Chapter 2

What is complexity?

> I think the next century will be the century of complexity.
>
> Stephen Hawking (eminent physicist cited on www.comdig.org)
>
> She blinded me with science. She hit me with technology.
>
> Thomas Dolby (from 'She blinded me with science' a pop chart hit in 1983)

These two quotes nicely capture the problem of talking about complexity. On the one hand, it has been around for some time, is firmly established throughout the natural sciences and is even seen as a future dominant paradigm for the sciences. On the other hand, like all sciences, it often wallows in its own language, focuses on questions and concerns that do not easily relate to common human experiences, and is easily ignored and parodied by popular culture. This chapter focuses on bridging this divide. Complexity has a fascinating history that even a pop star can understand (though to be fair to Thomas Dolby, he was one of the most technically advanced stars of the 1980s).

So how do we begin? We all know what complexity means – sort of complicated only messier. The *Oxford English Dictionary* identifies complexity as a derivative of 'complex', coming from the Latin root *complexus*, and defines it as 'consisting of many different and connected parts . . . hard to understand, complicated.' However, complexity science is much more than this common definition. To understand complexity science and its relevance to medicine in general and diabetes in particular, we must take a slight detour through a few hundred years of intellectual history.

The vision of order

The seventeenth- and eighteenth-century Enlightenment was an astounding time for Europe. Relatively stagnant and intellectually repressed during the so-called Dark

Ages, the intellectual energies released by the Renaissance came to fruition in the Enlightenment. During this time, Europe was reborn and became the centre of an intellectual, technical and economic transformation. Science was liberated from centuries of control by religious stipulations and blind trust in ancient philosophies. The Frenchman René Descartes (1596–1650) and, slightly later, the Englishman Sir Isaac Newton (1642–1727) set the scene. Descartes advocated the power of human reason and its inherent rationality, while Newton unearthed a wondrous collection of fundamental laws of nature. A flood of other discoveries in diverse fields such as magnetism, electricity, astronomy and chemistry soon followed, injecting a heightened sense of confidence in the power of human reason to tackle any situation. Later, the eighteenth-century French scientist Pierre Simon de Laplace (1749–1827) pushed the orderly nature of the Newtonian framework to its logical conclusion by arguing that 'if at one time, we knew the positions and motion of all the particles in the universe, then we could calculate their behaviour at any other time, in the past or future.'[1] From this, Laplace implied that human beings could know not only the present, but also the past and the future.

The irony of these thinkers of natural and human order is that their lives were anything but orderly. Descartes hated to get out of bed and would often work in it all day. He later died of pneumonia when forced to get up at 5am by the Queen of Sweden. Newton produced most of his intellectual work during a five-year period in his twenties. Much of the rest of his life was spent trying to turn lead into gold, fighting with other intellectuals and promoting a small Christian sect. Laplace struggled to keep his head on his shoulders during the French Revolution.

The subsequent phenomenal success of the Industrial Revolution in the eighteenth and nineteenth centuries, which was based on this new vision of order, created a high degree of confidence in the power of human reason to tackle any physical situation. By the late nineteenth and early twentieth century many scientists believed that few surprises remained to be discovered. For the American Nobel Laureate, Albert Michelson (1852–1931), 'the future truths of physical science are to be looked for in the sixth place of decimals.'[2] Implying that there was a finite amount of knowledge, humanity had already found most of the fundamental bits, and there really weren't many more important things to learn about the universe. Science had lost its romantic appeal. It was like being a clockmaker and only being able to play with the small gears.

To simplify, this vision of an orderly universe was founded on four golden rules.

- **Order:** given causes lead to known effects at all times and places. (Dropping a ball from my hand will lead to the same effect – hitting the floor – no matter where I am on Earth or what time I do it.)
- **Reductionism:** the behaviour of a system can be understood, clockwork fashion, by observing the behaviour of its parts. (There are no hidden secrets to a mechanical clock. The parts move and the hands tell the time. Parts can be separated.)
- **Predictability:** once global behaviour is defined, the future course of events can be predicted. (If the clock works perfectly, assuming no breakdowns, we can know where the hands will be at midnight, noon, 8am, and so on.)
- **Determinism:** processes flow along orderly and predictable paths that have clear beginnings and rational ends. (The hands of the clock start when we add energy to them by plugging in the clock, winding it up, etc. The hands only go around the

dial – they don't make erratic movements or jump off the dial – and they stop when the energy supply runs out.)

From these golden rules a simple picture of reality emerged as shown in Figure 2.1.

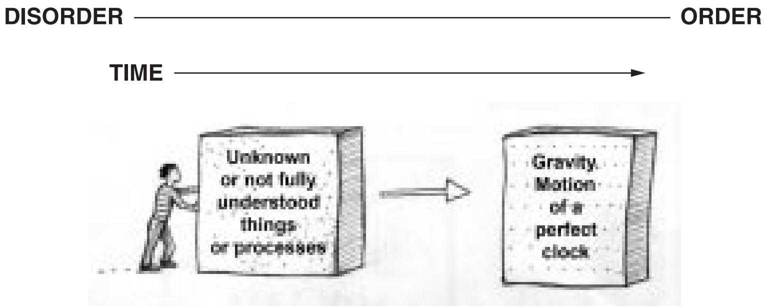


Figure 2.1: Phenomena in the vision of order.

