 'actors', we have made a case for the recognition of a broader set of relationships that mediate our associations with technological devices and apparatuses. What is at stake are clear definitions of mastery, subjectivity and objectivity and how these definitions are changed by mediated environments.

So let's consider briefly just one of the agentic components in this actor-network: the corporeal schematic of the human body and its variable ontology within sociotechnical spaces such as virtual/game environments. As Zoë Sofoulis notes, in actor-network terms, 'what a body is becomes more a matter of what it is connected to, which kinds of nonhumans it shares its world with, and what properties it has swapped with those entities' (Sofoulis 2002: 275). The interpretation of 'embodiment' as itself agentic and changeable according to its 'environment' or situation, is also proposed by theorists such as Donna Haraway in her concept of the 'material-semiotic actor', and perhaps can be traced much earlier to phenomenologists such as Hans Jonas (1966) and Maurice Merleau-Ponty (1964). As Merleau-Ponty famously claimed, the body 'applies itself to space like a hand to an instrument' (1964: 5), an 'application' that depends as much on the specificities of perception and bodily movement as it does on the materiality of the tool-in-use. In his well-known description of the blind man and his stick, Merleau-Ponty describes how the corporeal schema of the body 'dilates' and 'retracts' to accommodate tools:

The blind man's stick has ceased to be an object for him and is no longer perceived for itself; its point has become an area of sensitivity, extending the scope and active radius of touch and providing a parallel to sight. In the exploration of things, the length of the stick does not enter expressively as a middle term: the blind man is aware of it through the position of objects rather than of the position of objects through it. The position of things is immediately given through the extent of the reach that carries him to it, which comprises, besides the arm's reach, the stick's range of action (Merleau-Ponty, 1962: 143).

Such an interpretation of human-tool relations clearly resonates with this comment from Latour: 'the very shape of humans, our very body, is already made in large part of sociotechnical negotiations and artifacts' (1994: 806). In a similar way, Haraway's postmodern materialism in 'A Cyborg Manifesto' (1991) was deeply consonant with Bruno Latour's actor-network theory, and also offered a radical understanding of agency in technoculture. For Haraway, ontology is relational, with an agency equally defined by materiality (biology, matter, 'natural' processes) and semiosis (language, meaning) (Haraway 1991: 208). We are all material-semiotic actors — humans and non-humans, organic and otherwise — hybrids of social or semiotic construction and materiality neither of which can fully account for nor be prioritised over the other. In this way, the boundaries and extendibility of our own bodies can be seen as a matter of social construction, negotiation with tools and technologies, and contingent upon the material environment. In other words, the construction of knowledge and social reality become cooperative effects achieved with other non-human partners, such that we are not the only actors in that production.

Thus, for example, we are accustomed to controlling and interacting with information spaces primarily by way of screen-interfaces, vision and hand-control, with a mouse, keyboard or a VR data-glove and headset, sometimes directing an avatar as the embodiment or vehicle of our location, movement and action within the virtual space. Here we have a sociotechnical network; a cluster of meanings and habits, and a collective of combined agencies, human and non-human (indeed, such a distinction barely makes sense in the context of an immersive virtual environment). Yet the default hand-eye-device interface is not 'fixed' or immutable; it can effectively be challenged and reorganized by alternative interfaces and meaning-making which deploy a different ratio of bodily perception and involvement, and a different 'literacy' of the virtual space. This pliability of the corporeal schema in virtual environments is explored by a number of new media artists and installations, such as those created by Canadian VR installation artist Char Davies and her team (see <http://www.immersence.com>). The priority given to the hand and eye in most media interfaces — through the use of screens, keyboards, mouse, remote controls or data gloves as orientation tools — has become so habitual as a way of controlling virtual environments, that we find it difficult to imagine otherwise. As Davies notes, in her environments the 'hands-off interface' (where the immersant must rely only on a head-mounted display, motion-tracking device and harness to monitor breathing) frees embodiment from the 'gravity-bound modes of interaction and navigation,' and also from the desire to touch or 'handle things'

(Davies 1998). Hence, to navigate through Davies' simulations is to appropriate unfamiliar devices in concord with non-habitual bodily movements and orientations, and to emplace one's mode of 'having a body' within an altered 'collective' of perceptual and material agencies.

