Mapping the Genome of Human Intention

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Summary

The Human Genome Project found too few genes for physical DNA to determine human characteristics. Advances in epigenetics have demonstrated that environmental factors – nutrition, emotions, mental state – govern the switches that turn on or off specific genes. In this paper we outline our discovery that human intention – a key environmental factor that determines who we are – is structured according to the mathematics of complex systems. These principles enabled us to build a 'genome of human intention'. When tested against Google Search™ the genome demonstrated the ability to predict the choices people make.

Properties of Complex Systems

Different researchers define complex adaptive systems in different ways. Perhaps the most succinct general definition is "macroscopic collections of simple (and typically nonlinearly) interacting units that are endowed with the ability to evolve and adapt to a changing environment" (Dooley, 2003). Regardless of the precise definition, complex adaptive systems exhibit several properties in common. The key properties of complex adaptive systems are (a) populations, (b) communication, (c) emergence, (d) coherence, (e) boundaries, and (f) resilience.

These properties are easiest to describe through example. In the case of a vortex, such as those created by an oar while rowing, its *population* is the water molecules that are part of or flow through it. The *communication* in this system is the forces that act on the molecules. The *coherence* is the visible structure of the system – the whirlpool shape. This is an *emergent* system – developing out of the lower-level interactions between its constituent molecules. Its approximate *boundaries* can also be seen – they are the limit at which a floating particle would get drawn into the vortex rather than drifting past it. These type of vortices do not, however, have much *resilience* – the ability to maintain the system in the face of environmental changes – and typically dissolve in a few seconds. This demonstrates that they are complex systems, but not adaptive ones.

The mathematics governing the properties of complex adaptive systems is remarkably similar across a diverse range of such systems, from cell biology to aircraft control systems. Even though precise modeling is sometimes thwarted by chaos principles, the same mathematical principles can be observed at work in each case.

All complex systems have at least one *global property*, generally referred to as temperature. When the temperature is close to the *critical point*, the system becomes ordered. While some complex systems are transitory phenomena, existing only for so long as their environment keeps them at the critical point, complex adaptive systems have the ability to self-regulate to keep themselves at (or in some cases above) the critical point. In other words, complex adaptive systems exhibit resilience.

The temperature of the system affects another important feature, known as *correlation length*. Correlation length is a measure of how strong the communication within the system is, or, to put it another way, how easy it is for small changes to propagate themselves and spread through the system. At the critical point, the maximum correlation length present in the system is the size of the system itself, resulting in the system becoming ordered and behaving as a whole, rather than a collection of parts. When the correlation length in a physical system is larger than the effective range of the forces that act on the individual particles, it is no longer useful to describe the particles as individuals. Rather, the overall system properties are what matter. This is why the same equations are able to govern the whole class of complex systems.

A widely-observed outcome of these principles is the presence of *power laws* (equations of the form $f(x) = a.x^k$ where a and k are constants). In the standard model of complex systems, this has been taken to mean that the structure of the system is self-similar on all levels (fractal). However, a new model recently developed by Carlson and Doyle (1999) casts a different light on the reason why power laws apply to complex adaptive systems. Their model shows that some systems with more than one global property can self-organize and maintain themselves some distance above the critical point of the system, resulting in higher performance. Their model simulates with particular accuracy systems shaped by evolution or design. This form of self-maintaining behavior is what we mean by the 'adaptive' part of the phrase 'complex adaptive systems'.

Exploring Human Systems

Various researchers have noted that certain features of human society function as complex adaptive systems (see for example Wheatley (2001) and Johnson (2001)). For the remainder of this paper, we will refer to social complex adaptive systems as 'human systems', and refer to non-human complex adaptive systems as 'natural systems'. Generally human systems have been considered on a case-by-case basis. Yet as we have seen, common principles are at work in all complex systems, including human systems.

