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The hidden persuasions of algorithms

by

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Abstract

Algorithms are increasingly present in our lives and responsible for many aspects of society – but are hidden from inspection. As codified instructions they require design (unless simplistic) and this design emerges from a web of social factors. Web sites and video games contain decision-making algorithms, their decisions make statements about the user's world. Persuasion occurs in social contexts; as interactive devices inhabit social roles these decisions have persuasive effects. Additionally, the algorithmic design may contain doxa (unexamined assumptions), or exist within a hyperreal system - a simulation accepted as real by the user. In these ways the influence of the algorithm passes unexamined to the user. Also, through neuroplasticity tools become incorporated into the cognitive processes of the user's mind, becoming an agent of the enmeshed mind. The thinking of the algorithmic tools becomes a cognitive bias, its influence situated in the mind of the user.

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Since it is pertinent, I will note that I used Google (Search and Scholar) often in researching this paper. As I reflect on it, however, the key ideas and the central books and papers that are the backbone of this thesis were, with just a few exceptions (e.g. Lindley), discovered through conversation, academic courses or browsing the shelves. But for the Lindley paper I thank the algorithm.

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Introduction and Overview

The motivation for this thesis was to explore how interactive technologies can affect various users' persuasions. They have become entrenched within our modern society with little scrutiny concerning the impact they might affect beyond performing their designated tasks. The lack of exploration of algorithms as part of the technologies of persuasion presented a suitable field of enquiry. I argue that hidden algorithms in interactive technologies can create hidden persuasions in their users, changing their behaviours, attitudes and beliefs.

Facebook's News Feed provides an introductory example of algorithmic persuasion. The News Feed selects ‘interesting' and ‘significant' (Facebook n.d.) posts from friends, but the algorithm that makes these selections has particular biases in whose content it chooses to display and what types of content it displays. The design of the algorithm gives greater frequency and prominence to friends whose behaviour is more in Facebook's interest. As a result of this promotion, those friends may seem closer or even more significant. Facebook's algorithm argues that your better friends are those who behave most similarly to Facebook's idea of friend.

Algorithms are undoubtedly useful. Their step-by-step processes permit simple and complex operations, providing powerful short hands and allowing control and exploitation with the promised certainty of reliable outputs. Douglas Hofstadter defines them as "a specific delineation of how to carry out a task" (Hofstadter 1979) and it is this strict codification of process, aided by the speed and power of computers, that encourages their increasing use.

Algorithms exist in a wide variety of forms. The calendar is the result of an algorithm for designating a given 24 hour period with a label of day, day of the week, month, and year. In order for everyone to agree on what day it is a precise method for deriving this label must be shared. A tax return is an algorithm for converting the financial activities of an entity over the course of a year into a single value of taxes owed. The search results from a query on google.com are the result of a computer algorithm for transforming a given search query into an ordered list of web pages most relevant to that query. In all these cases the algorithm provides a set of instructions that are followed in order to achieve a desired outcome. Wherever there is standardization, there is probably an algorithm. Whenever the agent carrying out a task is beholden to certain behaviours, there is potentially an algorithm. And whenever a computer is performing a task, there is almost certainly an algorithm. The variety of forms of an algorithm are one aspect that enables their prevalence.

Algorithms are pertinent because of their increasing presence in our lives. Examples abound, from planes and business to schools.

• Amazon and other merchants rely on algorithms to set the prices of their merchandise. One book was listed at $23,698,655.93 (plus $3.99 shipping) after its algorithm and a rival pricing algorithm became locked in an inflating spiral (Eisen, 2011). Used copies of the same book were available for $35.54.

• Up to 70% of Wall Street trading is now run by so-called black box or algo-trading. Their operations have been blamed on at least one market crash (Slavin 2011). Additionally, a 1327 km fibre-optic connection between Chicago and New York has been constructed using dynamite and rock saws in order that trades between the two centres can be completed three microseconds faster.

- McDonald's uses strict Standard Operating Procedures for instructing workers how to make identical hamburgers in every franchise store. The success of this algorithm is determined by the franchise owners' and workers' commitment to the process, but in theory a hamburger from Buenos Aires and one from Moscow should be effectively indistinguishable. (Martin 2009 p.17)

- Proctor & Gamble go further than using algorithms for products and have tried creating algorithms for the "soft skills" of business as well. They are iteratively improving a document that tries to make explicit the process by which brand building occurs (Martin 2009 p.98) – a move toward an algorithm of identity.

- Algorithms from Target use customer purchasing history to determine when customers are pregnant (before any announcement and potentially before family members are informed) in order to send targeted advertising (Duhigg 2012).

- Doctors report that adherence to algorithms for administering drugs for operations can override the operating surgeon's own orders (Parks, 2012).

- Pilots rely on the algorithms of automated flight systems so much that they are unable to fly when the automation is inoperable (FAA 2000) (Lowy 2011).

• The simplex algorithm is used to make so many decisions in a wide variety of operations that it has been called “the algorithm that runs the world” (Elwes 2012).

Such prevalence has prompted many cautions and much commentary. The bestselling video game *Portal* (Valve 2007), for example, focuses on exploring the nature of algorithms and how they affect us as humans, presenting a powerful argument for the loss of agency as we cede control to algorithms, such as Quality Assurance for products. It is an algorithmic indictment of algorithmic processes.

Why are people so keen to transfer human agency to algorithms in so many parts of their lives? These examples provide hints: stock trading algorithms can trade faster than any human; hamburger and brand-building algorithms provide certainty for customers and producers. Automated systems can handle tasks that are too dull, dangerous or dirty for humans.

Computers require precision and not all algorithms have precisely-defined objectives within precisely-defined problems. A broad division into three cases is possible: algorithms that are essentially mathematical solutions to precisely defined problems with precise objectives, such as the shortest route along an abstract network. The second case are those with precisely-defined objectives for an ill-defined or incompletely-specified problem, such as maximizing ad revenue. The third case involves using algorithms to achieve imprecise objectives for ill-defined problems, such as maximizing fun. In this paper I focus on algorithms as they are applied to society. Social factors are by their nature imprecise and ill-defined, and so the third, and then second, case are the most applicable types of algorithm. The first case only becomes applicable when the certainty of the abstract is applied to real world scenarios, such as finding the shortest path along a city's road network for a particular driver.

But what is an algorithm? Though algorithms can certainly apply to contexts outside computing, this paper's focus on interactive technologies means I will chiefly be considering computer algorithms[1]. The nature of implementing computer algorithms is that their developer must specify every operation and control statement in order to write the algorithm. Hofstader's definition explains algorithms as specific, denotative instantiations of knowledge processes, but unlike human knowledge of how to do a task, which can remain tacit, algorithms must be explicit. One of the key properties of code is that there is no hand-waving: everything that is to be in the algorithm must be written as an instruction. Explicit knowledge must be fully expressed.

But in forcing everything to be explicit, code all but guarantees assumptions through omission. No-one can articulate every possible circumstance – except for very simple tasks – and in choosing (consciously or not) what to articulate and what to assume the algorithm's developer instills bias in the algorithm. The enthymeme of verbal rhetoric, in which a statement is left unstated, has its parallel within code not as an unstated statement but as an unconsidered possibility. The algorithm is a specific definition of a task, but the task that the algorithm delineates may not be precisely the same as the desired task. Or, the developers understanding of the task may not align with the users.

The requirement to express all instructions does not typically make the algorithm visible to the end user. All programming ultimately resolves to a

1 Although computer algorithms can exist as abstract entities separate from any implementation, they can only function when instantiated within program code. This paper focuses on the latter form.

series of machine language tasks that read and write binary information, but the actual list of instructions may lie hidden within compiled code readable only to the machine that executes it[1] Alternately, it may lie hidden on the server that operates a web page. In either case the content of the algorithms is not available to scrutiny by the users (for those wishing to look), and will only be available to such scrutiny if the developer or owner makes the effort of publishing them in some form.

Developers rely on the algorithms of other developers. There are few circumstances in which a developer creates code using only the instructions of machine language. Machine language code resolves to a set of the most basic instructions; for example: read byte, write byte, move register to new memory location, and move if the current byte is true. These simple sets of instructions form the basis all computer programs[2]. But the millions of instructions required by a typical program mean that a hierarchy of code development forms, with each developer relying on the work of other developers' algorithms. Even the developer rarely knows the true behaviour of their own algorithm.

Developing algorithms is a process of design. The final algorithm for a task is not a certain outcome given its requirements – there may be many different ways in which the task's requirements can be adequately implemented in code. As a result, the algorithm developer's task is "the making of decisions ... that establish how an object is to be made."[3] (Buchanan 1989, p.106). They work within constraints to create an effective result, as opposed to a true result (the focus of science) or their own interpretation (the focus of the humanities) (Cross 1982, p.222).

1 Or those willing to painstakingly reverse-engineer the machine code into a human readable form.
2 John Conway's *Game Of Life* demonstrates how a handful of instructions can result in complex behaviours.
3 John Pile's definition of the designer's role.

Examining the persuasive effect of these algorithms builds on previous work – chiefly by B.J. Fogg and Ian Bogost – concerning persuasion by technological devices. The ability of interactive technologies like video games and web sites to exert persuasion upon their users is a topic of increasing influence. In recent years two notable works have set out to examine this phenomenon more clearly. The first is B.J. Fogg's *Persuasive Technology* (2003) which covers the use of computers to persuade toward constructive goals. The second is Ian Bogost's *Persuasive Games* (2007) which introduces the idea of procedural rhetoric – the ability of representations of rule-based systems (particularly video games) to mount an argument.

Fogg's approach uses lab tests to discover simple, quantifiable techniques by which technology can create an effect in its users. In his book he reveals forty-two principles such as the Principle of Tunnelling (guiding a user through a process), the Principle of Reciprocity (instilling a need to reciprocate by having the computer perform a favour), and the Principle of Ease-to-Use (which makes web sites more credible).

Critically, Fogg makes no mention of algorithms in his book. His interest is in developing something approaching a science of technologic persuasion, where hypotheses are examined by simple tests that notionally isolate one factor for study by random subjects, with measurable results determining whether persuasive change occurred or not. It is not surprising then that he pays little attention to how computers operate beyond what can be instantiated in a test and what is apparent to the user. He does not make a distinction between algorithmic processing and any other computer processing in discussing the ways in which computers can persuade.

Bogost's procedural rhetoric "is the practice of using processes persuasively, just as verbal rhetoric is the practice of using oratory persuasively, and visual rhetoric is the practice of using images persuasively" (Bogost 2007, p.28). Process is used to argue about process – how things work – and computers are innately procedural (Murray 1997, p.71). By presenting a representation of a system the computer software (particularly video games) makes an argument about how the system behaves. The game *Civilization* (Microprose, 1991) makes arguments about historical process by presenting them within a game. The video game *Animal Crossing* (Nintendo EAD, 2002) makes arguments about material acquisition by presenting simplified versions of such processes, as well as alternatives, within the game. Bogost's focus is on "rule-based models [or systems]" (Bogost 2007, p.4) which leaves the persuasion of algorithms unconsidered. His interest in algorithms is only to the extent that they enforce the rules – the mechanism through which a representation is generated – that allow procedural exploration. Although procedural rhetoric could potentially be used to encompass all computing, Bogost's focus on rules restricts this. On tasks as simple as loading the Facebook page (and its News Feed) the rule-based process is negligible ("open the web page"), constituting a single unit operation, and so the procedural rhetoric is also negligible. And yet the algorithms that create the News Feed are complex and contain persuasion. Although Bogost intends procedural rhetoric to encompass all high-process activity of machines, such activities that have negligible interaction fall outside his scope. Algorithmic persuasion begins in the exploration of such activities.

The persuasive algorithms that contain high procedurality and yet low interactivity are the focus of this paper. Algorithms with low procedurality are likely to fall within the testing of Fogg's Principles. Algorithms with high interactivity are likely to fall within Bogost's procedural rhetoric. This paper focuses on the unexamined group. Such algorithms are exemplified by those that make decisions or simulate judgements. It is not that the algorithms provide incorrect information, but that their decisions differ from those the user would otherwise make. Judgements require thinking, which involves heavy procedural computation. And yet judgements occur without interaction, although they may utilize interactions that have already occurred as part of their input. And decisions entail strong potential for persuasion, because it is within decisions that possibilities are made and removed. This is especially true for devices that take account of the user as an individual, utilizing social factors within decision making. The algorithmic decision-making in video games and web sites forms the basis of the persuasive analysis in this paper.

The persuasion of decision-making algorithms can be as hidden as the algorithms themselves. The simplest approach to their persuasion is to see the results of their decisions as statements about reality, akin to the propositions of an argument. In the example of Facebook's News Feed, the decisions of the algorithm amount to statements about who the user's friends are. This is no small detail but a crucial aspect of life. Other examples to be examined in this paper involve statements just as significant: what the user knows, what movies they like, and who they date. But such statements are reasonably visible – the results of the decisions are presented to the user as facts to be accepted, ignored, or corrected. Other potentials for persuasion are less visible. The cognitive processes of the user are susceptible to alteration not just from algorithmic statements about reality, but also in subtler ways.

Ideological framing presents one hidden avenue for algorithmic persuasion. The design decisions involved in the creation of an algorithm occur within a cultural context. Within this culture certain ideas will be ‘doxa', a term Pierre Bourdieu (1977) uses to refer to the unquestioned beliefs of a society. If the algorithm's decisions differ from the user's decisions in a consistent manner, as a result of the doxa of its creator's culture, then this 'bent' will be passed onto the user. Just as most algorithms build upon lower-level code, human thinking builds upon previously developed ideas – including the doxa of others' decisions.

Jean Baudrillard's (1983) notion of the hyperreal suggests another way that a web site's or video game's decisions can influence the user's cognitive processes. In the hyperreal, signs become completely disconnected from reality and refer only to a system of other signs. The potential for a hyperreal Facebook persona that functions as the most important aspect of a person's life would then position the decisions within that simulation as true aspects of their reality. The decisions of Facebook algorithms would not merely contribute statements that could be applied to reality, but provide statements that were reality for the user – more real than the user's decisions outside the simulation. The user's thinking exists within the framework of the hyperreal, its contours formed by the algorithms behind the web site.

Two further hidden persuasions from algorithmic decisions emerge by examining the way that tools connect with our cognitive processes. Cognitive processes are not a single unified element, and tools can become integral to them.

The concept of mind extension suggests that the tools we use constitute a real aspect of our mind. Our brain's neural plasticity enables the physically external tools we use to be as much a part of our cognitive processes as the biological processes within our brains. Algorithmic tools are no exception, the decisions of their simulated thinking become an aspect of the user's own cognitive processes. They persuade from within, just like any other cognitive bias.

Physical neuroplasticity goes further than mere extension of the mind, it is the way that tools restructure our brains. This demonstrates more substantial impact than mind extension, which treats the mind's acceptance of input from external tools. Physical neuroplasticity indicates that the brain accommodates tools by replacing the biological structures that formerly provided the functions the tools provide. The user does not simply defer their decisions to the algorithmic tools, but loses their own abilities as the tools replace that functioning. The result is that the algorithmic thinking becomes an essential aspect of the user's own thinking – the user is entirely reliant upon the decision of the algorithms.

In developing this argument I will begin in chapter two with a deeper examination of the nature of algorithms, and a review of the relevant existing literature on this topic. Among the ideas explored are how the hidden nature of algorithms has parallels to the notion of a hidden curriculum in education, and the tendency to institutionalize knowledge – a form of encoding. This is further explored by Roger Martin's (2009) knowledge funnel – a process toward algorithmic knowledge. These ideas present a richer understanding of how persuasions can come to be within the algorithm. This chapter also examines persuasion studies, beginning with Aristotle's three-fold approach of examining the ethos, logos and pathos. Since its origins, the field has diverged into approaches that are focused on the effects of the persuasion (for example, Fogg) and those that focus on analysis of the persuasive message (including Bogost). As well, the rhetoric of design is discussed as an early approach to understanding algorithmic persuasion. This rhetoric is also considered in connection with Donald Norman (1988) and the affordances of designed objects, as well as Neil Postman (1993) and the ideology within the design of technology. Finally I review the conception of the mind as a separate entity from the body and brain, and competing theories that present compelling arguments for a strong integration – to the point of enmeshment – between the mind, brain and body.

The third chapter applies the theories of persuasion in interactive devices to examples from video games and web sites. I use Lindley's taxonomy to provide a structure, dividing video games into their simulation and game mechanics elements. Procedural rhetoric is a crucial approach for understanding persuasion in interactive devices, and through a series of examples I examine its scope and its lack of appreciation for the influence of algorithms. The video game series *Civilization* and the video game *Animal Crossing* provide the key examples. The issue of simple and complex algorithms is explored with reference to Fogg's approach. From this discussion the focus turns to algorithms of high-process intensity but low interactivity. Web sites provide the best examples of this, particularly when they make decisions or simulate thinking. The examination of algorithmic persuasion now turns to three main examples in this form: Facebook's News Feed, Google's search, and Netflix's recommendation engine. All of these are elements of massively popular web sites and also demonstrate deep algorithmic decision-making. Some examples of persuasion from these include favouring Facebook friends who demonstrate certain behaviours, increasing visibility of search results that align to Google's search philosophy, and using psychological techniques to understand a person's preferences better than they do themselves. But these examples treat the web sites as external entities, and their persuasion as similar to a speech of verbal rhetoric: a message to be considered by the user. Hidden persuasions also exist in uses of these algorithms that bypass such a divide between message and recipient.

The fourth chapter concerns the impact of algorithmic tools upon the mind, and the resulting hidden persuasions. Using Baudrillard's notion of hyperreal I discuss how these decisions become real through treating the simulation as real. Another method of hidden persuasion is the subtle transmission of ideological doxa. I also examine the concept of mind extension as well as structural neuroplasticity to present two more aspects of hidden persuasion from algorithms. The final discussion engages these four hidden persuasions of algorithms: the impact of the hyperreal, the unexamined assumptions of doxa, the cognitive biases brought in through mental extension, and the results of neural restructuring. These four examples of hidden persuasion show the susceptibility of users to algorithmic influence in ways that are as hidden as the algorithms themselves.