In terms of multiplayer gaming, then, we can imagine how MMOGs and MMORPGs are very complex networks, vast body corporates in which actions, intentions, bodies, devices, material and social contingences are all variably and dynamically intertwined. Massively multiplayer online games are environments in which thousands of users are simultaneously absorbed into a game. Connected to a game server via the Internet, players can interact in real time with other users worldwide. Moreover, most MMOG's can not be played as stand-alone or single player games and can only be played online. Networks in this scenario could be seen in two ways. The most obvious is the Internet network made up of machines connected by the very material, world wide information systems. The second and infinitely more complex are the networks made of associations between heterogeneous human and non human entities that inhabit the collective. Such entities are as diverse as the complex interplay between the rules and affordances of a game, the user's offline context, and the online world created with other players and machines. All these networks together with their collective actions and intentions accrete a sense of history that will eventually structure social, technical and material relations towards the development of a collective intelligence.

Collective intelligence is very much a contested term, somewhat resonant with the term distributed cognition in human-computer interaction. At its most basic collective intelligence refers to the dynamics of collective problem solving. Namely, that problems may be solved with more efficiency as a co-operative collective rather than individuals. As seen in the simple gun/man collective of Figure 1, an agent has a problem, detours to another agent in order to fix the problem. Through their association a collective action is made possible that significantly influences both agents toward an action would have otherwise been impossible. In this way the artifact has become a part of the humans cognitive architecture significantly influencing human thought (Clark, 2003).

But the success or failure of this influential relationship is dependent on a number of agents in a network which shape or determine possible actions. Latour defines such mediated action as translation. Translation refers to the work that various agents do that modify, displace and translate various interests. That is to say that agents can expand their competencies by enrolling the interests of other agents into their networks and thereby mobilizing a collective force. This can be seen in the many ways players in MMOG's like Ultima 2 allow "players" to personalize their avatars and clan paraphernalia, weapons or environments made available to them via the affordance of computer software, gender and any number of coercive or manipulative agents. Indeed this behaviour has seen the definition of player not just as

simultaneous creator but essential to the evolution of the collective that produces seemingly effortless play.

In order for any network to remain stable various agents will need to negotiate and eventually agree to be defined and held in place by a system of influences. In this way agents are able to negotiate, compensate for other's weaknesses and work together towards establishing a solid network that will stabilise relations. These reified relations work together to make the world of MMOGs and MMORPGs both persistent and pervasive. In this way a game world may depend on a complex network of events, agents, and practices; from the computer components of the game server based in London, to the subscribers and their embodiment as 'players' and the concomitant social, ergonomic, and visceral factors involved, to the persuasive articles written in game magazines, to the code that enables the game to run, to the players interacting with the code, to the virtual artifacts traded and produced, to the interaction between players, to the evolving allegiances and political persuasions of online communities, and so on - the chain of agents is more or less endless. To trace the trajectory of this trans-ontological collective from its mythical beginning to its unpredictable ends is no longer possible. This is because in multiplayer online games the greater collective that allows and produces play is made on the fly, in real time and without limit; to have limits would see the end of the game, the end of stable relations and the end of persistent gameworlds.

*

In this paper we have suggested that it is useful to consider our experience of games and virtual spaces, and the human-technology relation more generally, in terms of actor-network theory and its relational ontology. The 'agents' that comprise any collective or network - whether it be a simple human-tool relation or a far more complex assemblage of actors in massively multiplayer games - are equally human and non human, semiotic and material, corporeal and technical. This understanding aims to facilitate a more nuanced, non-humanist and anti-visualist understanding of gameplay that exceeds the more conventional user- and viewer-centred interpretations, and is therefore more organic to the open-ended and constantly changing nature of our engagement with online environments.