Our insight has been to notice that, for many human systems, the defining properties of coherence, boundaries, and optimization behavior depend upon *the intention* of the humans who participate in the system. While for natural systems it is physical laws that enable the formation of the system (for example, the force of pressure acting on water molecules to create vortices), in human systems it is the existence of a shared purpose, shared values, and a shared focus that enables and encourages the human system to develop. Put simply, *human systems self-organize around a shared identity comprising of purpose, values and focus.*

We came across this insight while researching company cultures. In 2001 we initiated a project to validate the work of Collins and Porras, (2002) as described in *Built to Last,* where they suggested that companies with strong cultures out-perform those with weak cultures. We did this by developing a methodology that enabled us look at publicly available information on a company to determine the strength of its culture. We then applied this methodology over the next three years to all 500 of the S&P500 group of companies, determining which had strong cultures and whether strong-culture firms gained a performance advantage over weak culture firms.

Our research did indeed validate the importance of a strong culture, with strong-culture firms outperforming weak-culture ones across a range of measures.

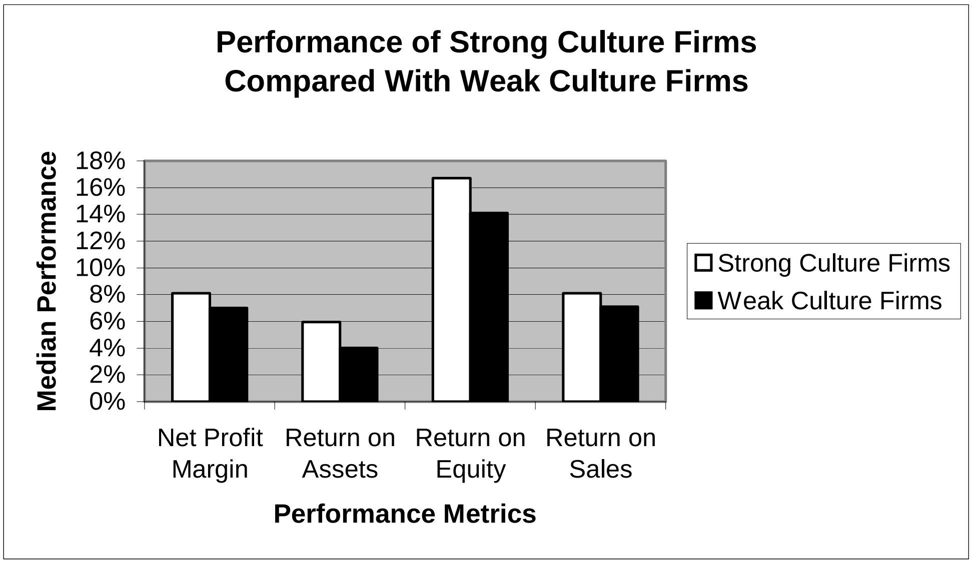

Figure1. Performance of Strong Culture Firms Compared with Weak Culture Firms (Performance from September 2003 to September 2004)

But these findings left us with an even bigger question – why should the presence of a strong culture improve a firm's performance?

Applying our understanding of complex systems, and their shared attributes, we gradually came to understand that companies in the S&P500 were themselves complex systems and that the out performance of strong culture firms could be explained using the same principles that govern the performance of natural systems.

For example, in natural systems, the coherence of the system is a key variable that determines the performance of the system. In the case of water flowing out of a bath, when the molecules align with each other to form the spiral of a vortex, the water flows out of the bath faster – the system has improved its performance. During our research we saw the same centrality of coherence in company culture as a key determinant as to whether the company had a strong culture. Collins and Porras (2002) devote an entire chapter – 'Cult-like Cultures' – to this attribute.

Looking deeper, another way of explaining the attribute of coherence is to look at its opposite: discordance – caused by the friction between those parts of a system that are not aligned into a coherent whole. The friction present within a system rises as coherence decreases. We saw evidence of friction when we measured the return per employee of strong culture and weak culture firms. In both cases, the return per employee declined as the number of employees increased. This is to be expected – each new employee that is added to the system increases the potential for friction in the system. At the same time, the decline is less for strong culture firms. This, we believe, is because the strong culture of the system creates a greater alignment between the parts of the system (employees). Since more employees share the same purpose, values and focus more often than staff within weak culture firms, fewer frictional encounters occur.