Literature Review

In this chapter I examine the previous work that contributes to my argument, from six general areas. The first area is algorithms, which allows a deeper consideration of the nature of algorithms than already discussed in the introduction. The second area is persuasion and rhetoric, focusing on persuasion related to technology. The third area is persuasion in video games, which is chiefly concerned with procedural rhetoric. These establish the basic ideas of persuasion in interactive devices when considered as an overt dialogue between persuader (device) and user. But the aspects of hidden persuasion from algorithms concern a collapse of the distance between the technology and the user. For this I cover the cognitive effect of tools from a philosophical standing, which incorporates hyperreality and the doxa of ideology. A further collapse occurs when there is no separation between the mind and the tool. In discussing this I examine the arguments for a separation of the mind from the body as well as arguments against – those for enmeshment. This leads to a consideration of the cognitive effect of tools from a biological view, which includes forms of neuroplasticity: mental extension of cognitive functioning to tools as well as structural changes within the brain. Both of these treat the tool as a part of the mind, allowing the persuasion of the tool to become the persuasion of the mind.

Considering a sample of definitions for algorithm from different approaches, the variety of definitions share deep commonalities. I have already referred to Hofstader's "a specific delineation of how to carry out a task". Another definition comes from the computer scientist known as the father of the analysis of algorithms (ACM 2010), Donald Knuth: "a finite set of rules which gives a sequence of operations for solving a specific type of problem[1]" (Knuth 1973 p4). Knuth restricts the algorithm to following rules, but widens the scope from a single task to type of problem. Knuth's use of rule does not refer to a customary governing of behaviour (as in 'rule of thumb') but to an order or command. When computers process code (in which rules are instantiated) they always follow the rule exactly. He additionally states five basic characteristics of algorithms: finiteness, definiteness, input, output and effectiveness. The first of Knuth's attributes ensures that the algorithm will eventually halt (computers can easily slip into infinite loops), while the second underlines the precise and unambiguous nature of the rules. The third and fourth concern the interactivity of the algorithm (with users or with other systems) which explains how a single task becomes a type of problem: by being the same algorithm with different input. The last attribute is interesting as it is also a chief concern of the field of design (Cross 1982), and the studies of the rhetoric of design informs the rhetoric of persuasion.

Alexander Galloway provides a seemingly different approach to a definition by considering an algorithm as similar to the philosophical idea of a concept. A concept is a cognitive vehicle for moving thoughts, and in a similar way Galloway considers an algorithm a "machine for the motion of parts" (Galloway 2006, p.xi). Such a machine would seem to differ from Knuth's "set of rules". But Knuth's algorithm is indeed a machine for moving an input to an output, or at least the instructions for performing such a motion. Yet as Mariana Olea Paredes (2009) notes, Galloway considers code to be the only executable language, which implies that the algorithmic machine is inert until performed by the computer – the algorithm only becomes a machine under performance by the CPU. Without the CPU the algorithm reduces to instructions awaiting action, and

1 Knuth's definition has resonance with mathematics, a field from which computer science emerges

in this form Galloway's definition shows its essential similarity to Hofstader's and Knuth's.

The defining nature of algorithms is further clarified by considering the related term ‘heuristic'[1]. A heuristic can be seen as a partial algorithm – not quite providing the desired task but providing something close enough to be useful. In examining how knowledge (particularly knowledge involving design) comes to be, Roger Martin considers heuristics as a "rule of thumb that helps narrow the field of inquiry" (Martin 2009 p.8). For Martin the acquisition of knowledge can be likened to a funnel that progresses through three stages: hunches, heuristics and algorithms. Hunches are "pre-linguistic intuitions" (p.10) about a mystery and relate to the wide mouth of the funnel where many answers are potentially applicable. Heuristics move the hunch down the funnel, restricting its scope by transforming it into an explicit state. But heuristics are still not complete solutions; they are the beginning of understanding. At the narrowest point of the funnel, algorithms represent a fixed formula, bringing with them a massive gain in efficiency (p.17).

The knowledge funnel provides a conceptual vehicle for understanding the application and use of algorithms in providing knowledge. For Martin, algorithms represent a particular end point of a search for knowledge. Martin's focus is the conflict between analytical management and innovative management in businesses that seek to understand problems better. The goal of the former "is mastery through rigorous, continuously repeated analytic processes" which represents a focus on pushing deeply into the knowledge funnel for a small number of mysteries. This focus allows a greater understanding of a smaller field, to the point where any

1 Although this term has specific meanings within Computing Science, I am using it in the general sense

inputs (questions) can be confidently moved into outputs (answers) for that domain. The latter is "centred on the primacy of creativity and innovation" and represents a wider interest in many problems without specializing in any (Martin 2009 p.5).

Martin's division of the acquisition of knowledge can be compared with Harold Innis' division of the communication of knowledge into space-based and time-based (Innis 1951). Communication encoded in durable commodities, such as the pharaohs' pyramids, emphasize time and continuity. Such communication requires significant effort to reach a small territory. The efforts of a time-based empire are over a geographical area; visualizing knowledge as a landscape, pursuing algorithmic knowledge similarly requires a deep understanding of a small domain. Both require a concentration of resources. An emphasis on communication over space, on the other hand, requires lighter and more mobile means of communication, able to move easily through multiple domains, in an echo of the wide interest in many problems (a vast portion of the knowledge landscape) held by an innovative knowledge acquisition.

Martin's placement of algorithms deep within a funnel of knowledge hints in some ways in which the answers they provide can be or become incorrect. Martin suggests that solutions to mysteries can "grow stale with time" (Martin 2009 p.21). Most mysteries are not about fundamental states of existence but reference malleable situations, such as the nature of a society at a particular time. When the situation that the mystery references alters, then the algorithm for that mystery will no longer fit because the overarching situation has changed. Just as a time-based monument will falter if not maintained, so too algorithmic knowledge is not permanent. This is significant for this paper because it shows a process by which algorithms can find their way into procedural systems to which they poorly match. The algorithm is originally well-suited for its situation, but as it is applied to other contexts, or as its own context changes, the assumptions and designs of the algorithm no longer fit the situation. But by virtue of being hidden, buried in the code, this change is difficult to notice. It is also possible for an algorithm to be applied outside its intended context when a developer uses another developer's code. Without thorough documentation of the code, the first developer may unintentionally put the algorithm toward a use for which it was not intended. Or even with full documentation the developer may do so anyway, assuming that the algorithm will still function sufficiently well (treating it as a heuristic).

A concern with making knowledge more rigid so that it will endure is a social issue that exposes the difficulty of using algorithms in such cases. Organizations and societies form rituals around practices that they wish to institutionalize (Meyer & Rowan 1977). This can be seen as an attempt to codify socially-desired practices. The law, for example, can be seen as the institutionalization of all the customs and rules of a society (Lieberman 1983). But, the concept of a rule in computer algorithms and the concept of a rule in legal frameworks are quite different. Legal rules are closer to heuristics because interpretation is often required in order to apply them in the best way – and these interpretations can be disputed. Though desirable as a form of institutionalization – providing a common response – it is problematic to apply the strict rules of an algorithm's instructions for tasks that rely on interpretable and changing social rules. The use of algorithms to solve problems that are essentially social in nature is always at risk of error.

Algorithms are a form of encoded knowledge that can be likened to the ‘model' within Willard McCarty's analysis of the humanities, further demonstrating their impermanence. Computer algorithms are literally encoded, but all algorithms require the explicit notation of instructions that correspond to knowledge of how to perform a task. Encoding knowledge is also a process of importance in the academic approach to knowledge. In assessing the fundamental tasks of computer-based humanities, McCarty anatomizes the methods into four perspectives: analysis, synthesis, context and profession. The first of these is synonymous with modelling, the act of making models to act as a bridge between the modeller and the modelled. The model "instantiates an attempt to capture the dynamic, experiential aspects of a phenomenon" (p.23), and is the way "we give form to knowledge" (Drucker 2007). Furthermore, for McCarty the model is not a fixed end-product of knowledge but "a temporary state in the process of coming to know" (p.27), just as the result of inquiry is not answers but more questions. How does the model change? J. Drucker, summarizing McCarty, writes that "only through an iterative process of feedback and rework can modeling remain open to the intellectual challenge of humanistic inquiry" (Drucker 2007), while McCarty specifies that the 'approximating convergence' (between modeller, model and modelled) is through "a continual process of coming to know by manipulating things (McCarty 2005, p.28) – and it is the distinguishing feature of computers that they run by manipulation. So, the experiential refinement of the model is through an iterative process of manipulation. The ultimate desire is for convergence but the immediate goal is somewhere short of that. Crucial to this assessment of the modelling process is the idea that the gap between modeller and modelled can never be completely bridged. There is no perfect model – the process is always ongoing. As with Martin's funnel concept of knowledge and algorithms, McCarty articulates the impermanence of algorithmic knowledge. If there is always a model that is a better bridge between modeller and modelled, for algorithms that represent such models there is always the potential to be superseded by an improved version.

The designed, improvable nature of algorithms is a key aspect of their rhetorical nature. But before discussing the way in which encoded or instantiated knowledge can be used as a form of rhetoric, it is important to consider the study of persuasion and rhetoric.

What is meant by persuasion? Richard Perloff (2007, p.11) examined the major definitions within communications study, quoting them as

- A communication process in which the communicator seeks to elicit a desired response from his receiver; (Andersen[1])
- A conscious attempt by one individual to change the attitudes, beliefs, or behaviours of another individual or group of individuals through the transmission of some message; (Bettinghaus & Cody[2])
- A symbolic activity whose purpose is to effect the internalization or voluntary acceptance of new cognitive states or patterns of overt behaviour through the exchange of messages; (Smith[3])
- A successful intentional effort at influencing another's mental state through communication in a circumstance in which the persuadee has some measure of freedom. (O'Keefe[4])

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1 Andersen, K. 1971. Persuasion: Theory and practice. p.6
2 Bettinghaus, E. P. and Cody, M. J. 1987. Persuasive communication. p.3
3 Smith, M. J. 1982. Persuasion and human action: A review and critique of social influence theories. p.7
4 O'Keefe, D. J. 1990. Persuasion: Theory and research. p.17

The composite definition derived by Perloff is that persuasion "is a symbolic process in which communicators try to convince other people to change their attitudes and behaviours regarding an issue through the transmission of a message in an atmosphere of free choice" (p.12). These definitions appear to divide the results of persuasion into two forms. The first form is external: a change in behaviour, response or action. The second form is internal: a change in attitude, mental state or cognitive states. Bettinghaus and Cody, however, list three, with belief separate from attitude. Perloff (and O'Keefe and Smith) conflates these but the distinction is suggestive of a split between singular beliefs as against a pervasive worldview, or the person's complete belief system. The question of intent by the persuader is also relevant. All the persuasion researchers above are concerned with intentional actions that aim to achieve persuasive effects and would label events that cause unintended persuasive effects as something other than persuasion. B.J. Fogg, for example, considers side effects of technology to be outside the field of study of computers as persuasive technologies (a field Fogg terms "captology") (Fogg 2003 p.16). One reason for this distinction is that persuasion studies are chiefly concerned with determining methods by which persuasion can be affected, and so unintentional persuasive effects are akin to bugs in code. But the purpose of this thesis is to demonstrate and analyze the ability of algorithms to cause persuasive effects. Whether these effects are intentional or unintended does not impact the ability of these effects. And crucially, today's side effect may be tomorrow's intentional technique. My concern is the effects of persuasion, which fall into external change and two types of internal change. From this I develop a definition: persuasion is interaction that results in change in behaviours, attitudes, and beliefs (or worldview) of the recipient.

The earliest known studies of persuasion, those of the ancient Greeks and Romans, recognized that the content of the argument was only one of many factors for good persuasion. Rhetoric, at the time defined as the art of persuasion (Bogost 2007 p.15), was a key element of Athenian and Roman life as part of the civic process. Aristotle writes of it (in *Rhetoric*) with attention to the style, arrangement and organization of the speech. He identified three key methods of persuasion:

- Ethos, referring to the character and credibility of the speaker
- Pathos, which is an emotional appeal
- Logos, which includes the logic and structure of the argument

Modern researchers have continued Aristotle's quest to discover the methods and techniques of persuasion. One prominent example in this field is Robert Cialdini (2001) who identified six ‘weapons' for persuasion:

- Reciprocity, a social desire to return a favour given (even if the return is of a different form, or the favour given is merely perceived).
- Commitment and Consistency which is an internal desire for consistency of person. It also manifests as a social desire for consistent behaviour.
- Social Proof which is the desire to copy the behaviours of others or to know that others also perform the behaviours. This ties with conformity. Social proof can be ‘informational influence' when it is accepted as evidence from another about reality (Deutsch & Gerard 1965).
- Authority or the desire to follow instructions from perceived figures with authority. The Milgram (1963) experiment is an example of this.
- Liking which aligns with Aristotle's Ethos as it refers to persuasion from people that the persuadee likes.

● Scarcity as a motivator for action, particularly in persuading action to occur within a certain time frame in order to avoid missing access to the scarce resource.

It is worth noting how prominently social factors are within these methods. Persuasion from a person is clearly privileged. However Fogg notes that computers are increasingly taking on roles of social influence. His work is concerned with identifying the methods by which computers are able to affect persuasion, and through a series of studies has identified forty-two principles to this effect.

Fogg's research attempts to encompass all usage of computer technology but is focused on fairly simple algorithms that map an input to a response using few control statements. In arranging his research, Fogg considers the computer within three functions in order to provide a taxonomy for his principles: the computer as tool, as media (referring to simulation) and as social actor. He additionally considers persuasion related to mobile computing, credibility and credibility on the web. As an example of the nature of these principles, the ones identified for computers functioning as tools are Reduction (simplifying a task), Tunnelling (restricting choice, such as a guided tour or registration process), Tailoring (customizing content to user information), Suggestion (intervening at the right time), Surveillance (improving service by gathering data on the user), and Conditioning (behavioural training). There is similarity and overlap with the methods identified by Cialdini, suggesting that the social nature of persuasion can be transferred to computers. Fogg does not discuss video games at any length. However he does note that they show complex uses of operant conditioning, since a "good computer game is one that players want to keep playing" (Fogg 2003 p.51). Because of this game designers include reinforcements to encourage continued play. Such conditioning is aimed at making the game the primary choice for how the player uses their time, a move toward addiction (p.51). The role of algorithms is merely to determine when to supply reinforcements. Typically this is a direct mapping: some action (kill an enemy) yields a reward (score points and hear sound), and the algorithm's role is minimal. Most of the other principles that Fogg identifies are similarly low-process intensity, where the algorithm's role is a simple mapping from a defined input to providing a defined output (and often the input is from a limited number of choices).

One simple form of persuasion from technology is the imperative to continue using the technology; Fogg has noted that for video games this appears as addiction. Tools that make tasks easier (such as through Fogg's Principle of Reduction) promote their own use. But video games are a past-time and continued use comes not from executing chores more efficiently but from satisfying intrinsic needs. Rigby and Ryan (2011) specify those needs as competence (mastery and ability), autonomy (agency and choice), and relatedness (connection and support). By providing mechanisms to satisfy these needs, video games are able to persuade players to continue play. But although this research provides insight into how technology can meet needs within its users, its applicability to persuasion is limited by its focus on mechanisms for delivering satisfaction, rather than for delivering arguments.

A different approach to the study of persuasion is less concerned with identifying the methods of effective persuasion than with analysis and criticism of persuasive messages. In modern studies of rhetoric (which has come to also mean the art of effective expression) the field is more focused on criticism of the discourse of the persuasive attempt, although attention is still paid to the methods of successful persuasion. For example, two prominent types of criticism in modern rhetoric are narrative and ideological criticism. Narrative criticism is concerned with how stories are used in rhetoric to impose order on experience in order to make meaning, since stories are persuasive vehicles (Sunwolf, 1999). Narrative elements in video games fall directly under this form of rhetorical criticism. Ideological criticism concerns the discovery of the dominant ideology expressed in rhetoric, and any ideologies muted by it (Foss 2004). For algorithmic persuasion, this can be used to criticise the ideologies within the process of taking the idea of a task and translating it into a specific delineation of instructions. The process of simplification that is entailed in translating a task into instructions is carried out within the worldview framing of the designer and developer of the algorithm, and in doing so their ideologies shape their design choices.

The scope of modern rhetoric has expanded beyond verbal language to include other mediums of expression, such as the visual rhetoric of television (Fiske & Hartley 1978) and of video games, as well as the rhetoric of technology and objects. In turning from verbal and visual rhetoric to the rhetoric of video games and technology, the rhetoric of algorithms becomes clearer.

Fiske and Hartley uncover visual rhetoric through a critical analysis of the sequences of images in television programs, especially news. Their approach centres on paradigms and syntagms. Paradigms are a "set of units (each unit being a sign or word), from which the required one is selected" (p.34). An example occurs in a shot of children in a playground. The number of children in the shot is paradigmic, and the rhetoric of the shot can be altered by using either a single child, or two children, or twenty children. The age of children in the shot is another paradigm, again altering the rhetoric if the children are four, eight or twelve years old. Syntagms are a "chain into which [each paradigmic unit] is linked with others, according to agreed rules and conventions, to make a meaningful whole" (p.34). The selection of the order of each unit effects the rhetoric of the whole. An example occurs in a sequence about institutionalized children, in which the first and final shots are of children alone and contemplative. These ‘contain' the active, unfocused shots of children in-between, suggesting the containment of children within the institution.

The ability of video games to contain rhetoric rests chiefly on their ability to convey process. Process is made of discrete units of operation, which can be likened to propositions. By presenting a representation of a system the video game makes an argument about how the system behaves. The representation is not the same as the actual process, and may even be biased toward a particular view. But the game invites the player to consider the argument and to dispute it or accept it. Bogost argues that other rhetorics are not sufficient to account for the unique properties of procedural expression. One of those unique properties is the procedural enthymeme: as the user explores the rules of the procedural system they uncover the hidden syllogistic element. For instance in *The McDonalds' Videogame* (Molleindustria 2006), the enthymeme is that it is not possible to run a competitive, global hamburger business without resorting to unethical practices: the rules of the simulation do not provide sufficient resource usage for all aspects of the business to operate ethically. Because discovering such enthymemes requires effort through interaction, they may well be more compelling than being told, just as reading a complex text may make it more memorable than reading a simple text. Another property of procedural expression is the malleability of content, particularly toward personalization. Manovich has pointed out that the essence of new media is its use of database for content (Manovich 1998), and in this essence is the ability to manipulate any content. Allowing players to load their own images into a game (such as an image of a local hamburger business) increases the persuasive rhetoric of the game (Bogost 2007 p.28) and, Fogg notes, its credibility (Fogg 2003 p.172).