4. REFERENCES

- [1] Akrich, M. (1992). 'The De-Description of Technical Object,' in *Shaping Technology*, eds. W. Bijker and J. Law, Cambridge, MIT Press: pp205-224.
- [2] Callon M. (1991). 'Techno-economic networks and irreversibility,' *Sociology of Monsters: Essays on Power, Technology and Domination*, ed. J. Law, London, Routledge.
- [3] Chesher, Chris. (2004) 'Neither gaze nor glance, but glaze: relating to console game screens', *SCAN Journal of Media Arts Culture*, vol. 1, no. 1, available at: http://scan.net.au/scan/journal/display.php?journal_id=19
- [4] Clark, A. (2003) *Natural-born cyborgs: Minds, technologies and the future of human intelligence*, Oxford, Oxford University Press.
- [5] Crary, J. (1992) *Techniques of the observer: on vision and modernity in the nineteenth century*, MIT Press, Cambridge, Mass.
- [6] Crary, J. (1999) *Suspensions of perception: attention, spectacle and modern culture*, MIT Press, Cambridge, Mass.
- [7] Davies, C. (1998). 'Changing Space: VR as an Arena of Being.' http://www.immersence.com/eph_vrpaper-B.htm
- [8] Ellis, J. (1982) *Visible Fictions: Cinema: Television: Video*, Routledge & Kegan Paul, London.
- [9] Haraway, D. J. (1991). *Simians, Cyborgs and Women. The Reinvention of Nature*. New York, Routledge.
- [10] Harper, C. (2000) Honours Thesis, *The Corporeal and Instrumental Embodiment of Technoscience*, Murdoch University, Western Australia.
- [11] Ihde, D. (1991) *Instrumental Realism: The Interface Between Philosophy of Science and Philosophy of Technology*, Indiana UP, Bloomington.
- [12] Jay, M. (1993) *Downcast Eyes: The Denigration of Vision in Twentieth-Century French Thought*, University of California Press, Berkeley, California.
- [13] Jonas, H. (1966) *The Phenomenon of Life: Toward a Philosophical Biology*, Dell Publishing Co., New York.
- [14] Kucklich, J. (2003) 'Perspectives of Computer Game Philology,' *Game Studies: International journal of computer game research*, v3, n1 (July) www.gamestudies.org
- [15] Latour, B. (1994). "Pragmatogonies: A Mythical Account of How Humans and Nonhumans Swap Properties." *American Behavioural Scientist* 37(6): 791-808.
- [16] Latour, B. (1999). *Pandora's Hope: Essays on the Reality of Science Studies*. Cambridge, Harvard University Press.
- [17] Levin, D. M. (1988) *The Opening of Vision: Nihilism and the Postmodern Situation*, Routledge, London.
- [18] Levin, D. M. (1993) *Modernity and the Hegemony of Vision*, University of California Press, Berkeley, California.
- [19] Manovich, L. (2001). *The Language of New Media*. Cambridge, Mass., MIT Press.
- [20] Martin, P. (2002) Honours thesis, *Embodiment and Discipline: Agency in the Transmedia Environment*, Murdoch University, Western Australia.
- [21] Merleau-Ponty, M. (1962) *Phenomenology of Perception*, Routledge and Kegan Paul, London.
- [22] Merleau-Ponty, M. (1964). *Signs*. Illinois, Northwestern University Press.
- [23] Naughton, R. (2003) 'Drawing Aids to Perspective,' <http://www.acmi.net.au/AIC/DRAWING_MACHINES.htm>
- [24] Newman, J. (2002) 'The Myth of the Ergodic Video Game,' *Game Studies: International journal of computer game research*, v2, n1 (July) www.gamestudies.org.

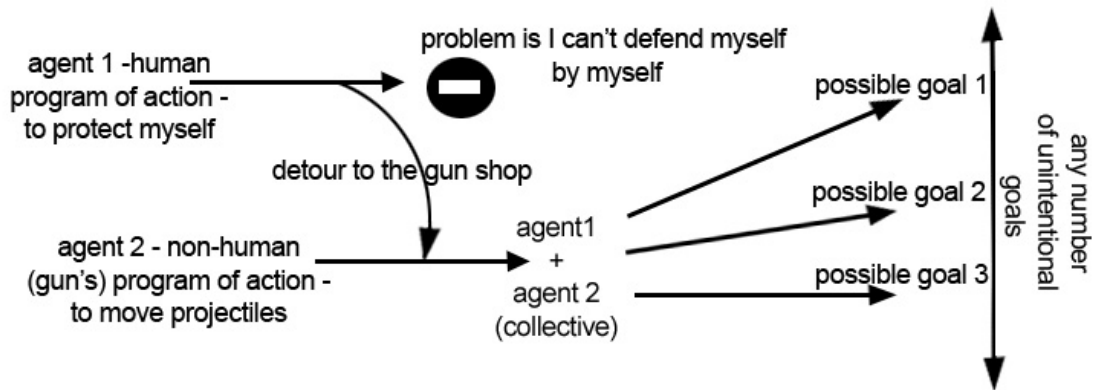
[25] Romanyshyn, R. D. (1989). *Technology as Symptom and Dream*. London, Routledge.

[26] Sofoulis, Z. (2002). Cyberquake: Haraway's Manifesto. *Prefiguring Cyberculture: An Intellectual History*. D. Tofts, A. Jonson and A. Cavallaro. Sydney, Power Publications.

[27] Weibel, P. (1996). The World as Interface: Toward the Construction of Context-Controlled Event Worlds. *Electronic Culture: Technology and Visual Representation*. T. Druckrey. New York, Aperture

APPENDIX

Figure 2 - Image adapted from Latour (1999: 179)



NOTE- referencing guidelines- Cypher, M., Richardson, I., 2006. An actor-network approach to games and virtual environments. *Joint Computer Games and Interactive Entertainment Conference, 2006, 4-6 December 2006 Perth, Australia*.