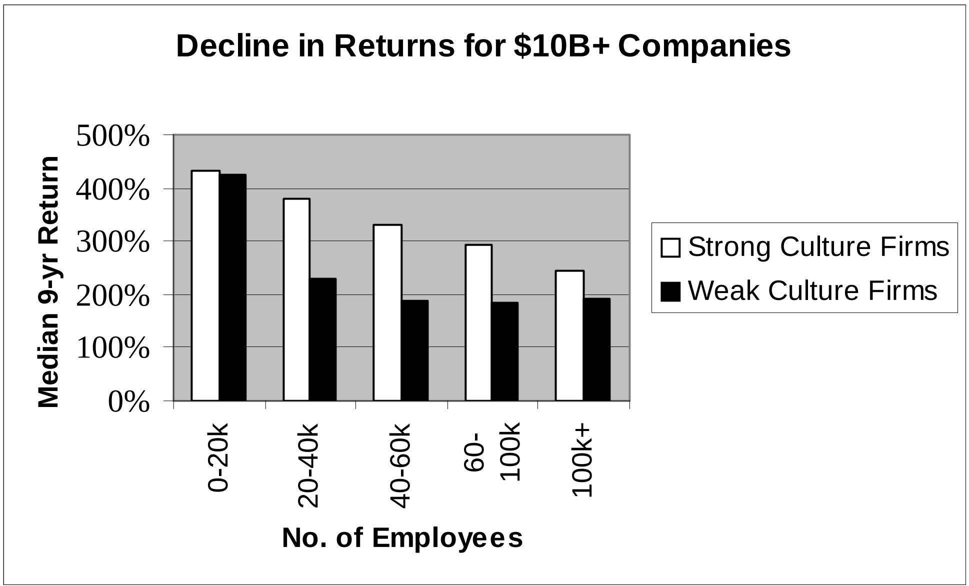

Figure 2. Decline in Returns for $10 Billion plus Companies Based upon Number of Employees. (Performance based on returns from July 1994 to June 2003)

The fact that strong culture firms reduce the friction within the system through their cultures is also suggested by the fact that the companies with the largest numbers of employees were more likely to be strong culture firms. Conversely, 80% of companies in the S&P 500 with less than 10,000 employees were weak culture firms. It seemed to us this was further evidence of the effects of friction at work. As companies grow larger, it becomes increasingly important to have a strong culture capable of aligning all the employees into a whole system and reducing the friction within the system. Weak culture firms simply can't grow as big as strong culture firms – the friction (lack of coherence) in their system means that they cannot function effectively once they grow beyond a certain size.

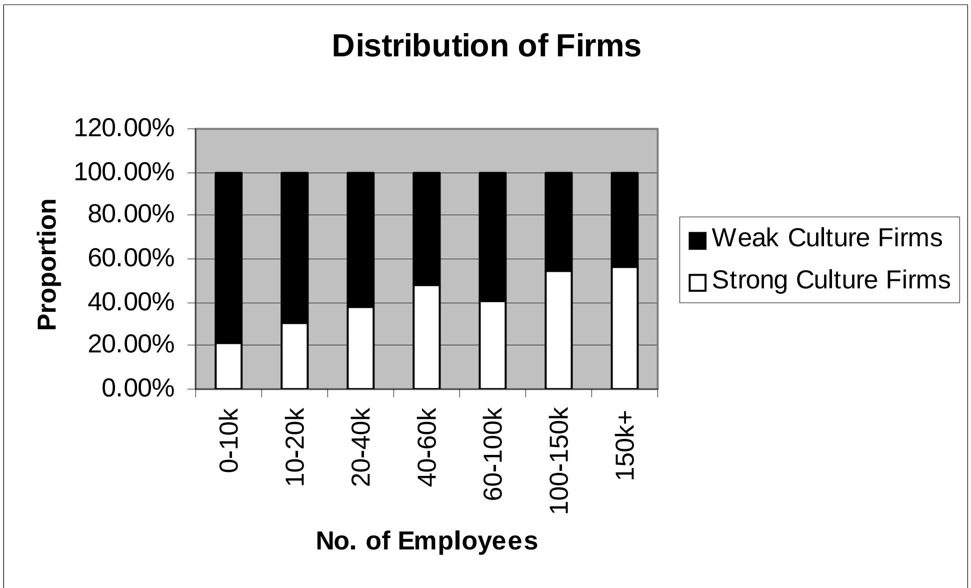

Figure 3. Distribution of Strong and Weak Culture Firms based upon Number of Employees. (Proportions as of July 2003)