An important aspect of procedural rhetoric is the idea of a unit operation, which Bogost introduces in an earlier work (2006). They are “modes of meaning-making that privilege discrete, disconnected actions” (p.1). Unit operations are the means by which games create relations between themselves, the player and the world (p.106). As the player interacts with the game they develop a model of the game's functioning, based around these discrete units of operation. It is this model, as it becomes a part of the player's mental framework, that provides the ability for the game to have meaning: “the unit operations of a simulation [or game] embody themselves in a player's understanding. This is the place where instantiated code enters the material world via human players' faculty of reasoning” (p.99).

Bogost is primarily interested in procedural representations that afford interaction. A *Sim City* (Maxis 1989) style game in which the player could only set a few input conditions (budget allocation to public transport, level of regulation of industry) and sit back and watch the results would be mounting a simplistic procedural argument. For Bogost the persuasive power of a procedural representation increases as interaction increases. Drawing on a definition from Chris Crawford that interaction is "a cyclic process in which two actors alternately listen, think, and speak" (Crawford 2003 p.5). Bogost notes that in the *Sim City* example above the player does very little speaking and the computer little speaking or listening. A low process intensity procedural representation involves little thinking from the computer.

The interaction between player and game exposes a limitation of procedural rhetoric – its focus on the message of the game mechanic without due regard for the player. Video games require play, and Miguel Sicart (2011) notes that play is personal. He asserts that "play, the performative, expressive act of engaging with a game, contradicts the very meaning of authorship in games." This is a useful reminder that criticism of a persuasive message can only achieve so much without consideration for the uniqueness of the persuadee, a reminder that is amplified for the interactive nature of video games. This can be seen as an application of Roland Barthe's (1977) "death of the author" to this medium, a point Bogost considers in relation to the distance between the user's experience of a simulation and of what it simulates (2006).

An earlier work of Sicart on game mechanics can be used to show how visual rhetoric applies to video games. Game mechanics are "methods invoked by agents, designed for interaction with the game state" (Sicart 2008), such as pressing the A button to invoke a ‘take cover' action. Such an interaction is accompanied by an animation, and the paradigmic and syntagmic elements of that animation convey a visual rhetoric that augments the procedural rhetoric of the process in which the interaction takes place. A ‘cover' action that is a controlled squat conveys a different rhetoric than a desperate dive to the ground.

It is valuable to note the distinction between algorithms within the game mechanics and algorithms that uphold the simulated world. This division is based on Craig Lindley's (2003) taxonomy for video games, which divides the basic framework of a video game into narrative, rule and simulation elements. Video games are unlike most other games in that they create (simulate) the world as well as the game, and often the world is filled with agents. Interaction with the game is not limited to interaction with the game rules but extends also to interaction with the simulation. The distinction between algorithms underlying the game rules and those of the simulation underscores the difference between analysis through procedural rhetoric and the potential for algorithms – only when simple algorithms uphold game mechanics is the role of algorithms reduced to procedural rhetoric.

Although this thesis builds on the work of the proceduralist approach, it primarily considers algorithms of low interactivity, minimizing the role of play and mechanics in the discourse. In this paper I will show how such algorithms can exert rhetoric even with low interactivity. This moves beyond the focus of the proceduralists and into new territory – the exertion of persuasion through the thinking of the computer.

The analogy of interaction as conversation highlights the role of thinking in algorithmic rhetoric. It is when the computer is doing a lot of thinking that algorithms become more pertinent. Bogost considers a computer game to be "a system of nested enthymemes" because the player's interactions slowly reveal the rules underlying the representation. But equally a video game can be seen as a system of nested algorithms. When the computer does a lot of thinking, the various principles outlined by Fogg can emerge into sophisticated results. But there is another way to distinguish between simplistic and interesting algorithms, one which is focused on the ability of designed objects to convey rhetoric.

It is straightforward to recognize that the design of certain objects can exert an influence on their users. Winston Churchill (1924) provided an example in asserting, "there is no doubt whatever about the influence of architecture and structure upon human character and actions. We make our buildings and afterwards they make us. They regulate the course of our lives." Computer systems, being both architecture and structure, have the same potential (Grant 1976). In its simplest form a phrase will suffice: We shape our tools, and then they shape us. The shaping from our tools exists both in what they constrain and what they allow. The second of these is also known as the "affordance" of the tool, which refers to "the fundamental properties that determine just how the thing could possibly be used" (Norman 1988). The design of an artefact determines what uses the artefact can be put toward, and they shape the ‘ways and means' of the user. It is important to separate this from "perceived affordance" which is the "information specifying the adaptive value of objects or events" (Mace 1977). In essence the perceived affordance is a persuasion that the physical design of the object has upon its users, suggesting the affordances it contains. The shape of an object tells the user how to use it.

Nigel Cross and Richard Buchanan are among those who have noted how arguments are contained within man-made objects. Crucial to this is the existence of knowledge and information within the design of an object. Cross argues that there "is a great wealth of knowledge carried in the objects of our material culture" (Cross 1982 p.224). Cook and Brown (1999) have noted the ability of experts to extract otherwise tacit knowledge from objects in their domain merely by interacting with them. Cross adds that "objects are a form of knowledge about how to satisfy certain requirements, about how to perform certain tasks" (Cross 1982 p.225). Buchanan argues that technologists can press their ideas about practical living on the human community through the design of their products. They design a world, large or small, and "invite others to share in it ... [persuading them] to adopt new ways and means ... in their lives" (Buchanan 1989 p.95). The impact that the design of an object can have upon the user can take multiple forms. Objects contain power "to enrich or impoverish the quality of their [users'] lives." (p.92). Designers have the power of "shaping society, changing the course of individuals and communities, and setting patterns for new action" (p.93). A well-designed object, finding use among many people, will change the behaviour of those people. He notes that designers have directly influenced the actions of individuals and communities through the centuries (for example, by presenting the audience with a plow, or a light bulb).

An important distinction is made between created objects that represent "necessary solutions" and designed objects. Buchanan argues that the primary obstacle to treating designed objects as rhetoric is the belief that technology is part of science – "a deduction from scientific principles" (Buchanan 1989 p.106) – and concerned with the necessary rather than the probable and appropriate. Martin has already argued that algorithms require revision and improvement lest they "become stale" and Buchanan, talking about designers of technology, offers a reason by distinguishing between scientists and technologists. The latter deal with issues of human affairs, where there is "seldom a single solution dictated by the laws of nature". Technology designers "do not provide necessary solutions," meaning that there is no solution that objectively follows from the given circumstances. Such solutions require no design decisions. But technologist must make decisions and Buchanan notes that the bases of these decisions are a "web of human factors, attitudes and values" (p.109).

The distinction between algorithms that are essentially "necessary solutions" and those whose design emerges from a "web of human factors" provides a way to understand which algorithms are potentially interesting for their rhetoric. An algorithm that implements a simple task in the obvious way borders on the necessary, and in doing so its rhetoric belongs not to itself but to the task it implements. Discussing the rhetoric of such an algorithm gains little beyond discussing the task itself. An algorithm that implements a task that is sufficiently complex that design and abstraction is required will contain within its design the possibility of rhetoric, just as other designed objects contain rhetoric.

The influence of designed objects is not limited to their influence upon the actions of their users but also includes how design of objects affects the thinking of their users. Neil Postman argues that the affordances of technologies prejudice their users to value certain perspectives. Put colloquially: to a person holding a hammer everything looks like a nail. Embedded in any instantiation of a technology is one or more ideas that develop from the relationship between the technology and its users. But their abstract nature means that they are "often hidden from our view" (Postman 1988). For communication technologies, McLuhan has captured the essence of this in saying "the medium is the message". Some tools and technologies, like those of communication, assist us in our thinking. The alphabet assists our formulation of words to express ideas. The map assists our comprehension of space, the clock our comprehension of time. Tools such as these also contain embedded ideas, but because their relationship is to our minds, they impose their ideas on our thinking. Nicholas Carr expresses this as "every thinking technology embodies an intellectual ethic, a set of assumptions about how the human mind works or should work" (Carr 2010 p.45). In the same way that the affordance of any other tool prejudices its user to perspectives of value, so does a tool for thinking.

The ideology of computers is complicated because they are universal machines able to be programmed for any task. And also because they are often integrated within other machines or techniques. Postman offers a few suggestions for the ideology of computers. They redefine humans as "information processors" (Postman 1993 p.111). This blurs the distinction between human and machine until humans are considered machines and machines are considered humans, a distinction I will return to. As well, computers are more human than other machines in that they do no work: they direct work (p.115). They have little value without something to control. A further ideology is through automation, which focuses attention on the success of the automation itself, and validates the process being automated, distracting from questions about the usefulness or legitimacy of that process[1].

In discussing the ideology of computers, Postman is using the term in a way closer to "a system of ideas and ideals" that form the basis of a thing (Oxford Dictionary) rather than as the "imaginary relations of individuals to their real conditions of existence" (Althusser 1971). But Postman is talking about a necessary ideology that derives from the nature of the technology. Although this is important, the ideology of algorithms goes beyond this to

1 To consider the ideology embedded in the internet, one avenue would be the use of hyperlinks, which promote decontextualization, and the TCP/IP network layer, which makes all systems equal, and promotes self-reliance, individuality and anonymity.

include the ideology embedded within their design. Here Pierre Bourdieu's concept of doxa proves useful.

Bourdieu (1977) uses the term doxa to indicate an idea that a particular society takes for granted. It represents those things that fall within the "the universe of possible discourse ... the universe of things that can be stated, and hence thought, and the universe of that which is taken for granted" for that society (p.169). Algorithms are designed with reference to a web of human factors, and consideration of these factors occurs only within the doxa of the designer. Ideology shapes algorithms through tacit assumptions. In specifying and articulating the instructions of algorithms, the requirement that everything must be specified leads to much being taken for granted. The doxa need not apply to the entire society but merely the society around which the algorithm design occurs. This could include the technical culture of the designer or the business culture of the company.

The use of algorithmic tools to make decisions entails an incorporation of the doxa of the algorithm's design. Decisions build upon previously developed ideas, and in using the decisions of algorithms these building-block ideas are hidden, just as the algorithm itself is hidden. The doxa present within the design of the algorithm are carried through to the decisions that the algorithm produces. In a simplistic example, the preferences of a designer of a GPS route-planning algorithm toward particular aspects of a journey are carried over into the experiences of those that use the route-planner. As these decisions are accepted by the user, so the doxa hidden within them are transmitted to them. This presents an avenue through which algorithmic tools can subtly impact the minds of their users.

Another avenue for assessing the impact of digital tools upon the mind is Baudrillard's (1981) concept of the hyperreal. Baudrillard proposed the hyperreal as the final stage in the replacement of reality by signs. In cultures of scarcity signs reflect the actual social hierarchy and have no impact on reality. The first order of simulacra emerges when signs are emancipated from duty, when they no longer reflect obligation but can be produced. Social mobility, competition and fashion encourage signs to take over all aspects of social life. In the West, Baudrillard places this stage between the Renaissance and Industrialization. The second order occurs with mass-production of signs. Signs no longer refer to reality but to each other; the original is not a concern. To accumulate signs one needs money not social power. The third order of simulacra is when simulation is dominant, and Baudrillard positions this as the present stage. Here the real is only that which can be equivalently reproduced. Signs construct the real as simulations. This is the more real than real, references with no referents – the hyperreal. As an example, he points to Disneyland, which is a simulation of an idealized American child-orientated life. It presents an endlessly reproducible simulation of a better world. Because people in suburbia aspire to live in Disneyland, and behave accordingly, they leave reality behind and live in a simulation: they attempt to simulate Disney, which is hyperreal.

Digital tools can act as simulations of the real to the extent of being hyperreal. Facebook is a pertinent example. It is first a simulation of friend connections: a model. But it is a hyperreal of friendships. The nature of the friendship is contained within the Facebook framework and through symbolic reference to Facebook friendships themselves. The user has complete control over what is posted and can manipulate photos in order to create an online persona that is almost perfect. It leaves the real behind. People's real lives then become the simulation: they are more concerned about the online persona, in fact they "live" on Facebook in the same way that a suburban American can live within the Disney hyperreal. This hints at a key way in which the reality of the algorithm becomes the reality of the user, and in so doing affects persuasion. But there is more to the impact of digital tools than accepting them as real or hyperreal.

The conceptions of how the digital tools can affect the mind as so far discussed assume a separation between the mind and its tools, echoing the historical conception of the mind. Although the conception of the mind has developed and altered over time, there have always been advocates for an essential division of the mind from the body. In the seventeenth century, Descartes, in his *Meditations* (1641), conceived that the mind and the body were distinct entities and this distinction was crucial to the concept of being human. Opposing this dualism, materialists brought the mind into the physical housing of the body, situating it in the flesh and blood of the body's brain. But the physicality of the mind within the body's organs does not necessarily impair its separation as a functioning entity. An Industrial Age metaphor conceived of the brain as a mechanism, like a steam engine or electric dynamo (Carr 2010 p.22). The nervous system was made of many parts, each contributing in some specific way to the overall functioning. It is through this metaphor that Freud and others operated, conceiving of "pressures" on the mind that find "release". (Daugman 2001 p.24). With the arrival of the digital computer, the mechanistic metaphor was extended so that the mind was now conceived as a thinking machine. (Carr 2010 p.23). Terms such as ‘circuitry' and ‘hardwired' became commonly used to describe the human mind's functioning and state. One can see in this historical progression how technological doxa underpin the metaphors of the mind. The idea of the mental computer developed with the fields of cybernetics and information systems during the course of the twentieth century (Hayles 1999, p.7). These fields conceived of information as a pattern, and although Hayles notes that patterns must always be instantiated in a medium (p.13), that does not preclude the possibility of exact replication of a pattern. And if the mind's knowledge is a pattern that could be instantiated in another medium, then artificial intelligence that mimics human thinking must be possible.

One objection to the possibility of a separate mind concerns the ability to separate the information of the mind from the mind itself. Ari Schulman (2009) suggests that,

> much work in A.I. has assumed that the layers of the mind and brain are separable from each other in the same manner that the computer is organized into many layers of abstraction, so that each layer can be understood on its own terms without recourse to the principles of lower levels.

He then demonstrates the difficulties that Artificial Intelligence (AI) research has encountered in attempting to operate under this assumption. One challenge is memory. Rather than mimicking the digital storage of computers, in which the precise patterns of bits can be copied and transferred without alteration, biological memory is context dependent (Carr 2010 p.191). The hippocampus appears to consolidate the cortical stimuli in order to form a narrative of events. These memories exist in working memory and short term memory before being transferred to long term memory in the cerebral cortex. But the transfer is not a copy. Rather a long interaction takes places between the hippocampus and the cerebral cortex during which the short term memories of the former are recontextualized to fit within the existing schemas of the long term memory. Formation of memory is not ‘a pattern' but contextualized, and results in a schematic change to the cerebral cortex's long term memory. This connects with an alternate definition of knowledge proffered in opposition to Claude Shannon's concept of knowledge as a pattern. Donald MacKay argued for a definition that "linked information with change in a receiver's mindset and thus with meaning" (Hayles 1999 p.18). Knowledge is not an extractable entity but a change in the recipient (which has resonance to our definition of persuasion as a change in the recipient's behaviours, attitudes and beliefs). The process to extract memories is equally contextual. Memories are not simply copied out of long term storage in order to be examined afresh. Instead they are adjusted into the mind's new consciousness, adjusting to suit the changed circumstances in which they now exist. Moreover, these memories are then returned altered – accessing memory is not a Read Only process.

The entangling of the mind within the brain is not the only difficulty for conceiving of a separate mind, as the enmeshment of the mind within the body has also been demonstrated. In 'Docile Bodies', Foucault considers various methods for the mastery of the actions of the bodies of soldiers, schoolchildren, factory-workers and others (Foucault 1975). Through such techniques as spatial enclosure to segment space, time-tables to segment time, and drill exercises to segment activity, the progress of an individual into a disciplined soldier, scholar, or worker can be achieved. The behavioural shaping of the body alters the person's mind; "one has 'got rid of the peasant' and given him 'the air of the soldier'". Likewise the discipline or indiscipline of the mind can influence the body, as studies in the field of body language demonstrate. A person whose mind is in a cheerful state carries their body differently to one whose mind is sorrowful

(James 1932). The connection is bidirectional. Holding a hot cup of coffee makes other people appear friendlier while holding a cold object can lead to self-interest in choices (Williams & Bargh 2008). In the prologue to *How We Became Post-Human*, Hayles argues for the importance of embodiment in consideration of the mind. "Thought is a much broader cognitive function [than an isolated cognitive system] depending for its specificities on the embodied form enacting it" (Hayles 1999 p.xiv). She highlights the integration of the mind within its body as a non-trivial connection, and one that forms a crucial part of the mind. This also suggests the mind not as a single unified 'I' but as a collection of agents, both from the brain and the body. David Laurie (2006) surveys the development of this idea, the mind as a property of networked biological agents. The information theorists saw information as a pattern which could be extracted from its medium, but the mind's knowledge does not extract so simply: it would not be the same mind if its patterns were separated from its embodiment (if they can be separated at all).

The culmination of the progression toward an enmeshed mind is the recognition that when tools are used the mind encompasses their workings within its own. The first stage of this is the extension of the mind's conception of its faculties not just to the body but the tools used by the body. What I mean is that when a tool is in hand, the mind treats the tool as though it were an extension of the body. Andy Clark (2003) argues that the tools we use constitute a real aspect of our mind. In doing this he takes the original idea of a cyborg as a being that is physically enhanced with implemented components and rescopes it to include any use of technology – such as cell phones or watches – that extends our biological mental capacities. It is our brain's neural plasticity that makes this possible. With this rescoping he argues that we are all cyborgs. Clark, however, stops short of considering tools with algorithmic processes, which is the focus of mind extension in this paper.

The mind's connection with tools is pushed further with the concept of physical neuroplasticity, which argues that the brain's architectural support of the mind is able to change and adjust in response to how tools are used (Carr 2010). Tools of the mind, for example maps and GPS navigators, take over the functions of the mind, possibly reducing our sense of direction (Frankenstein 2012). Mind extension concerns the plasticity of the brain to the extent that it can accommodate external tools as though part of its own cognitive processes. But physical neuroplasticity goes further, indicating that they are more than a part of our cognitive processes but akin to our own cognitive biases. The brain restructures itself in order to utilize tools more effectively, allowing the cognitive functioning that was once internal to it to be performed by external tools. This takes the concept of mind extension into a deeper position, indicating that as the mind extends to the tools it allows them to take responsibility for cognitive functions, and then reallocates the mind's own equivalent cognitive functioning into new tasks. This enables the mind to reach higher levels of cognitive functioning, but at a cost of reliance upon the tools to which it delegates. As with mind extension, Carr's examination of this topic does not push too far into the idea that the tools have their own algorithmic thinking. This idea is explored in this paper as the final form of hidden persuasion within algorithmic tools.

Key to the notions of algorithmic influence through mind extension and neuroplasticity is the decision-making capability of algorithms. Unlike other tools, algorithmic tools are able to exert their own agency. The extension of the mind's cognitive functioning to its tools, and the subsequent reorganization of the mind through neuroplasticity, requires deeper consideration when the tools are not inert. The persuasive possibilities emerging from such tools would be very subtle indeed.

Persuasion in Video Games and Web Sites

In this chapter I analyze the persuasion from algorithms within video games and web sites. I begin with video games where the approach of procedural rhetoric has been most applicable. Using a taxonomy of video games developed by Craig Lindley (2003), a separation is made between the rules and mechanics of a game and the simulation aspect of a video game, in order to show the different natures of each and their applicability to algorithms. I use this in discussing *Civilization*, an interesting example because it has long attracted academic interest for its potential to persuade players about history, and Ian Bogost's analysis of *Animal Crossing* which demonstrates some core issues concerning the place of algorithms in procedural rhetoric. But video games often contain fairly simple algorithms. In the second half of the chapter I will discuss online tools that enable more complex algorithms that better simulate decision making. Three web sites in particular provide examples of algorithms (Facebook's News Feed, Google's search, and Netflix's recommendation engine) whose decisions demonstrate persuasive effects.

Craig Lindley (2003) presents a taxonomy that divides the elements of a video game into narrative, mechanics and simulation. The classic division in video game studies is between the narrative elements (story, visual representations, etc) and the ludological elements (the game mechanics). Lindley suggests a third aspect to video games, or rather a division of the non-narratological side into the gameplay (challenges within set rules) on one hand and the simulated world of the game on the other. Lindley argues that video games are better understood by making a clear distinction between their three aspects of ludology, narratology and simulation. For Lindley simulation is the background game world, where "authored principles [specify] how time develops from frame to frame based upon physics, the representation of game objects and their behaviour, and discrete event simulation" (Lindley 2005, p.1). In essence, the simulation is how the video game behaves without player interaction – without advancement within the game rule system. This is particularly important for video game studies as opposed to other game studies. In a sporting match the 'simulation' is the actual world, and the game's rules tend to operate in order to minimize the impact of it upon the game itself. In a board game the simulation is the actions taken by non-player characters (typically enacted according to strict rules by the players). Sports and board games are focused on the game mechanics that play on top of the simulation.

Although Lindley's three elements can be considered in a temporal hierarchy (Lindley 2005) – where the simulation updates every frame, the gameplay updates when the player interacts with the game, and the narrative unfolds as change occurs to and within the representative symbols – it is more useful to diagram them "within a unified heuristic triangular space" (Amory 2007, p.62) with each element a point on the triangle. Video games and their genres each offer a greater or lesser amount of each of the three elements, enabling us to place them within the triangle. A game like *Tetris* (Pajitnov 1989) has little narrative or simulation, existing almost entirely as a "challenge for the player". Chess has slightly more narrative, but like most video game versions of board games and early games like *Pac Man* (Namco 1980), it exists mostly as a player challenge based around game mechanics – there is little story or simulated world. *Civilization*, *The Sims* (Maxis 2000) and *Gran Turismo* (Polyphony Digital 1997) exhibit a strong simulation (the earth, a household, a car race) and strong gameplay (*The Sims* provides many awards and challenges even without strong goals), but these games provide little narrative – it is up to the player to create a story from the events of the game. Even when no narrative is provided, the player may develop their own from their experience of the provided material (Ryan 2001) but the location in the taxonomy is unaltered[1]. *Myst* (Cyan 1993) and *Final Fantasy* (Sakaguchi 1991) provide a narrative and game challenges but their simulated worlds are very shallow systems. DVD movies and text adventures fall close to the narratology dimension, with little simulation or game challenge. Avatar worlds, such as *Second Life* (Linden Labs 2003), and simulated environments fall close to pure simulation. An interactive virtual theatre, such as the 'ractives' described by Stephenson (1995), exhibits strong narrative and a simulated environment, without much game challenge. *Grand Theft Auto* (Rockstar 1997) is an example of a video game exhibiting all three aspects in strong measure.

1 The impromptu generation of story can also apply to game play, as when people decide to 'make a game' of a non-game activity with which they are involved. Simulation would seem more difficult to spontaneously generate, except for the imaginative worlds of children (often during play without rules).

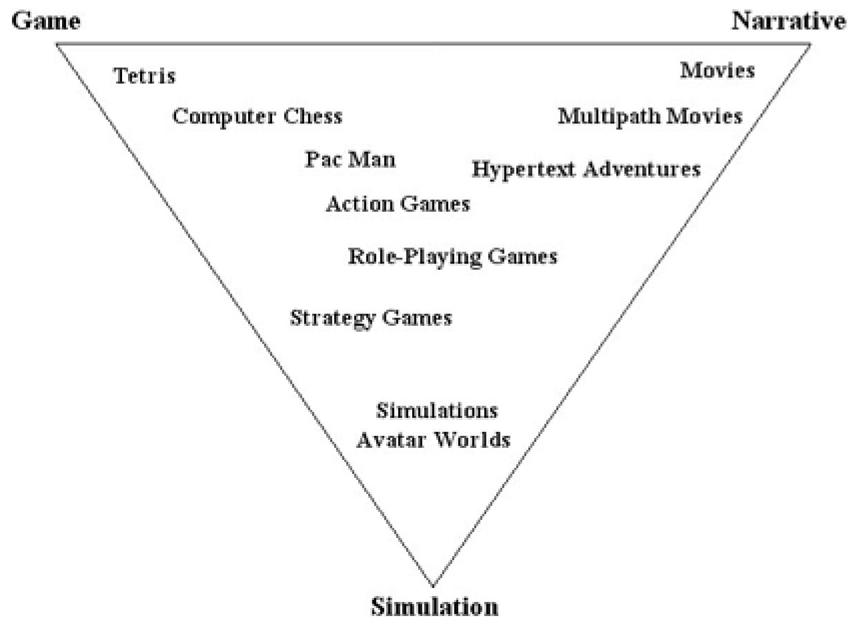

Figure 1. Lindley's Triangle (Lindley 2005)

The division of video games into simulation and game rules elements provides a structure for discussing the role of algorithms in persuasion in video games. Discussion on persuasion within video games most easily focuses upon the narrative elements, although analysis of procedural rhetoric aims to extract the less evident persuasion within the mechanics of the game. But even less evident is the algorithmic persuasion. Just as Lindley's taxonomy offers a temporal hierarchy in which simulation sits at the bottom, updating every frame, algorithmic processes operate within the elements that construe the processes of the video game. Algorithms have a role in both game rules (where they enforce rules or operate player entities that exist within them) and in simulation (where they provide the underlying calculations of the world, or operate non-playing entities that exist within the world). I will explore these four aspects one by one by examining some games that have received rhetorical analysis, and noting the algorithmic influences. The first example of *Civilization* also provides an opportunity to see how rhetorical analysis has been applied to a video game. Much of the analysis is of the game's procedural rhetoric, which is concerned with rules. The game's rules are contained within the ludological aspect of Lindley's triad, but later examples will also consider the simulation aspect.

Civilization (or *Sid Meier's Civilization* (Microprose 1991) and its sequels) allows a player to take control of a civilization at the beginning of history (4000 BC) and guide it through the centuries until the present day. The play includes settling new lands, trading with other civilizations, building cities, and fighting wars. It fits within the '4X' genre of strategy games defined by Alan Emrich, games whose mechanic challenges the player to eXplore, eXpand, eXploit, and eXterminate. The game includes a lengthy 'technology tree' which allows research to uncover successively more complex technologies (such as Iron Working and Gunpowder) in a semi-linear fashion that roughly corresponds to the actual historical progress. Technologies confer significant benefits; examples include more advanced military units, new forms of government, or better improvements to cities. The game's comparatively deep simulation of history has lead some to suggest that it might be a useful tool for teaching history in the classroom, both as an experience of historical forces as well as for fluency with historical features (such as nations, technological discoveries, military types, etc) (Squire 2004)(Jenkins, Squire 2003).

The *Civilization* series of games presents an opportunity to examine the potential for procedural rhetoric as a tool for criticism of the persuasive potential of video games because the *Civilization* games have been the subject of academic scrutiny for the particular shaping they give to history. The game's designer, Sid Meier, has noted that it was always intended to be a game primarily and that historical accuracy was a secondary consideration (Chick, et al. 2001), but this does not change the fact that players may still treat it as a history simulation. Or even if they do not consciously treat it as such, playing the game may give rise to particular understandings of history. Henthorne (2004) argues that by allowing players to construct and interact with 'utopias', stimulatory video games like *Civilization* carry a power that literary utopias do not: "to rethink the nature of their social lives as they play out alternative social realities". Bogost makes references to *Civilization* but not in any depth, chiefly noting how it presents a process-based argument about historical development as opposed to an inscribed argument about historical processes[1].

Many of the criticisms of *Civilization* concern its procedural rhetoric: the underlying rules of the game. Friedman (1999) objects to the game being fundamentally competitive, promoting the "the notion that global co-existence is a matter of winning or losing". Douglas (2002) observes that space unexplored by the designated civilizations is considered 'unoccupied territory' yet contains 'barbarians' that must be conquered. As Douglas notes, the game "construct[s] the indigenous population as another obstacle of the landscape – and one which, like the others, needs to be settled and disciplined".

Some procedural rhetorics verge on the ideological. Bitz (2002) notes that the game has a uni-linear notion of development: "the idea that there is a single path to 'progress' that each and every society must follow". This is primarily achieved through the technology tree, which roughly corresponds to actual historical progress – progress that has shaped and been shaped by contemporary United States ideologies. This leads to repeated criticisms that the game presents a United States-centric view of the world

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1 For example, Jared Diamond's "Guns, Germs and Steel" makes a written argument that geography shapes historical development, while *Civilization* makes the same argument through process: over multiple plays the player may notice that the richness of their starting geography is a factor in whether they win.

(Friedman 1999)(Bitz 2002)(Douglas 2002)(Hankins 2007). Henthorne (2004) and others have noticed the environmental themes in the *Civilization* games. In the game, as nations progress technologically they inevitably find themselves in an industrial age. This age confers benefits in terms of increased production and new materials (and thus new military units) but comes at a price: pollution. As industrial cities increase their output they also increase their polluting count, and a player that did not wish to advance themselves by increasing production would be conquered by rival civilizations that did. Cities and civilizations with higher polluting counts are more likely to experience a random pollution event, in which a square of territory is temporarily covered in pollution and dramatically lowers its yield.

The placement of pollution is the first hint of an aspect of the game's persuasion that is algorithmic yet (mostly) falls outside procedural rhetoric. The tiles around a city typically range from high-yield cropland to barren desert. If the pollution is placed randomly then the impact will be less than a placement that considers distance to the city (cropland is usually closer). Additionally the contribution of the city's polluting count can also have an impact of the perceived effect of pollution. In earlier version of *Civilization* that total polluting count of all cities was used to determine whether pollution was placed. This differs to random chance on a per city basis. All these issues work toward the fundamental question of how far industrialization can be pushed without consequence. Arguably, since the determination of whether and where to place pollution is made according to some script, it falls within the ‘rules of the game' which the player discovers through interacting with the system. But this pushes the concept of exploration of the rules to breaking point. Only a hardcore player would consider trying to determine the algorithm that underlies pollution placement, and the method they would use stretch the idea of interactivity too far. It is too deeply nested to be discovered in practical terms. As well, in terms of process, it is a single unit operation. There is no process to discover: pollution is placed, or not.

Another example of the role of algorithms beyond the scope of procedural rhetoric is found in the decisions made by enemy players (referred to as AI, for Artificial Intelligence). The portrayal of Gandhi, leader of the Indian civilization, provides an interesting example since *Civilization's* Gandhi character has an extreme preference for acquiring nuclear weapons. This trait is rather at odds with the historical figure's pacifism (Civilization Wiki n.d.). Some might see this as political commentary. Others might see this as an unfortunate statement on post-nuclear realpolitik (as evidenced by the real India's successful pursuit of nuclear capabilities). Rumour suggests that Gandhi's AI behaviour is somewhat innocent: a developer accidentally keyed 12 instead of 1 for the nuclear proclivity field (rated on 1-10) that forms one parameter for the personality characteristics of Gandhi. Since the behaviour was so unexpected from Gandhi, it was kept for its humourousness ("Civilizations" 2011). This presents another potential example of algorithmic influence that falls outside procedural rhetoric. Though the behaviour of enemy AI can be discovered over time, it does not form a part of the rule system of the game. Like the placement of pollution it pushes the idea of exploration of process to breaking point. It is the following of a script rather than the generation of a representation from rules. Yet players will probably feel the difference between Gandhi's behaviour and those of another enemy AI (and adjust their approach to play), so it is not inconsequential either.

I prefaced the discussion of *Civilization* by noting that within the simulation and game rules division, algorithms can operate on both in two ways: being responsible for the rules or simulation, and when operating entities within the rules or simulation. The two examples of pollution and Gandhi represent these different ways for the game rules.

First is algorithms that operate agents that act within the rules of the gameplay, which is demonstrated by the AI civilizations in *Civilization* such as Gandhi. Here the algorithm attempts to replicate the choices of a player's behaviour: to act according to the rules of play in order to achieve victory. The enemy AI is bound by the rules of the gameplay, just like any other player. At its most developed such an algorithm attempts to model human thinking, or a subset of it (focused on operation within the given rules) in order to play effectively. The AI takes on the role of a social actor and so it exerts persuasion in this way. Because the AI acts like another player, the persuasions resulting from these algorithms most likely align with the social persuasions outlined by Cialdini: reciprocity if the AI acts to benefit the player, Social Proof if multiple AI act in the same way, Liking if the AI's behaviours mimic the player's own, etc.

Second is being responsible for the rules of gameplay, in which algorithms can control the specific enforcement of rules. An example of this is the placement of pollution in *Civilization*. Here the algorithm determines how to interpret the game rules. I noted earlier that in some games, like sports, the world itself is the ‘simulated world'. In such a circumstance the upholding of rules falls to referees who determine how to interpret the rule to each unique context (i.e. different referees will respond in their own way to the issue of diving in soccer/football). It could also be likened to the IRS agent who decides whether a person's excuse is valid[1] or a store clerk deciding whether to accept a return that does not fit neatly within the store's prescribed rules. To the extent that the AI takes on a clear social

1 "[B]ased on your explanation that 'the adult brain turns to jello those first few months raising a baby', we have decided to remove all penalty charges" is apparently an IRS agent's response to Erica Firment's request for leniency (as posted on Facebook)

role (such as a referee) the persuasion may align to the social persuasions. But the decisions that uphold the game rules are often hidden, as in the pollution example. Instead the algorithm may be exerting persuasion through the procedural rhetoric – augmenting the discoverable rules of the game with inscrutable modifications based upon its decisions. In most video games such decisions are performed according to simplistic mapping, but it does not necessarily have to be the case.

The other aspect of Lindley's taxonomy to consider is simulation in video games – the parts of the game environment that are not part of the game rules. Some examples of persuasion through simulation are provided by Fogg. One of these is the video game *Rockett's New School* (Purple Moon 1997), which presents a story in which a girl is new to a school and the player must choose her attitude in reaction to events (the game deliberately rewards self-confidence (p.67)). Like many other examples used by Fogg the algorithms are simple: in this game the designers determine the outcome to each input and the algorithm simply maps these relationships. However, other examples in the use of computers in simulations show Fogg's approach when dealing with some more complex algorithms. Many of these examples involve substantial tangible elements (as opposed to being entirely virtual like most video games). Fogg's examples include a Virtual Reality system to allow users to overcome phobias (allowing for example interaction with virtual spiders), and the 'Neon Drunk Driving Simulator' car that provides the experience of impaired driving. These devices attempt to persuade by simulating reality, and the algorithms play a crucial role in creating the world of that reality, whether it is a virtual spider or delayed brake reaction.

In a second video game example, *Sim City*, Fogg comes closest to engaging with the issue of the potential of the algorithms within the simulations to affect persuasion. In this game the player grows a city by zoning land, providing infrastructure and setting tax rates. It has been called the poster child of simulation-as-subtle-propaganda (p.67) because the success of the city's growth depends on the designer's interpretation of how those factors effect the citizen's behaviour. For example, in the game rail transportation is preferable to roads (p.68) so players that favour rail transport are more likely to develop successful cities. The role of algorithms in such a simulation goes beyond a simple mapping between choice and predetermined effect, as in *Rockett's New School*.

The power of algorithms to persuade by creating a pretend reality through simulation is not fully explored by Fogg. Discussing *Sim City* he notes the risk of bias within the design of the simulation, with the potential that this could lead to the user of the simulation to develop an errant perception of reality. Buchanan's suggestion that designers create a world and then invite us to share in it has extra resonance when the world is presented as correlating to our own. Fogg notes this risk and rather optimistically suggests that designers should reveal their biases to the users (p.68), before acknowledging that they may be reluctant to do this. This also disregards the problem that designers may not be aware of their own biases, a point I will return to in discussing doxa.

The easy dismissal of the problem of designer bias suggested that Fogg sees the problem as akin to one of wrong information. The bias could be likened to the bias of a writer of history, who chooses to omit certain facts in order to demonstrate a falsehood. But I contend that there is much more persuasion in algorithmic simulations than just the spreading of wrong information. By virtue of our interaction with these tools and our minds treatment and accommodation of them, they affect our cognitive process beyond just the comprehension of incorrect propositions of an argument.