The closer we looked the more we saw that the performance of strong-culture firms was due to the same structure, and hence same mathematics, as natural systems. Looking at the boundaries of a system, it is obvious in natural systems that a larger sunspot, for example, dissipates more heat than a smaller sunspot. When we looked for the system boundaries within companies we noticed that firms with an inclusive focus – those that focused on meeting the needs of a range of stakeholders such as customers, employees, shareholders, and society in general - performed better than firms that focused on just one area. This lead us to suggest that the boundaries of human systems can be measured by the extent of their focus – the more inclusive the focus the larger the system boundaries.

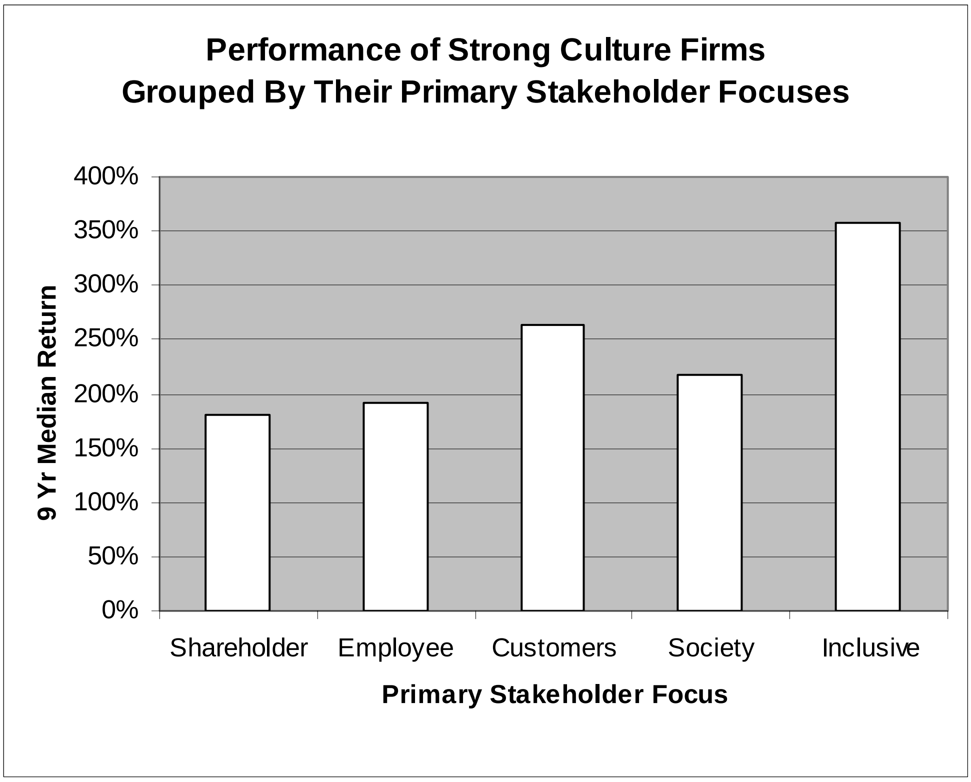

Figure 4. Performance of Strong Culture Firms Grouped By Their Primary Stakeholder Focus. (Performance based on returns from July 1994 – June 2003)

Meanwhile, resilience in natural systems depends upon a variety of positive self-reinforcing feedback loops that maintain the structure of the system. Also called autopoiesis, the presence of positive feedback loops in strong culture firms is the central thesis of *Built To Last.* Collins and Porras (2002) described this behavior as ‘clock-building rather than time-telling’, meaning that companies with strong cultures spend enormous time and resources on activities such as induction processes, special names, internal leadership development programs and other techniques, all of which are designed to maintain the purpose, values and focus on which their culture is centered.

Building the Genome of Human Intention

Having found evidence for the mathematics of complex systems at work in companies, we asked whether the same principles were also at work at the individual level. Just as the mathematics of complex systems could help us predict which companies would perform best in the financial markets, could a ‘genome of human intention’ help us predict the characteristics and choices people make in their lives?