Instead the use of tools changes the way we think, not just providing information but changing thinking processes.

Another simulation example is found within Bogost's detailed examination of *Animal Crossing* (Nintendo 2002). Although he defines procedural rhetoric as concerning the rules of procedural systems, which would seem to restrict it to the mechanics of the video game, Bogost applies procedural rhetoric to both game rules and simulation elements of the video game without distinguishing between them. Bogost's use of procedural rhetoric encompasses both the competitive rules system that emerges from the game rules, and the rules system that underlies the simulated world. But as with the analysis of *Civilization*, underneath these rules lies the influence of algorithms.

Animal Crossing is a video game for the Nintendo GameCube that provides an "animal village simulator". Bogost presents a sustained examination of the procedural rhetorics in this game (Bogost 2007 p.267-275), focusing on the conflict between material acquisition and an eco-pastoralist community. The link between debt, material possessions and commercial leverage is condensed into the player's relationship with a single game character, Tom Nook. Tom lends the player money to expand their house, and also operates the town store which sells goods to fill the space. More goods require more space and a larger house brings more debt. Paying down the debt enables Tom to expand his store and provide more goods for the player to buy. The player's resources "remain effectively constant" (p.269).

An algorithmic mechanism that assesses the player's house forms a part of the procedural rhetoric of the game. Connected to material acquisition is the daily receipt of a letter from the Happy Room Academy (HRA) which provides a numeric rating of the player's house. The rating is based on a "complex interior design simulation that is not disclosed in the game or its manual" (p.270). It is an algorithm. Bogost notes that the application of a single lifestyle calculus to everyone's home "quickly offends" (p.270). The procedural rhetoric of the HRA letter is its daily receipt and the application of a single calculus. The nature of that calculus is relevant to procedural rhetoric only in that it is generally difficult to discern, but the calculus has potential for persuasion beyond this rhetoric. It rewards behaviour that manages to fulfil its calculus (some aspects of which, like matching furniture, are easy to discern). The daily receipt of the letter demonstrates that this is an important aspect of the game, and the players may spend some time adjusting their play to suit the lifestyle judgements of the calculus. A different HRA calculus would fulfil the same unit operation within the procedural rhetoric of the game, but with a different outcome. This shows that algorithms have a role within, yet separate to, the procedural rhetoric of the game.

Another consideration is the actions of the other animals in the village. They seem to enjoy a simple life devoid of much material acquisition. "[They] enjoy walks outdoors [and to] snooze on their porches [and they] stop to watch the player fish" (p.269). They do not partake in the debt-upgrade-purchase cycle. If these non-player characters (NPCs) were imbued with sophisticated AI and did partake in the cycle, it would not affect the procedural rhetoric of the game. The procedural rhetoric emerges from the behaviour that emerges from the rules, and the rules remain the same. But if the animals in the village were engaging in a variety of behaviours, including the debt-upgrade-purchase cycle, it might offer additional forms of persuasion. Again the algorithms operate within yet separate to the rhetoric of the processes of the game. For Bogost, the behaviour of the NPC animals is part of the game's rhetoric because for him they form an aspect of the rules of the simulation of the village. But as with the HRA calculus, he does not engage in a counterfactual examination of their influence by asking how they would impact the game's procedural rhetoric if their algorithmic decisions differed: if the animals showed different behaviours toward material possessions, to their activities within the village or toward the player.

Just as the algorithms within game rules operate both in being responsible for the rules and when operating entities within the rules, so the algorithms within the simulation aspect of video games fall into those responsible for the simulation and those operating entities. *Sim City*'s development algorithms and the NPC animals in *Animal Crossing* provide examples of each.

First, within the rules of the simulation, algorithms can control the behaviours of NPCs as part of the simulated game world. These characters are not in competition with the player so have little interest in following the game rules in order to compete. Instead they abide by the simulation rules and otherwise follow their own inclination. Typically video game NPCs have very simplistic inclinations as a result of simplistic algorithms. The animals of *Animal Crossing* show a slightly more diverse range of behaviours. At best the algorithms would attempt to make the world as realistic as possible by imbuing the NPCs with fully-realized personalities[1]. As with the enemy AI, because the NPCs often take on social roles their influence may be through social persuasion methods similar to Cialdini's, including Authority if the NPCs have roles with such

1 Bogost notes that a procedural rhetoric in *Grand Theft Auto: San Andreas* (Rockstar North 2004) is that the player is treated by NPCs in Compton the same as NPCs in Beverly Hills, echoing a conservative position that external social treatment does not affect criminal tendency (Bogost 2007 p.117). If the NPCs did have their own prejudices a different rhetoric would emerge, but not a procedural one.

designation. But also, NPCs can influence the procedural rhetoric of the game. The barbarians of *Civilization* are presented as "another obstacle" but this consideration might alter depending on whether their behaviours were migratory, aggressive or benign.

Second is upholding the rules of the simulation, in which algorithms are responsible for creating the world. A common example is physics engines. Typically the algorithm aims for a representation of the real world. The example of *Sim City* shows how bias in this regard can be pertinent. The simulated world does not behave exactly in accordance with the real world, but according to the designers attempt to implement their interpretation of the world through rules, and algorithms that uphold those rules. If the algorithmic calculations behind citizen happiness value rail infrastructure over road infrastructure, then the player can be influenced by this design choice. The 'Neon Drunk Driving Simulator' is a non-video game (though some might consider it similar to an arcade machine) example of the same thing – the extent to which its algorithms reflect the actual experience of driving drunk for a sober driver will have an influence on the reception of the driver toward alcohol and driving. If the algorithms are not sufficiently accurate (either under-representing the difficulty of driving drunk or over-representing it to the point it is disregarded as propaganda) their persuasion may not be as intended.

Does the complexity of the algorithm impact its persuasive potential? Many video games use simple algorithms for the tasks discussed. NPCs and enemy AIs often lack particularly complex behaviours or individual personalities. To better answer why the complexity of the algorithm might have an impact, I consider an example within the principles of persuasion identified by Fogg.

B.J. Fogg's forty-two principles of persuasion by technology often use fairly simplistic algorithms – essentially mapping an input to an output. As an example, for the principle of Suggestion Fogg notes that "the suggestion technology simply serves to cue a relevant behaviour" (Fogg 2003 p.41). The examples for this principle provided by Fogg use fairly basic algorithms, such as a proposed toy that would sing a jingle about French fries when it was within a certain distance of a McDonald's. Note the low-process intensity of such a technology: a GPS application uses the position of the toy to detect when the user is at a location. The designer of the algorithm determines a distance considered close enough to be persuasive, and the algorithm simply performs distance checks until the range matches, at which point it plays the song. The persuasion is chiefly in the song and the context, the role of the algorithm is to determine the distance – a minor role. Such algorithmic persuasion does little to demonstrate the potential of algorithms, as the task of the algorithm is trivial; it mainly shows the ability of a designer to have remote agency for a prepared pitch.

It is possible however that the decision of when to cue the sound could be more complex, related to subtle weighting of numerous factors. Fogg notes that the recipient's mood, social context, feelings of connectedness to others, and financial situation could all factor into their reaction at the decision point and whether they are persuaded to act (p.43). The cue might be based on location, its persuasion connected to the user's proximity. Or the cue might be based on time, its persuasion based on anticipated eating cycles. A high-process intensity evaluation of multiple data elements may well be capable of performing a nuanced judgement about when to play the song, based on more than raw distance. Such an algorithm would be much more interesting to consider, assuming the algorithm's judgements about when to play the sound were more persuasive.

One reason a ‘complex decision' algorithm is more interesting than a ‘simple mapping' algorithm rests in the role of design and its use in engaging the user. The discussion on the methods of persuasion (such as the six identified by Cialdini) highlighted the role of social factors in successful persuasion. A simple mapping provides little avenue for social factors, while good design incorporates the use of a web of factors, primarily social. As well, a simple mapping is apprehended fairly easily by the user, who is then conscious of the persuasive attempt. After a short time with the French fries device, the user would apprehend the relationship between the distance and the proximity to a McDonald's, in effect discovering the nature of the algorithm. Because the algorithm is focused on the McDonald's and not the user, this maintains a distinction between the device and the user, reducing the possibility of a social connection. On the other hand, a sound that cued based on a complex decision related to variables concerning the user is centred on the user. This enables the device to engage in socially-relevant behaviour toward the user (such as playing when the user has left the gym). As well, to the user the jingle would simply appear at opportune times. In such a situation the distance between the device and the user is narrowed. If it is designed well, such a device is more likely to become a part of the user's thinking, because it performs its own.

In many of the examples already discussed the goal of the algorithm is to simulate human behaviour, human thinking or human rule interpretation. Just as the fundamental aspect of algorithm design was the judgement of the designer, so the ability of algorithms to perform decision making is at the heart of these examples of algorithmic persuasion. The algorithm's potential to persuade emerges best when the algorithm is involved in judgement, decision, and simulated thinking. Attempts to simulate human thinking typically require high-intensity processing.

Crucially, when the algorithms perform their tasks through a simple script it is easy for their impact to blur into procedural rhetoric. But when the decisions are made from high process intensity, when there is little likelihood of the player's interactions discerning the algorithm, then procedural rhetoric fails. It would take a computer to analyze the computer because humans are unlikely (though some hardcore gamers probably will) to map the inputs and outputs in the expectation of eventually modelling some semblance of the underlying complexity. To the extent that simulated thinking (or decision making) is a simulation it could be understood using procedural rhetoric. But thought is really a different kettle of fish, and should be treated as such. Their models border on inscrutable. They are deeply nested rule systems which defy understanding through procedural literacy, which is the goal of understanding procedural rhetoric.

Video games do not tend toward complex examples of simulated human thinking. It has been necessary to work with video game examples in order to fully explore the difference between procedural rhetoric (which claims application to all procedural systems but is primarily used on video games) and algorithmic influence, and to clearly separate the two. Using Lindley's division of video games into simulation and game rule aspects, and a further division into algorithms that are responsible for either of these, or that operate entities within either of these, I have shown that there is clear potential for algorithmic persuasion in video games. But a more compelling case for persuasion from simulated thinking can be found when looking at computer interactive devices other than video games: those with higher process intensity. One problem is that most devices have fairly limited computational power, typically less than any video game console. Fogg's use of low process-intensity techniques indicates this. Yet algorithms with complexity are likely to be algorithms with high process intensity.

Two examples of procedural systems that have simulated thinking with high process intensity are banking credit and dating systems. Banking credit systems use personal factors to decide whether to give loans (especially mortgages) or not. An applicant provides the necessary financial information (the input) and then the algorithm makes a decision about how much can be loaned, or whether a loan can be made at all. Due to the financial power of such decisions, the algorithms that constitute the thinking are carefully guarded – possibly not even accessible to the human intermediaries (the bank staff) who process the request. Dating match-making algorithms also offer simulated thinking from algorithms. Similar to the way the bank credit system absorbs financial information, such match making absorbs numerous factors from the personal profiles of the date-seekers. The results are more complicated than a yes-no or a credit limit, and concern assigning compatibility likelihoods to other date-seekers. Ultimately the decision of who to date rests with the date-seeker, but the match-making algorithm's selection and ranking provides potent influence over their choice.

The internet provides a way for examples like these to provide tools with high intensity on devices that otherwise lack the computational ability and data storage. Though the traditional interaction with these examples is through a human representative of the bank or matchmaking agency, those agents have little thinking function beyond transferring input from the client to the algorithm and transferring the results back to the human. Banking credit checks and date match making predate the world wide web, but tellingly are now enabled by it. With the advent of the world wide web users can access algorithms and provide the necessary input from any browser. Online sites offer enormous potential for providing interfaces to algorithmic decision-making. Some rich examples of algorithms performing simulated thinking are

● Facebook's News Feed, which processes the activity and postings of friends in order to create a prominent list of ‘significant' and ‘interesting' activity to display each time a user opens the site.

● Google Search, which takes textual input queries (even mistyped and partial ones) and returns a ranked page (and further pages) of the best web sites matching the criteria.

● Netflix recommendation, which uses the ratings and viewing habits of a user in order to recommend new films and predict (with accuracy) the rating the user would assign to these films.

These online tools will form the core examples for the rest of this chapter, enabling an exploration of high process-intensity, complex algorithms within regularly-used devices.

My first example is Facebook's algorithm for selecting stories to display in the site's News Feed. Facebook is the world's largest social network ("Facebook" 2012), with 845 million monthly active users and 100 billion friendships at the time of their S-1 filing (Ebersman 2012). When a user logs into the site the central feature of the page they see is the News Feed, which displays "a constantly updated list of their friends' Facebook activity" ("Facebook features" n.d.). When it was released, Mark Zuckerberg described it as the "information people used to dig for on a daily basis, nicely re-organized and summarized so people can learn about the people they care about.... [The] stories coming in are of interest to the people receiving them, since they are significant to the person creating them." (Zuckerberg 2006). Facebook's News Feed is like the friend who greets you when you arrive at a party. You ask: "so what did I miss?" How they respond is going to shape your understanding of the people, their character, who they are and what they do. How Facebook determines this 'interest' and 'significance' is through an algorithmic process that they have not published in full, although their help section does contain a sentence describing how the Feed determines what is interesting: "The news feed algorithm uses several factors, including: how many friends are commenting on a certain piece of content, who posted the content, and what type of content it is (e.g. photo, video, or status update" (Facebook n.d.).

An independent analysis of the News Feed by Thomas Weber in late 2010 provides greater insight into the functioning of the algorithm. Weber spent a month observing the Facebook activity and News Feed of a newly created account and the accounts of over two dozen volunteers who were the new account's only friends (Weber 2010). They observed that the new account's activity did not appear on the friend's News Feeds until after they began to interact with the account (potentially a catch-22 if the friends never see the posts on their News Feeds). Once a few friends began to interact with the new account, its activity began to appear on not only their News Feed but on the News Feeds of friends who had not interacted. When the friend's interactions included comments, the results were an even higher visibility of the new account's activity on friend's News Feeds. There was also a noticeable hierarchy within content that appeared. Photos and Videos were more likely to appear than Links, which were more likely to appear than Status Updates. A final observation was that the activity of the new account was more likely to appear in friends with smaller overall friend counts – the friends with the highest friend counts never saw anything from the new account in their News Feeds. The conclusions from this study indicate that the algorithm for determining the content of any News Feed is more complex than as described by Facebook's help page. In particular, the fact that only after friends began clicking (without commenting or posting) on content on the new account did the new account's activity began to show in their and other friend's News Feeds. The hierarchy of content gives advantage to rich content (photo and video) over textual content, but also to rich content that is hosted on Facebook compared to content hosted elsewhere (Links). The News Feed algorithm not only encourages sharing but particular kinds of sharing: sharing that makes Facebook a richer experience for friends.

The power of the News Feed is that it acts as a gatekeeper to the lives of friends. Zuckerberg's quote reflects this: "the people they care about", with the implication that if a friends' activity does not show on the News Feed then you may not care about them. Accounts that receive no interest from friends are also considered ‘not cared about', as demonstrated by the need for friends to click before a new account's activity appears on other News Feeds. Facebook is arguing, through its algorithmic selection of the most ‘interesting' and ‘significant' activities of your friends that some of your friends are better than others, and the better friends happen to be those who demonstrate behaviours consistent with the desires of Facebook. The reasoning behind the design of the algorithm is not discussed. It may even be that the designers are unaware of this bias in their design. But there is an argument that an ideology is being pushed through Facebook's News Feed – an ideology about what constitutes friendship. Those working at Facebook may consider, like Facebook itself, that this *is* what constitutes friendship.

My second example is the algorithm behind Google's search engine. Google is the world's most popular Internet search engine with an "outsize influence over the online world" ("Google" 2012). Google's search initially worked using an algorithm to determine Page Rank (named for Larry Page) using the hyperlinks between web pages to determine relevancy of content to search terms. Links from authoritative sources were more valuable than from other sources. By scanning much of the entire web and mapping links and terms the algorithm could determine a ranking for each page for every term that occurred on that page, or on pages linking to that page. When Google arrived it was praised for the relevancy of its search results compared to other search engines (Carr 2010 p.194). Google's original algorithm has been improved over time and now uses over 200 signals (p.158). There have been major updates to the algorithm, such as Panda in 2011 (Levy 2011). Panda targeted content mills, which produced large volumes of cheap content that targeted user searches. The release of these versions is not made visible on the Google Search results, but the results can be dramatic. Panda was "notorious" and its effect resulted in some web businesses closing down (Dudley 2012). Matt Cutts, a prominent Google engineer, defended the role of the algorithm in an interview, likening it to an "editorial judgement" that was the very reason users searched with Google (Levy 2011).

The effectiveness of Google's search positions it as a gatekeeper to online knowledge. Because Google is so effective at finding content amid the world wide web, it becomes easier to rely on it to find information rather than remember it ourselves. Why take the effort to remember content when Google can find it for you in a few seconds? A refrain among proponents is that "memorization is a waste of time" (Carr 2010 p.181) Moreover, the ease of searching for information on the web has encouraged posting information on the web (not that it needed much encouragement), which has lead to an information overload of epic proportions. Against such an information overload, the best recourse (presumably) is to rely on search engines to find the best information[1]. In a sense search engines promote the problem they are trying to solve. Carr has written "Inundated at every moment by information of immediate interest we have little choice but to resort to automated filters, which grant their privilege, instantly, to the new and the popular." (Carr 2010 p.171). Search engines are a particular kind of automated filter – reducing the infinite pages of the world wide web to a list of twenty of the most relevant ones.

As well as general search, Google offers specific search like Google Book Search. One of these searches news sites in order to to create a snapshot of what is happening in the world – it algorithmically aggregates the latest selected news from a wide variety of sources. Although the list of around 25,000 source publications is overseen by humans, the selection of articles from these sources is purely algorithmic (Cohen 2009). This process does not stop Google News being a popular source for news and information. Recent surveys place Google News' readership at around a quarter of the readership of the top online news source, with a monthly audience of 11,000 and a market share of 2% (Olmstead, Mitchell & Rosenstiel 2011). These numbers suggest that a sizable audience gathers at least a portion of their news from articles that are chosen by an algorithmic process. The selection of news articles that a person reads, over the course of time, has the power to shape their perception of what is happening outside their immediate reality. By leaving such a decision to an algorithm, the viewers of Google News are allowing the accuracy of

1 Like the infinite library in Jorge Luis Borges' "The Library of Babel", an endless supply of data is only useful with a good index.

how informed they are about the world to be determined by the design of that algorithm, including any biases contained within that design.

In 2002 Google began an ambitious project to extend the reach of its search index by scanning all the world's books (Carr 2010 p.161). By making the content of all books as accessible as the text on web pages, Google's search algorithm moves closer to become the filter for all published knowledge. If users choose to rely on this filter in order to find knowledge in any form (books, newspapers, web pages, etc.) then Google truly becomes the gatekeeper to what they know. In discussing Google Books, Robert Darnton, librarian at Harvard University, invokes Pierre Bourdieu's notion of "literature as a power field" to emphasize the potential for abuse (Darnton 2009). This is especially true if users choose not to memorize what they find but instead to search for it again when they need it.

The nature of Google's search algorithm is necessarily hidden in order to prevent it being gamed. Prominent placement on search results can have financial gain because search is a form of advertising. Because AdWords operates on an auction system, it is possible to use the AdWords rates to gauge the potential worth of a ‘native' high search ranking. ‘Insurance', ‘Loans' and ‘Mortgage' were apparently the most expensive search terms in 2011, costing up to $50 per click (Kim 2011). If advertisers are paying these sums in order to appear in proximity to native search results for these terms, the native search results are presumably worth at least a similar amount. This leads to serious attempts (an industry even) to discover effective ways to modify sites so that they will be more attractive to Google's relevancy algorithms (Carr 2010 p.94). "Google Bombs" are a term for performing such an action, though the use of the term is more widely applied to attempts to make political statements rather than money.

Amit Singhal, a Google engineer suggests that "there is absolutely no algorithm out there which, when published, would not be gamed" (Levy 2011). In order to return the best results, Google's algorithm must be hidden, or else it would simply be returning a list of sites that have been most effectively tweaked toward the search algorithm.

Google benefits from returning search results, and this potentially shapes how content is made available. Google benefits because its revenues are primarily driven by advertisements, so more searches mean more advertisements which means more potential revenue. Just as Facebook has an interest in promoting friends who behave in Facebook-friendly ways, Google has an interest in returning search results that encourage people to surf the web faster (Carr 2010 p.156). One simple way this shapes the web is that information needs to be available to be returned in search results. Encouraging sites that make their information free benefits Google. Long encoded texts that are not easily able to be broken into search results are of less value to Google's search than text that can be searched term by term and broken into small pieces for return in search results. Moreover, Google benefits by users finding information one chunk at a time and then searching again rather than digesting long prose. Sites offering smaller pieces of text allow users to read quickly and then search again. This leads to content producers "chopping up their product" (p.94)[1]. A recent New York Times article[2] was victim to chopping: a Forbes article quoted the most interesting passages and stole the traffic (O'Neill 2012). The preface to Jaron Lainer's "You Are Not a Gadget" captures this plainly:

> It's early in the twenty-first century and that means that these words will mostly be read by nonpersons – automatons or numb mobs

1 Reminiscent of the commonplace books of earlier eras.

2 The previously referenced article on Target using customer purchasing history to determine when customer were pregnant.

> composed of people who are no longer acting as individuals. The words will be minced into atomized search-engine keywords .... They will be copied millions of times by algorithms designed to send an advertisement .... They will be scanned, rehashed, and misinterpreted by crowds of quick and sloppy readers .... Real human eyes will read these words in only a tiny minority of cases. (Lanier 2010, p.ix).

This is not to suggest that Google or Facebook actively design their algorithms around self-interest like this. In Facebook's case it is quite likely that their conception of friend is precisely the kind of friend that their site affords (hence the reason they afford it). But the potential for self-interest presents an interesting challenge, because the algorithms are unpublished. How can a user tell whether honest results are being fed to them?

My third example is the recommendation algorithm that Netflix uses to provide suggestions for what a user should watch based on their previous viewing. Netflix is a company that offers access to visual media such as television and films. It first allowed this through posted DVD rental and, since 2007, through online streaming. One key way that Netflix differs from a retail DVD rental store is by offering a much wider range of content: Netflix has over one hundred thousand DVD titles available for rental[1]. Because of the enormous amount of content available there is a significant need to guide renters to films or television shows that they wish to rent. One way to achieve this is through search, by title, actor, genre, year, etc. Another way is through recommendation. Based on a renter's past viewing habits, and any ratings about how much that content was enjoyed, Netflix attempts to recommend new films or television shows that might interest

1 As per the Netflix 2008 Q2 report.

the renter. This saves the renter from searching through the multitude of offerings and potentially offers a much better experience if the recommended content turns out to be enjoyed by the renter.

Due to the significance of accurate recommendations to Netflix's business, in 2006 they offered a one million dollar prize for any person or group that could construct a better algorithm than their own (Amatriain 2012). Their recommendation algorithm, Cinematch, was about 10% more effective than a naive implementation, and the prize would be awarded to any algorithm that could beat Cinematch by a further 10%. This meant the winning algorithm would be able to determine the likely rating a user would give any film to an accuracy of 0.8572 (out of 5 stars). This prize was awarded in 2009 to BellKor's Pragmatic Chaos who, as part of their award, published their algorithm. The winning algorithm attempts to understand the person's rating (i.e. their preferences) better than they do themselves. The rating given to a film is not considered absolute, but is adjusted based on a variety of psychological factors. An example is that the ratings given to films immediately after a viewing are weighted differently to ratings given after some time has elapsed (Piotte & Chabbert 2009). This presents the interesting situation that to make a recommendation the algorithm uses a better version of the user's rating than the user themselves is able to express.

The algorithms in these examples make important statements about the user's world. These algorithms are central to the functioning of crucial aspects of these sites, appearing front and centre on the main screens of each site, and so the decisions of these algorithms carry that importance. Each algorithmic output reflects a decision about the user, or those close to them. Facebook's News Feed makes statements about what activities of your friends are interesting and significant (and by implication what activities are irrelevant and uninteresting). Google's search makes statements about what knowledge and content is applicable to any search term. As memorization is more difficult than searching when needed, these statements become statements about what knowledge exists in the world, on any topic. Netflix's recommendation engine makes statements about what films and television shows a renter will like, and not like. These statements are not obscure. Facebook is the world's most visited web page, and connects over 845 million user accounts. Google is the world's largest search engine, processing over a billion search queries a day (Levy 2011). Netflix is the largest distributor of streaming content online, at one point accounting for 30% of all delivered internet traffic in the United States (Upbin 2011). The statements inherent in the central algorithms of these sites are voluminous. Nor are they minor details. The decisions made by the algorithms of these online sites concern important aspects of the users' life – who their friends are, what a user knows, what they like, and more.

But what is the persuasive effect of these statements? Do they alter the belief, worldview or behaviour of their users? They do not have process sufficient to be considered using procedural rhetoric, since these statements are typically generated with trivial user interaction. In the remainder of this chapter I will provide a few approaches toward answering this essential question.

Crucial to the potential for persuasion is the idea that the decisions by the algorithms differ from the decisions that the users would make themselves. Indeed, they might be substantially different. But, it is most likely that users notice at least some degree of difference between their decisions and those made by the machine. So why continue to use algorithms, if their decisions are not our own? One reason to do this is because the tools are better (in some key ways, like memory and speed) than ourselves. Fogg recounts a study that found that error rates as high as 30% "did not cause users to dismiss an onboard automobile navigation system" (Fogg 2003 p.138). Even 30% wrong may be better than the driver's having to look up the route. It would take longer for the driver to do it themselves, so the ease and speed of the GPS's directions are preferable, even if wrong. Occasional mistakes may not be concerning, after all friends are not perfect either. And the algorithms have advantages – the human mind cannot possibly compete with computer algorithms on terms related to speed, storage or retrieval.

The simplest approach for algorithmic persuasion is when the user defers their own decision making to the machine, accepting the algorithm's decision in place of their own. Instead of laboriously performing their own search on a library index and collating the result, the user defers the decisions involved in this process to Google's algorithm, and accepts the result of its work. Instead of sifting through a list of film reviews and recommendations, the renter accepts Netflix's assessment of the films and watches accordingly. The persuasion is complete to the extent that the user does not question the work of the algorithm. Though this is possible, there is not much more to be said about it. In this simple case, the persuasion is complete to the extent that the algorithm affects the user's behaviours.

Another simple form of persuasion is through control of information: filtering, gatekeeping and censorship. As the flow of information and connection available becomes overwhelming the need for gatekeepers of some form is essential. We cannot filter everything, so we are forced to rely on algorithmic filters (even simple ones such as "ignore all newspapers except X"). The News Feed is the gatekeeper to the activities of friends. It can even make friends invisible (as Weber found). Google Search is the access point for finding information on the world wide web. What it is unable to search or unwilling to display becomes invisible – what the Google user knows becomes limited by what it knows. Netflix's recommendation engine shows films with a high potential for liking by the user, but selects these from its database of available content. If its recommendations are good enough that these satisfied, this restriction may not even be noticed. It also might control what you like, by feeding films to be watched that likely align with your interests, you come to like those particular films (rather than others in the same genre). Censorship is an underlying concern of filtering, that certain content might disappear because it does not serve certain prevailing ideas about what is valid or because they threaten in some way. But censorship makes itself known through absence. When Apple accidentally censored the outgoing mail of its MobileMe users, the censorship was noticed by the absence of receipt in a single case, and through that one case the problem was recognized in many cases (Brownlee 2011). Removing content through censorship (deliberate or accidental) is not a subtle form of hiding, because absence can be noticeable. As long as alternate communication channels are available and a small fraction of users are vigilant, censorship will be noticed. In an atmosphere of choice, providers like Apple work hard to show that they do not censor.

A third approach is to consider mechanisms of persuasion, such as Cialdini's weapons, and consider how they can apply to the algorithms in our examples. This could also be performed with a sampling of Fogg's principles. Looking at most of Cialdini's weapons there are strong possibilities of persuasion within these algorithms:

Reciprocity. A study conducted by Fogg showed persuasion through reciprocity for users who received helpful results from a search engine (designed to be like Google Search) (Fogg 2003 p.108). The users who received such results were willing to spend almost twice as long on a colour-task for the computer that had earlier helped them. Such reciprocity might translate into a form of loyalty: users who benefit from Netflix's recommendations may spend more leisure time with Netflix than with other pursuits, or users who benefit from Google Search results may increasingly seek knowledge from Google.

Social proof. Facebook's News Feed is a display of the activities of friends: this constitutes a strong social proof for those activities. By selecting what activities to show on the News Feed, the algorithm has control of the nature of this persuasion. But there is also the social proof that comes from repeated exposure to evidence. The statements that these algorithms make about reality, if repeated often enough, form a social proof of their own. An example is Google Search results: by consistently showing Wikipedia.com results highly in searches for queries, Google is providing a form of social proof about the applicability of Wikipedia as a source of knowledge on many topics.

Authority. Although Fogg has a Principle of Authority, it refers to narrative (visual or otherwise) elements that suggest the computer is performing a certain role, and the algorithm has little to do with this. However his Principles of Earned Credibility ("it performs consistently in accordance with the user's expectations" (Fogg 2003 p.137)) and of (Near) Perfection ("it never (or rarely) commits what users perceive as errors" (p.138)) suggest that algorithms can have a persuasion role connected to authority. By performing their task (or the user's expectation of it) well, the algorithm earns credibility that can translate into authority. In this way Google's search can become a *de facto* knowledge portal: its authority as an index to knowledge derives from its success at performing this task.

Liking. Fogg's Principle of Similarity ("similar to themselves in some way" (p.99)) bears a resemblance to Cialdini's weapon. Netflix's recommendation engine exists in order to like what the user likes. When successful, the Netflix algorithm should bear a striking similarity in choice to the user's own. Such a similarity can translate into persuasion through liking: enjoying the recommendations of Netflix has parallels to find a friend who enjoys the same films.

Scarcity. The Facebook News Feed changes over time: as new content is produced by the user's friends the algorithm will return a different selection into the News Feed. This produces a form of persuasion through scarcity, because there is a timeliness to the visibility of content. Strictly, the content is still visible on the friend's personal Facebook pages it only disappears from the News Feed. But the convenience of the News Feed – a single location for catching up on all friends – is persuasive in its own right, and this makes the scarcity of content in the News Feed persuasive as well (leading perhaps to the need of some users to check their Facebook constantly).

These examples show that there is persuasive potential within the statements and activities of these algorithms. Both when the user blindly accepts their decisions as their own, through the control of information, and through mechanisms akin to the typical weapons of persuasion. But, there are also deeper persuasive possibilities. So far I have treated the algorithmic tools as akin to a social actor. That is, acting in a human role either as a censor, or providing decisions, or offering social persuasion. In the final chapter I consider the persuasive effect when the tools are not a distinct entity, but operate upon the cognitive processes of the user more directly, and more subtly, mimicking the hiddenness of the algorithms themselves. In the final chapter the persuasive potential of algorithms moves beyond a consideration of the technology acting in a way akin to traditional social persuasion, and considers the persuasive cognitive impact of tools that think.

Further Analysis and Conclusion

In this final chapter I will explore the potential for algorithms in interactive tools to affect the cognitive processes of their users. Algorithms have persuasive effects that operate in a hidden manner – directly affecting the cognitive functioning of the mind beyond the forms of persuasion associated with behaving as a social actor.

My focus divides into two aspects. Firstly the philosophically-related ideas of hyperreal and doxa that can be likened to the framing and framework of belief. These are shaping pressures, a form of persuasion that speaks to the definition of persuasion's final element: a change in worldview. Doxa are the unexamined assumptions within any entity, and the transmission of doxa through interaction with algorithmically thinking tools represents a hidden mechanism for persuasion. The tool does not make its case as an argument, instead it surreptitiously passes its unexamined beliefs onto the user through the interaction. Likewise the hyperreal is not an argument but a simulation that becomes the user's reality, bringing its persuasive elements with it. These do not necessarily involve a complete change in the worldview of the user, but they emerge from different worldviews, bringing the decisions of a different worldview into the mind of the user.

The second aspect concerns the biological functioning of the brain, specifically neuroplasticity as it applies to mind extensions and to physical changes in the brain. Neuroplasticity concerns changes to the brain's structure and functioning as it uses tools – the tools do not make an argument but act according to their nature while incorporated within the brain's cognitive fabric. Using the tools changes the user's thinking, their minds, influences their behaviours, beliefs and worldview as it does so.

These effects are more difficult to discern than those identified in the previous chapter because the persuasion works directly upon the mind, not in the guise of an external social actor. These impacts are, in many ways, hidden – just as algorithms themselves are hidden.

The first way in which algorithms may create hidden effects of behaviour, opinion or worldview upon the cognitive processes of their users is through doxa. In the second chapter I outlined Pierre Bourdieau's idea of doxa – the unstated assumptions of a society. This could include the technical culture of the designer (of an algorithm) or the business culture in which design decisions are made. If the algorithm is designed within the doxa of its culture, then its decisions will implicitly build upon those doxa. The decisions are only shown through their results, so these underlying doxa may be hidden, discernible only through careful analysis or if other information is available.

The role of doxa hinges on how the decisions made by algorithms differ from the user's own and whether these difference have a bent. In the last chapter I noted that there are good reasons for users to continue using web sites whose algorithms' decisions differ from those the user would make. But there is a significance to the way the algorithm's decisions differ from the user's own. I have already noted that the task an algorithm performs might not be the task the designer intended, neither of which may be the task the user expects. In such cases the difference may be essentially random. In other cases there might be a pattern to the difference of the algorithm's decisions. A problem emerges if the decisions are not simply ‘off' but have a differing view of reality than the user, formed by different underlying doxa. In this case there may be a bent or bias. By bent I mean a consistent direction in the difference of the algorithm's choice from the choice the user would make. By deferring functions to the machine, their bent becomes, in part, the user's bent, to the extent that the algorithm's decisions become the user's own.

Consider Google Search. The algorithm which determines the search results is built within a culture that holds certain doxa. One of these is that the mind is essentially algorithmic itself (Page 2007). Another is that an algorithm exists for returning accurate search results. These are easily discernible doxa, but there are likely many more that are less easy to discern. The potential of these doxa to affect cognitive processes emerges because the results of a user's Google search become a part of their base of knowledge. As an example, it is quite common to see a Wikipedia web page place within the top three results for many searches that relate to its topics (i.e. to find out more information about a scientific principle or about a country). The search algorithm is designed to apportion authority to sites as well as individual pages. It is quite possible that the algorithm translates the Wikipedia site's overall notion of authority (compared to other sites that cover many topics) to every page within Wikipedia, so that even though there may be more authoritative and accurate sources of information for, say, a specific disease, Wikipedia appears higher in the search results. As a result, users see Wikipedia as authoritative on many topics. In this way the algorithm's doxa that authority is a site-wide concept is passed onto its users. The repeated exposure to such high rankings, based on Google's algorithm, creates the impression that Wikipedia is an authoritative source of knowledge on all topics. This may be the case (although better sources probably exist for any single topic within Wikipedia), but it is a property of the algorithm's design. The case of Demand Media and the Panda update indicates the reverse situation. The ‘Panda' update tweaked the search algorithm to remove ‘content farms' such as Demand Media's large quantity of low quality web pages that used the design of the search algorithm to boost their rankings. After the Panda update, Demand Media's site rankings fell across the board (i.e. for most searches). Before

Panda the search algorithm gave Demand Media a measure of authority, the next day it did not. The doxa that authority is a site-wide concept can promote all pages within a network as well as demote them. And as the user interacts with these hidden assumptions of the algorithm, they are prone to take them on board in their own thinking.

In the case of Facebook there are doxa concerning the notion of friendship. Even the term ‘friend' that appears so ubiquitously on the site presents a hidden understanding. Many users appear to use Facebook connections as just that: connections, not friendships. The ability to Poke and the focus placed upon the ‘Interested In' field hints that Facebook's underlying origins may perhaps emerge from a flirting service for university students. So ‘friend' is ‘a potential partner' for Facebook but ‘a contact' for many users. The algorithms behind Facebook's News Feed may continue upon these assumptions. And in using the service, Facebook's doxa have the power to influence their users conception of friends so that it more closely matches Facebook's own. Just as the use of the term influences how users conceive of the social network it represents, the News Feed algorithms' presentation of friend events skews the connections experienced by the user. An emphasis on ‘potential partner'-related stories in the News Feed conveys the doxa that all friends (that are not excluded, i.e. kin) are potential partners. Although it is possible to see principles of persuasion such as Reciprocity and Social Proof having some application to this persuasive impact, the notion of doxa goes beyond this. The persuasion from doxa necessarily occurs without consideration of a persuasive argument – it is passed unexamined.