We began building a genome of human intention by starting with the mathematics that define the structure of complex systems. In particular we focused upon coherence, resilience and boundaries. We then built a survey in order to interface the mathematics with people. The survey asks people about their purpose, values and focus in their lives. We applied proprietary algorithms to the results of the survey in order to re-interpret the results according to the mathematics of complex systems. The output of this process was the creation of a seven-digit ‘genome’ for the individual, providing scores between 1 and 10 in the seven different areas of:

System Coherence
System Optimization (Resilience)
System Boundary 1
System Boundary 2
System Boundary 3
System Boundary 4
System Boundary 5

The next step was to test to see if the genome was predictive. As human intention shapes all artifacts of human society, we hypothesized that we could map a person’s genome onto any object and that other people with a similar genome would have a higher than average probability to also finding that object relevant.

We decided to observe individuals’ behavior through their web surfing activity, and in particular, through their selection of Google Search™ results.

We felt this was an appropriate context to observe individual behavior because, with such a wide variety of searches conducted – from cars to chess to carrots – the only commonality to link the searches of various users is their sense of intention.

To achieve this goal we built an extension to the Firefox browser that we named MywebDNA. Users were able to download and install the extension into their Web browser. As they performed Google searches MywebDNA recorded their click behavior for analysis.

By observing which users clicked on which search results, we built up ‘link profiles’ – a picture of the type of users more or less likely to visit a particular link. We were then able to assess the relevance of a particular link to a particular user: in other words, was that person, based solely on his or her sense of intention as expressed in his or her seven digit ‘genome’, more or less likely than an average user to click on that link?

We observed whether our predictions of which links were more relevant for particular users were borne out in the results of which links they clicked on. We controlled for link position and other confounding factors, and the results of our research were impressive. Users were 14% more likely to click on search results that we assessed as being of high relevance to them, compared with search results we assessed as of low relevance to them as individuals. This translates into a 3% higher click rate in absolute terms. Our results and methodology were subject to an expert review by Minimax Consulting, a consulting firm based in Rhode Island.

Human Genome Project II

What are the implications of these results? Consider the Human Genome Project, which found that there were fewer genes than had previously been assumed necessary to explain human characteristics and traits. This discovery helped usher in the new science of epigenetics (Pray, 2004) (Silverman, 2004) – recognizing the crucial role that the environment plays in determining which particular genes are expressed.

Prior to this, the general understanding was that humans were determined by their physical genes. Currently, the understanding is that humans are determined by both their genes and their environment. What our research adds to the picture is that humans, both as individuals and as groups, are also determined by intention – beliefs, purposes and values – and that human intention functions as a complex system.

We suggest that this insight is as important to science as Crick and Watson's discovery of the double helix structure of our physical DNA for it maps the structure of human intention in mathematical terms.

As human intention underlies all aspects of society – all our artifacts and all our individual and group actions (Navarro 1997), the discovery of the structure of human intention opens up the possibility of a second Human Genome Project to take on the challenge of mapping the human environment in mathematical terms, based on this scientific understanding of human intention.

Initiatives are already underway, harnessing the collaborative power of people to map the 'genome' of the Web. Other initiatives are pooling the collaborative expertise of entire industries to enhance people's lives in ways as diverse as providing better access to credit, enhancing recommendation techniques in areas such as dating, movies and advertisements, and improving life expectancy. Indeed, given the resources available now through the Internet, collaboration has the potential to improve every aspect of a person's life and choices, from which vacation destination to pick to which movie to go see based upon their personal genome. We look forward to participating in this adventure as people map out the world they have created through their intention, in order to make it more relevant to all.

As momentous as engagement in a second Human Genome Project could be, we suggest that the greatest contribution of this insight into the mathematical structure of human intention will be in the realm of human freedom and self-determination. As a society we are rapidly moving away from the belief that we as individuals are determined by our physical DNA. This disempowering self-image is being replaced by the realization that we are shaped by our environment, and that *we ourselves* are part of our environment. Our values and choices matter, affecting the complex systems that underlie every aspect of our lives. This places the responsibility, and the power, of self-determination back with us as individuals, as we begin to realize that we are the designers of the belief systems that help to shape and create the world around us. These beliefs are ours to discard, revise or cherish as we choose.

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