Decisions do not occur in isolation but build upon other decisions and ideas. In this way they are similar to algorithms, whose code builds upon the code of others. So the decisions of users build upon the decisions of the algorithms, and in this way incorporate the doxa of those algorithms.

Over time, this may lead the users to accept the doxa as well. The cognitive process are not just affected by the immediate decisions of the algorithm (as they are taken on by the user) but a wider range of decisions as well.

Algorithmic decisions within a hyperreal are another method for the persuasive acceptance of decisions by users. In chapter two I noted that the hyperreal is simulation unmoored from reality – an endlessly reproducible system of signs referring to itself. As an example I considered Facebook as a hyperreal of friendship, suggesting a way in which the simulation can become the reality of the user. As well, video games like *World of Warcraft* (Blizzard Entertainment 2004) are well known for their addictive potential – some players live through their game avatar, with their biological body merely the means supporting this existence. The game's world is more real and more important than the physical world. The hyperreal acts as a place[1] that is more real than the material reality for its users, and this provides a way of understanding how the decisions made within the simulation become real to their users: as part of the hyperreal they are more real than any other thinking; they become real through treating the simulation as real. In this way the decisions of the algorithm (within the simulation) become the decisions of the user – because the simulation is the most real existence for them, so decisions within it are real. The News Feed's decisions about which activities of the user's friends are interesting and significant is not merely a stream of potentially interesting activities, but a declaration. To not appear in the News Feed is to be deemed uninteresting. The statements made by the algorithmic decisions are not propositions to be weighed but absolutes that are part of the fabric of the simulated reality. The principles of persuasion are still important in this situation, but only within the reality of the simulation, not as explanation of how the simulation itself is persuasive. The simulation

1 A magic circle perhaps

itself is persuasive simply because it is the primary reality – what is within it is real for the user.

This perception of the hyperreal as an instance of a reality that people can choose to make primary (with an acknowledgement that the choice may not be conscious or involve much agency) suggests a continuum. The extent to which a player lives within the Warcraft or Facebook world and the extent to which their mental existence gives primacy to their avatar is not an absolute break. Players can exist with varying degrees of absorption into the hyperreal aspect of the game. In the same way, users of Facebook can give their online persona various degrees of primacy as their consideration of their real self and their Facebook friendships as their primary relationships. Such a continuum, although perhaps not the intention of the hyperreal notion, provides a useful cognitive vehicle for understanding how algorithmic tools exert this effect even when their users are not totally absorbed by the simulation.

Google and Netflix provide a similar persuasion through their hyperreal simulation of a better mind. Their algorithmic thinking does not operate within a simulated reality like Facebook or *World of Warcraft.* Instead they are attempts to create an algorithmic mind that operates better than any human mind. The algorithms simulate the thinking of humans; not of a specific human but of an idealized human. Google's search simulates the thinking of an idealized finder of knowledge, better than any human is capable of being. Netflix's recommendation engine strives to be within a fraction of a star of the user's own preference, and its algorithm attempts to know the user's preferences better than they can express. This has parallels to the hyperreal too. The ideal algorithmic mind functions on a symbolic logic that is disconnected from reality. It exists in reference to itself. Google Search's algorithm's knowledge is solely composed of that which is hyperlexia, the interconnected elements of the internet. Such elements refer to themselves and are disconnected from reality. To the extent that everything is either content or a link, then only those things that can be linked to are real. A blade of grass cannot be linked to from the internet – only a digital photo of it, or a digital description of it, or a set of co-ordinates. Google's knowledge is held within a simulation, and it is a mind within this simulation – a hyperreal mind. Netflix also tries to create a simulated mind greater than the real abilities of people to predict user's preferences. If this is a hyperreal – a simulation greater than the real – then it is because the users of the tool treat the mind as ideal. By accepting the notion that Google's search algorithm is an ideal finder of knowledge – a hyperreal information finder – the reality of that hypereal become part of the user's reality. The knowledge found within this simulation becomes the best knowledge that could be found, giving it an authority and value that makes it readily acceptable to the user. Again, although it is possible to apply principles of persuasion to this notion, the real persuasive value is in the acceptance of the hyperreal as reality not as argument.

But if the algorithms are able to simulate thinking, might not they simulate the user's own decisions, and thus not be persuasive so much as accurate? Google describes the perfect search engine as one that understands exactly what the user means, with the implication being that its results would be exactly for what they were looking. Often at the heart of the differences between user and algorithm (or indeed, between user and user) is different interpretations of meaning. The definition of any word, phrase or symbol is not concrete but depends on the person, context and usage. So, in order to improve, algorithms can attempt to learn meaning better. Learning system hope to grow closer to our meaning, and so be able to more accurately reflect the user's meaning in their decisions. They aim to know the average user's makeup better in order that the algorithm's weightings better reflect those of its users (moving away from any weighting bias of their designers). But there can be downsides to such attempts. Facebook's algorithm attempts to adjust its News Feed to reflect the activity of each user: promoting stories that the user shows interest in. But this does not always result in improved results. Pariser (2011), discussing algorithmic filtering behaviour, notes that the News Feed has determined that he was more interested in the links posted by his liberal friends and filtered his feed accordingly. "I noticed one day that the conservatives had disappeared from my Facebook feed." Pariser argues that the ability of online tools to algorithmically tailor the content they present to their users based on previous use has the potential to create "filter bubbles" in which people are only exposed to ideas with which they already agree. Another way of considering the filter bubble is as a simulated reality of information, treated by the user as real – an informational hyperreal which is better than any other because all opinions and information ultimately skew toward what the user already knows to be valid. By recognizing that the user participates in a simulation in which their attitudes are formed by the reality of the simulation, a hidden persuasion emerges. The simulation hides reality, and presents instead the simulated thinking which the user accepts as their own reality. Unable to distinguish the two, the algorithm's simulated decisions become accepted as ‘real'.

Is the persuasion, then, that reality is banished and all life is simulation? Baudrillard acknowledges the primacy of the real (for example, the police will shoot a person conducting a simulated hold-up), just that it is threatened by and yet cannot distinguish the simulation. So although the user's decisions differ from those of the algorithm, the user is not able to distinguish the nature of the simulation. The simulated reality of Google, Facebook or Netflix becomes the reality of the user, and the attitudes of the simulation become the attitudes of the user.

Neuroplasticity presents two more situations in which algorithmic thinking influences the cognitive processes of the user. As I noted in Chapter Two, there is growing evidence of the way in which the tools we use change the structures and process of the brain. Within this field of neuroplasticity I focus on two areas of interest: mind extensions and changes to the brain's biological structure.

Mind extension is the situation in which the mind considers non-biological tools to be natural extensions of the body. Such tools provide input and exert influence as though a part of the body. Their shape and design carries persuasion by constraining and enhancing what is possible. But the hidden persuasion occurs when these tools think. Their decisions occur within the cognitive framework, because they are considered by the mind as extensions of itself. Consider the effect of a cellular or mobile telephone (cell phone). Mind extension argues that use of such a device can entail the phone becoming a part of the mind's cognitive processes: telephone numbers do not need to be recalled in biological memory because they are stored in the phone; alertness to time and space can be moved from the biological brain into the phone's mapping and time functions; the phone's ring becomes akin to a shout of the person's name (and with caller-id, the origin of the shout is distinct). In these functions the phone becomes not a part of the environment but a part of the person's body for interacting with the environment. But, cell phones can also think (or provide algorithmic decisions). Fogg's example of a device that plays a jingle when near a fast food restaurant could easily be a cell phone. One solution to disruptive interruptions by persistent telemarketers might be a phone with a form of spam filtering for incoming calls – those it judged most likely to be unwanted it might send to voice mail. We generally do not perceive our tools as having their own agenda, but it becomes possible with devices like cell phones.

The impact of the mind extending to other thinking devices is further complicated by the idea that the biological mind is not a unified whole but a collection of agents. David Laurie (2006) surveys the development of the idea of the mind not as a single ‘I' but as an emergent property of networked biological agents. Humberto Maturana's work in cybernetics resolved the issue of the eye's role: not as an apparatus that sent signals to the mind but as an agent communicating to other aspects of the mind relevant information from what it perceived. In short, the eye perceives, thinks and then communicates, and this opens the way to recognize that other organs and elements of the body also think. The biological brain is not the sole centre of computation in the body, but one agent of many. Laurie notes of the work of Maturana and his collaborator Francesco Varela, "The theory [of autopoiesis] describes thought and consciousness in terms of interactions between internal states of a system as if they were independent entities (p.52)." In Chapter Two I discussed the development of the idea of the mind, culminating in Hayles pronouncement that "thought is a much broader cognitive function [than an isolated cognitive system]". The different elements of the body (eyes, etc) contain their own thinking. The addition of one more thinking agent is unremarkable. The fact that it is a non-biological agent physically separate to the body does not mean that the cognitive brain treats it differently to any other agent within its cognitive framework. The mind is a composition of agents rather than a unified whole, and the algorithmic tools thus become one among many mental agents.

The notion of cognitive bias provides further avenues for the reception of an agenda from a physically-external device as a natural aspect of the cognitive framework. The logic that the mind follows is not identical to the ‘natural logic' of set theory and truth tables (which, incidentally, forms the basis for bit operations of computers). People create decisions based on defined and repeatable biases toward certain outcomes, outcomes which go against pure logical reasoning. Daniel Khneman and Amos Tversky (1972) proposed the term "cognitive biases" for these deviations from rational logic. The cognitive biases of the mind, of which there are many, emerge from the biological cognitive agents. These include such examples as the choice-supportive bias (remembering personal choices more positively) (Mather, Shafir & Johnson 2000) and the belief bias (evaluating the strength of an argument according to belief in its conclusion) (Evans, Barston & Pollard 1983) and endowment effect (when we own something we are more likely to value it) and a natural tendency to "vastly overvalue what happens to us right now" (Chabris 2008). These biases have the ability to change our behaviour, attitudes and beliefs. The existence of these biases presents a strong explanation for the efficacy of the persuasive influences of mind-extended devices. They do not target rational thinking but appear as cognitive biases. The on-the-fly discursive construction by which people make decisions are bent due to the very structures of cognition, and external devices can add their own agendas to this bent.

Building from the concepts of mind extension and cognitive bias, the decisions of the algorithmic device are not merely presented to the mind of the user, but are part of it: the hidden persuasion within the decisions are hidden persuasions within the mind of the user. Mind extension provides the avenue for understanding the role of algorithmic tools as extensions of our cognitive processes. The decisions of their simulated thinking become an aspect of the user's own cognitive processes – just another part of the collection of mental processes. As these biological processes bring cognitive biases, so too the biases of the algorithmic process form a part of the mind's reasoning. In the example of a spam filtering cell phone, the algorithm makes decisions about the person calling based on its own biases, and acts accordingly. It then passes its ideas about the callers directly into the mind of its owner. This is similar to the way the eye perceives, thinks and communicates. The bias of the algorithmic tool joins the bias of the cognitive agents, these biases contributing to overall decisions. The decisions of the user are not simply deferred to the algorithm: the algorithm's decisions become part of the user's own cognitive processing. The principles of persuasion have little to offer: the cognitive biases of the algorithmic tools are not able to be considered in terms of a separate social agent which can exert authority or require reciprocity. Instead the biases of the device's decisions are as hidden as the cognitive biases that make us irrational when we strive to be otherwise. This is a potent form of persuasion, hidden from recognition because the entity attempting to recognize them has already accepted them.

The second neuroplasticity to consider is structural changes in the brain. The brain alters its structures during the course of its life and these alterations are intended to optimize the brain for the tasks it carries out. The brains of London cab drivers are optimized for driving cabs through the streets London, which requires heavy spatial navigation skills. The region of their brains concerned with spatial navigation is larger than in other people (Maguire et al. 2006). This expansion comes at the expense of other structures of the brain, which are diminished. In a similar way the repeated use of tools that provide decisions would most likely lead the brain to optimize around this use. Since the tools perform certain functions, the brain can diminish resources formerly used for those functions, and re-purpose them to other tasks. This leaves the brain better able to perform the tasks in which it is engaged, but at the cost of becoming increasingly dependent on the tools with which it is optimizing. If those tools became inaccessible, the brain would not have the internal resources to effectively perform the functions formerly performed by the tools. In becoming more efficient, the brain restructures itself in tandem with the tools, and in their absence.

The result of this is a growing dependence on the algorithmic tools as they become ever more essential to the brain, both in the functions that the tools perform and in the activities to which those functions apply. Becoming disconnected from the tool can result in a feeling of ‘lostness' as the brain is literally missing a part of its cognitive functioning. The brain's optimization also leads to a dependence on the activities of the tools around which it optimizes. In the example of the London cab drivers, by becoming proficient in street navigation they become less well-suited to tasks that do not require street navigation. This presumably leads, over time, to entrenchment in their occupations. For a user of Google Search, if the brain optimizes itself in tandem with the search engine (relying on the search engine as an index to knowledge) then the user is also optimizing toward a certain behaviour and attitude toward knowledge: that it is indexable. For a Facebook user, if the brain optimizes toward Facebook's function as an intermediary of friendships, then it also adopts the attitude and behaviours that Facebook associates with friendship: as a series of discrete lexia that can be accessed by refreshing the News Feed and posting updates. Given the essential ability of the brain to restructure, then it can always restructure itself away from the tools, should it cease using them, and away from the activities the tools represent. But while engaged with the tools, the brain becomes increasingly dependent upon the tools.

As the brain comes to rely on algorithmic tools the decisions of the tools become essentially the decisions of the brain as well. In the same way that the eye's decisions are accepted by the brain, the decisions of the algorithmic tools are accepted by the brain. And just as the brain then has no need to perform the functions which lead the eye toward its decisions, so the brain no longer has the need to perform the functions which lead the tools toward their decisions. The brain has the opportunity to optimize by restructuring away from performing those functions, and the example of the London cab drivers indicates that it would. In this way it can become dependent upon the decisions of the tools (created by algorithms). For the user of Facebook, this suggests that judgements about what is interesting and significant no longer need to be made (for information on the Facebook site) because the tool's algorithm performs this function. The validation that the News Feed provides indicates support for this – the user second-guesses their own judgements about interesting and significant if not supported by the News Feed. For the user of Google Search, the decisions about which web sites provide the most appropriate content for a given search query is handled by the algorithm. With this decision made by the tool, the user's internal cognitive functions do not need to make this decision themselves. With a page of results presented, the user may still choose from the options provided (biased toward those given higher placement) but the need to decide any further – to seek alternate sources of content or to look past the first page of results – is not necessary. For the user of Netflix, the web site provides a list of films to watch. With this decision made the user can simply select one of the films provided and start watching. The ability to recall a film to watch is replaced by the ability to recognize a film to watch. The result of this is an acceptance of the decisions of the algorithmic tool, because the brain is optimized toward such acceptance. Additionally, acceptance of the algorithmic decisions requires accepting any structures inherent in the tools themselves that come with the decision. This includes the presentation of the decision as a list from which to select, or the atomic presentation of friendship as status updates.

The ability of the brain to optimize its physical structure provides a more deeply-embedded form of the persuasion of mind extension to tools. Just as mind extension to algorithmic tools opens the cognitive processes to the biases of the decisions made by those tools, the physical restructuring also opens the user's cognitive processes to the persuasions contained within the decisions of the tools. But in the case of physical restructuring the brain also becomes dependent upon the tools. With this dependence, the persuasions within the tools become essential to the cognitive processes of the user.

My thesis is that algorithms in interactive tools contain hidden persuasions. My examination began with existing work in the principles of persuasion and rhetoric in interactive tools, and how these can be extended to incorporate algorithmic influence. At its simplest, algorithms within tools that take on social roles can exhibit principles of persuasion that result in changes in the user's actions, opinions and beliefs. In more complex cases algorithms provide decisions that influence unit operations of the rhetoric of procedural objects. These cases demonstrate the persuasive potential of algorithms. But going further, the impact of algorithmic thinking on cognitive processes presents less visible potential for persuasion. Algorithmic thinking can convey the unstated assumptions or doxa of their designers. They can transfer their decisions to users by operating within a hyperreal entity or by being produced by hyperreal simulated thinking. Through neuroplasticity the decisions of the tools can become a part of the cognitive processes of the user, with any biases acting the same as the biological cognitive biases of the user. The nature of algorithms is to be hidden, operating unseen and beyond scrutiny. The nature of their persuasion is similarly hidden. It remains that we shape our tools and then they shape us, but in the case of algorithmic tools, the methods of their shaping are not like the curve of a hammer's handle or the affordance of a watch. The algorithmic tools shape us through our thinking, persuading from within our cognitive processes.

Bibliography

ACM (2010). "David S. Johnson Named 2010 Knuth Prize Winner for Innovations that Impacted the Foundations of Computer Science". Online Press Release from Association of Computing Machinery (ACM). Retrieved 2012 Apr 12 from http://www.acm.org/press-room/news-releases/2010/knuth-prize-09

Althusser, Louis (1971) "Ideology and ideological state apparatuses", in Lenin and Philosophy and Other Essays, trans. B. Brewster, New York: Monthly Review Press.

Amatriain,Xavier. (2012). "Netflix Recommendations: Beyond the 5 stars (Part 1) ". blog post on Netflix.com, April 6 2012. Retrieved May 23 2012 from http://techblog.netflix.com/2012/04/netflix-recommendations-beyond-5-stars.html

Amory, Alan. (2007). "Game object model version II: A theoretical framework for educational game development". in Educational Technology Research & Development, 55(1), 51-77.

Barthes, Roland (1977). "The Death of the Author". in Image, Music, Text, pp.142-148. Retrieved 2012 May 22 from http://www.deathoftheauthor.com.

Baudrillard, Jean. (1981). Simulacra and Simulation. Transl. Sheila F. Glaser (1994). USA: University of Michigan.

Baudrillard, Jean. (1983). "Simulacra and Simulations: Disneyland" in C. Lemert (Ed.) Social Theory, 471-476. Boulder: Westview Press.

Bitz, Bako. (2002). "The Culture of Civilization III" in, Joystick101.org. 15 January 2002. Retrieved May 22 2012 from http://web.archive.org/web/20040324004449/http://www.joystick101.org/story/2002/1/12/222013/422

Bogost, Ian. (2006). Unit Operations: An approach to video ganme criticism. Cambridge, Mass: MIT Press.

Bogost, Ian. (2007). Persuasive Games: The Expressive Power of Videogames. Cambridge, Mass: MIT Press.

Bourdieu, Pierre. (1977). Outline of a Theory of Practice. Cambridge: Cambridge University Press.

Brownlee, J. (July 7, 2011). Apple May Be Invisibly Filtering Your Outgoing MobileMe Email [Updated With Apple's Response]. In Cult of Mac. Retrieved December 16, 2011, from http://www.cultofmac.com/103703/apple-may-be-invisibly-filtering-your-outgoing-mobileme-email-exclusive/.

Buchanan, Richard. (1989). Declaration by design: Rhetoric, argument, and demonstration in design practice. In V. Margolin (Ed.). Design discourse: History, theory, criticism, 91-109. Chicago: U of Chicago Press.

Buchanan, Richard. (2003) "Design, Rhetoric, and Humanism" in Buchanan, R., and Margolin, V., Discovering Design: Explorations in Design Studies. Chicago: University of Chicago Press. pp. 23-56.

Carr, Nicholas. (2010). The Shallows: What the Internet Is Doing to Our Brains. NY: W. W. Norton.

Chabris, Christopher F. (2008). "You Have Too Much Mail." Wall Street Journal, December 15 2008. Retrived June 8 2012 from http://online.wsj.com/article/SB122930180757905529.html.

Chick, Tom, Meier, Sid, Shelley, Bruce (2001). "The Fathers of Civilization: An Interview with Sid Meier and Bruce Shelley". CG Online, 31 August 2001. Retrieved May 22 2012 from http://notatwiki.dk/index.php?title=The_Fathers_of_Civilization.

Churchill, Winston. (1924). Spoken address to the Architectural Association. Reprinted in Architectural Association Quarterly, 5 (1), 44-46.
Clark, P., 1972, Organizational Design, Tavistock Press.

Cialdini, Robert. (2001). Influence: Science and practice (4th ed.). Boston: Allyn and Bacon.

Civilization Wiki (no date). "Mohandas Gandhi (Civ5)" in online wiki at Wikia.com. Retrieved May 22 2012 from http://civilization.wikia.com/wiki/Mohandas_Gandhi_(Civ5)

"Civilizations" (2011) "Gandhi's Nuke Problem" in online forum at 2kgames.com. Retrieved May 22 2012 from http://forums.2kgames.com/showthread.php?110483-Gandhi-s-Nuke-Problem

Clark, Andy. (2003) Natural Born Cyborgs, New York, NY: Oxford University Press.

Cohen, J. (December 2, 2009). Same Protocol, More Options for News Publishers. In Google News Blog. Retrieved December 14, 2011, from http://googlenewsblog.blogspot.com/2009/12/same-protocol-more-options-for-news.html.

Cook, Scott and Brown, John. (1999). "Bridging epistemologies: The generative dance between organizational knowledge and organizational knowing" in Organization Science. Vol. 10, No. 4, pp. 381-400.

Crawford, Chris. (2003). The Art of Interactive Design: A Euphonious and Illuminating Guide to Building Successful Software. Berkeley, USA: William Pollock.

Cross, Nigel. (1982). "Designerly ways of knowing". DESIGN STUDIES, Vol. 3 N° 4.

Darnton, Robert. (2009). "Google & the Future of Books" in The New York Review of Books. February 12 2009. Retrieved May 23 2012 from http://www.nybooks.com/articles/archives/2009/feb/12/google-the-future-of-books.

Daugman John. (2001). "Brain metaphor and brain theory." Chapter 2 in Philosophy and the Neurosciences, edited by W. Bechtel et al. Oxford: Blackwell Publishers.

Deutsch, Morton and Gerard, Harold. B. (1965). "A Study of Normative and Informational Social Influences upon Individual Judgment". In Proshansky, H. and B. Seidenberg (ed). Basic Studies in Social Psychology. New York: Holt, Rinehart and Winston.

Douglas, Christopher. (2002). "'You Have Unleashed a Horde of Barbarians!': Fighting Indians, Playing Games, Forming Disciplines". Postmodern Culture 13.1 (September).

Drucker, Johanna. (2007). "Philosophy and Digital Humanities: A review of Willard McCarty, Humanities Computing" in, DHQ 1(1). Retrieved April 2011, from http://www.digitalhumanities.org/dhq/vol/1/1/000001/000001.html

Dudley, Brier (2012). "TeachStreet leaves some lessons as it shuts down". The Seattle Times. Feburary 5 2012. Retrieved May 23 2012 from http://seattletimes.nwsource.com/html/businesstechnology/2017427132_brier06.html

Duhigg, Charles. (2012). How Companies Learn Your Secrets. New York Times Magazine article of 16 February. Retrieved 2012 Apr 6 from http://www.nytimes.com/2012/02/19/magazine/shopping-habits.html

Ebersman, David A. (2012). From S-1 filing with United States Securities and Exchange Commision. Filed Feb 1 2012. Retrieved May 23 2012

from
http://www.sec.gov/Archives/edgar/data/1326801/000119312512034517/d287954ds1.htm.

Eisen, Michael. (2011). Amazon's $23,698,655.93 book about flies. Blog post of April 22. Retrieved 2012 Apr 6 from http://www.michaeleisen.org/blog/?p=358

Elwes, Richard. (2012). “The algorithm that runs the world” in New Scientist 215 (2877) pp. 32-37.

Evans, Jonathan St. B. T., Barston, Julie L., Pollard, Paul. (1983). On the conflict between logic and belief in syllogistic reasoning. Memory and Cognition, 11, pp. 295-306.

FAA.(2000). A Comparitive Analysis of Flightdecks With Varying Levels of Automation. Report of June 8. Retrieved 2012 Apr 6 from http://www.tc.faa.gov/logistics/grants/pdf/1993/93-g-039.pdf

Facebook. (no date). "How News Feed works" (Help Centre entry). Retrieved May 23 2012 from http://www.facebook.com/help/?faq=166738576721085.

"Facebook" (2012). "Facebook" web profile on New York Times. Retrieved May 23 2012 from http://topics.nytimes.com/top/news/business/companies/facebook_inc/index.html.

"Facebook features". (no date). Encyclopedia entry in Wikipedia.com.

Retrieved July 2011 from
http://en.wikipedia.org/wiki/Facebook_features#News_Feed.

Fiske, John and Hartley, John. (1978). Reading Television, London: Methuen & Co.

Fogg, B.J. (2003). Persuasive Technology: Using Computers to Change What We Think and Do. San Francisco: Morgan Kaufmann.

Foss, Sonja (2004) [1989]. Rhetorical Criticism: Exploration and Practice (3rd ed.). Long Grove, Illinois: Waveland Press.

Frankenstein, Julia. (2012). "Is GPS All in Our Heads?" in The New York Times Sunday Review. February 2 2012. Retrieved May 22 2012 from http://www.nytimes.com/2012/02/05/opinion/sunday/is-gps-all-in-our-head.html

Friedman, Ted. (1999). "Civilization and Its Discontents: Simulation, Subjectivity, and Space" in, On a Silver Platter: CD-ROMs and the Promises of a New Technology (edited by Smith, G.). New York University Press, New York, pp. 132-150.

Galloway, Alexander. (2006). Gaming: Essays On Algorithmic Culture. Minneapolis: University of Minneapolis Press.

"Google" (2011). "Google" web profile on New York Times. Retrieved May 23 2012 from
http://topics.nytimes.com/top/news/business/companies/google_inc/index.html.

Grant, George. (1976). "The Computer Does Not Impose on Us the Ways It Should Be Used" in, Beyond Industrial Growth. University of Toronto Press, Toronto and Buffalo (edited by Abraham Rotstein), pp 117-131.

Hankins, P. (2007). "Civilization IV and its discontents" (blog post) on disgressed.consciousentities.com. Retrieved July 2011 from http://disgressed.consciousentities.com/?p=75.

Hayles, N. Katherine (1999) How We Became Posthuman: Virtual Bodies in Cybernetics, Literature and Informatics, Chicago, IL: University of Chicago Press.

Henthorne, Tom (2004). "Cyber-Utopias: The Politics and Ideology of Computer Games" in, Studies in Popular Culture, 25.3 (Apr 2003).

Hillis, Daniel. (1998). The Pattern on the Stone: the Simple Ideas that Make Computers Work. New York: Basic Books.

Hofstadter, Douglas R. (1979). Godel, Escher, Bach: An Eternal Golden Braid. New York: Basic Books.

Innis, Harold. (1951). The Bias of Communication. Toronto: University of Toronto Press.

James, William T. (1932). "A Study of the Expression of Bodily Posture" in The Journal of General Psychology. Volume 7, Issue 2, October 1932, pp 405-437.

Jenkins, Henry, Squire Kurt. (2003). "Understanding Civilization III" in, Computer Games (September 2003).

Kahneman, Daniel, Tversky, Amos. (1972) "Subjective probability: A judgment of representativeness". Cognitive Psychology 3 (3): 430–454.

Kim, Larry. (2011). "The Most Expensive Keywords in Google AdWords" blog post on WordStream.com. July 18 2011. Retrieved May 23 2012 from http://www.wordstream.com/blog/ws/2011/07/18/most-expensive-google-adwords-keywords.

Knuth, Donald. (1973). The Art of Computer Programming. Volumne 1: Fundamental Algorithms. 2nd ed. Reading: Addison Wesley.

Lanier, Jaron. (2010). You Are Not a Gadget: A Manifesto. London: Allen Lane.

Laurie, David Alan. (2006). Splintering the mind's 'I': Cognitive science and subjectivity. MA Thesis. Edmonton: University of Alberta.

Levy, Stephen. (2011). "TED 2011: The 'Panda' That Hates Farms: A Q&A With Google's Top Search Engineers" in Wired, March 3 2011. Retrieved May 23 2012 from http://www.wired.com/epicenter/2011/03/the-panda-that-hates-farms/

Lieberman, David (1983). "The legal needs of a commercial society: the jurisprudence of Lord Kames" in Istvan Hont and Michael Ignatieff (eds) Wealth and Virtue. Cambridge: Cambridge University.

Lindley, Craig. (2003). "Game taxonomies: A high level framework for game analysis and design" in Gamasutra.com. Retrieved 2012 Apr 23 from http://www.gamasutra.com/features/20031003/lindley_01.shtml

Lindley, Craig. (2005). "The Semiotics of Time Structure in Ludic Space As a Foundation for Analysis and Design" in Game Studies, volume 5, issue 1.

Lowy, Joan. (2011). "As planes become more reliant on automation, are airline pilots forgetting how to fly? "Associated Press article in The Gazette. Retrieved 2012 Apr 6 from http://thegazette.com/tag/airplane-crashes/

Mace, William M. (1977). "James Gibson's strategy for perceiving: Ask not what's inside your head, but what your head's inside of" in, Perceiving, Acting and Knowing: Toward an Ecological Psychology. Lawrence Erlbaum Associates, New Jersey (edited by Robert Shaw and John Bransford).

Maguire, Elanor, Woollett, Katherine, Spiers, Hugo. (2006). London taxi drivers and bus drivers: A structural MRI and neuropsychological analysis. Hippocampus, 16 (12), 1091-1101.

Manovich, Lev. (1998). "Database as a Genre of New Media" in AI & Society, Journal of Human Centered and Machine Intelligence, Issue: Database Aesthetics: Issues on Organization and Category in Online Arts Retrieved 2012 Apr 23 from http://time.arts.ucla.edu/AI_Society/manovich.html

Martin, Roger. (2009). The Design of Business, Why design thinking is the next competitive advantage. Boston, Mass.: Harvard Business Press.

Mather, Mara, Shafir, Eldar, Johnson, Marcia K. (2000). Misremembrance of options past: Source monitoring and choice. Psychological Science, 11(2), 132-138.

McCarthy, John. (2001). John Searl's Chinese Room Argument. Web response article. Retrieved 2012 Apr 9 from http://www-formal.stanford.edu/jmc/chinese.html

McCarty, Willard. (2005). Humanities Computing. Palgrave Macmillan, Basingstoke.

Meyer, John W, and Rowan, Brian (1977) "Institutionalized organizations: Formal structure as myth and ceremony." American Journal of Sociology. 83:340-63.

Milgram, Stanley. (1963). "Behavioral study of obedience." Journal of Abnormal and Social Psychology 67.

Murray, Janet. (1997). Hamlet on the Holodeck: The Future of Narrative in Cyberspace. New York: Free Press.

Norman, Donald A. (1988). The Psychology of Everyday Things. New York: Basic Books.

Olmstead, K., Mitchell, A., Rosenstiel, T., (May 9, 2011). Navigating News Online. In Pew Research Center's Project for Excellence in Journalism.

Retrieved December 14, 2011, from http://www.journalism.org/analysis_report/top_25.

O'Neill, Nick. (2012). "How Forbes Stole A New York Times Article And Got All The Traffic" blog post on nickoneill.com, February 19 2012. Retrieved May 23 2012 from http://nickoneill.com/how-fortune-stole-a-new-york-times-article-and-got-all-the-traffic-2012-02/

Page, Larry. (2007). Speech at AAAS Annual Conference, San Francisco. Retrieved June 5 2012 from http://cnet.com/1606-2_3-6160334.html

Parks, Jeffrey. (2012). How algorithm driven medicine can affect patient care. Online article. Retrieved 2012 Apr 6 from http://www.kevinmd.com/blog/2012/01/algorithm-driven-medicine-affect-patient-care.html

Paredes, Mariana Olea. (2009). Procedural Realism in Computer Strategy Games. MA Thesis. Edmonton: University of Alberta.

Perloff, Richard M., (2007). The Dynamics of Persuasion: Communication and Attitudes in the 21st Century (3rd Ed.). New York: Lawrence Erlbaum.

Piotte, Matrin, and Chabbert, Martin. (2009). "The Pragmatic Theory solution to the Netflix Grand Prize." Retrieved May 24 2012 from http://www.netflixprize.com/assets/GrandPrize2009_BPC_PragmaticTheory.pdf

Postman, Neil. (1993). Technopoly: The Surrender of Culture to Technology. New York: Vintage Books.

Postman, N. (1998). "Five Things We Need to Know About Technological Change". Spoken address to New Tech '98 (conference), Denver, Colorado (March 27, 1998). Retrieved 2012 Apr 22 from http://www.mat.upm.es/~jcm/neil-postman--five-things.html

Rigby, Scott and Ryan, Richard M. (2011). Glued to Games: How Video Games Draw Us In and Hold Us Spellbound. USA: Praeger.

Ryan, Marie-Laure. (2001). "Beyond Myth and Metaphor – The Case of Narrative in Digital Media" in Game Studies, volume 1 issue 1.

Schulman, Ari. (2009). "Why Minds Are Not Like Computers" in The New Atlantis. Number 23, Winter 2009, pp. 46-68.

Sicart, Miguel. (2008). "Defining Game Mechanics" in Game Studies, volume 8 issue 2.

Sicart, Miguel. (2011). "Against Procedurality" in Game Studies, volume 11 issue 3.

Slavin, Kevin. (2011). Kevin Slavin: How algorithms shape our world. TED talk filmed in July. Retrieved 2012 Apr 6 from http://www.ted.com/talks/kevin_slavin_how_algorithms_shape_our_world.html

Squire, Kurt. (2004). Replaying history: Learning world history through playing Civilization III. Thesis for PhD at Indiana University.

Stephenson, Neal. (1995). The Diamond Age: Or, A Young Lady's Illustrated Primer. Bantam Spectra, Westminster.

Sunwolf. (1999). "The Pedagogical and Persuasive Effects of Native American Lesson Stories, Sufi Wisdom Tales, and African Dilemma Tales". In Howard Journal of Communications, Volume 10, Issue 1.

Upbin, Bruce. (2011). "Netflix Is Not 30% Of Internet Traffic." online article on Forbes.com, May 18 2011. Retrieved May 24 2012 from http://www.forbes.com/sites/bruceupbin/2011/05/18/netflix-is-not-30-of-internet-traffic.

Weber, Thomas. (2010). "Cracking the Facebook Code" (web article), The Daily Beast. Retrieved July 2011 from http://www.thedailybeast.com/articles/2010/10/18/the-facebook-news-feed-how-it-works-the-10-biggest-secrets.html.

Williams, L.E. and Bargh, J.A. (2008). "Experiencing physical warmth promotes interpersonal warmth" in Science, 322(5901):606-7.

Ludography

Blizzard Entertainment (2004). World of Warcraft. [PC]. USA: Blizzard Entertainment.

Cyan (1993). Myst [Macintosh OS]. Brøderbund.

Linden Labs (2003), Second Life [PC]. USA: Linden Labs.

Microprose (1991). Sid Meier's Civilization [PC]. USA: Microprose.

Maxis (1989). Sim City. [PC]. USA: Maxis.

Maxis (2000). The Sims [PC]. USA: Electronic Arts.

Molleindustria (2006). The McDonalds' Videogame [Flash]. Italy: Molleindustria.

Namco (1980). Pac Man [Arcade]. USA: Midway.

Nintendo EAD (2002). Animal Crossing [Nintendo GameCube]. Japan: Nintendo.

Pajitnov, A. (1989). Tetris. [Game Boy]. Japan: Nintendo.

Polyphony Digital (1997). Gran Turismo [Playstation]. USA: Sony.

Purple Moon (1997). Rockett's New School. USA: Purple Moon.

Rockstar (1997). Grand Theft Auto [Playstation]. USA: Rockstar Games.

Rockstar North (2004). Grand Theft Auto: San Andreas [Playstation 2]. USA: Rockstar Games.

Sakaguchi, H. (1991). Final Fantasy [Nintendo Entertainment System]. Japan: Square Co. Ltd.

Valve Corporation. (2007). Portal [PC]. USA: Valve Corporation.