Given the golden rules and the picture of reality, several expectations emerged.

- Over time, as human knowledge increases, we shall realise that the world is more and more orderly.
- With greater knowledge/order, humans can increasingly predict and control more and more phenomena.
- There is an end point to the universe and hence to knowledge.
- Science (and knowledge) is orderly. It is hierarchical (some bits are more important than others) and can be divided into academic disciplines (e.g. natural sciences vs. social science and arts) or medical specialisms (e.g. paediatrics vs. surgery vs. geriatrics).

This last point is particularly important, since it implies that scientific knowledge is fundamentally different from and superior to common or everyday knowledge, that knowledge can be divided into separate domains (called departments in universities or specialties in medicine) and that there is a hierarchy in the sciences as well. As the Nobel prize-winning physicist Ernst Rutherford famously said, 'All science is either physics or stamp collecting.' Now the big question for you is how all of this relates to diabetes.

The natural sciences spill over into the social and medical sciences

Not surprisingly, success in these areas had a profound effect on attitudes in all sectors of human activity, spreading well beyond the disciplines covered by the original discoveries. The human and social sciences were no exception. Surrounded by the technological marvels of the Industrial Revolution, it did not take much of an intellectual leap to apply the lessons of the physical sciences to the social world. Academics in all the major fields of social science welcomed the new age of certainty and predictability with open arms. Economics, politics and sociology all became 'sciences', desperate to duplicate the success of the natural sciences. Moreover, this desire was institutionalised through the development of modern departmentalised universities.

In the fields of biology and human anatomy, the Italian physiologist Borelli (1608–1679) argued that:

> as the scientific recognition of all these things is founded on geometry, it will be correct that God applied geometry by creating animal organisms, and that we need geometry for understanding them.[3]

From this perspective, the body became just another type of mechanism – much more complicated than clocks, but fundamentally no different. The trick to understanding and controlling the body (correcting its mistakes) was to reduce it to its component parts and find tools for understanding and measuring its 'motions.' Whereas in the seventeenth century medical diagnosis was based heavily on listening to the patient's interpretation of his or her condition, by the eighteenth and nineteenth centuries a growing array of technological innovations (e.g. the microscope, stethoscope, blood-pressure monitors, X-ray machine, etc.) 'encouraged a physical separation of the doctor from his patient.'[4] With the growing technological advances of the late nineteenth and early twentieth centuries, medical laboratories and centralised hospitals began to proliferate, as well as the routine use of a wide array of medical testing procedures. Testing not only became a way of objectively evaluating the patient and protecting the doctor from charges of malpractice, but it even allowed doctors to feel that they were 'using the same rigorous methods as did the scientist who pursued truth in his laboratory.'[5]

Linked to this 'scientification' of medicine was the growth of specialisation. Specialisation was the logical outcome of the growing detailed knowledge of the human body combined with the belief that it was fundamentally a mechanical clock that could be separated into its key components. Large-scale medical institutions would bring together all of these specialisms into a 'one-stop' body shop! Eventually, with the growth of computers, more and easier testing and greater knowledge, disease could be eliminated as it was in the science fiction TV programmes and films of the 1960s and 1970s – *Star Trek*, *Logan's Run* and *Star Wars* to name just a few well-known (and maybe even embarrassing) examples. All it would take would be a wave of the doctor's computer-enhanced wand.

Science and society don't stand still

Certainty and predictability for all – the hallmarks of an orderly frame of mind – were too good to last. Cracks had existed for some time, and even Isaac Newton and Christiaan Huygens in the seventeenth century couldn't agree on something as fundamental as the nature of light (whether it is a particle or a wave). These difficulties bubbled under the surface of acceptable scientific discourse and the expanding university arenas. They were often seen as unimportant phenomena that would be resolved by the next wave of emerging fundamental laws. However, by the early twentieth century they could no longer be ignored. Henri Poincaré (1854–1912), the supreme physicist of his age, was one of the first to voice disquiet about some contemporary scientific beliefs. Later, the theory of relativity of Einstein (1879–1955), the quantum measurement problem of Erwin Schrödinger (1887–1961) and the uncertainty principle of Werner Heisenberg (1901–1976) all played a decisive role in pushing conventional wisdom beyond the Newtonian limits that had enclosed it centuries before. These scientists, all Nobel laureates, set in motion a process that eventually transformed attitudes in many other disciplines.

The new discoveries revealed that not all phenomena were orderly, reducible, predictable and/or determined. What this meant was that even at the most fundamental level, some phenomena do conform to the classical framework, while others do not. With this revelation, the boundaries of the classical paradigm were cast asunder. Gravity continued to function and linear mechanics continued to work, but they could no longer claim to be universally applicable to all physical phenomena. They had to exist alongside phenomena and theories that were essentially *probabilistic* – that is, providing probable solutions to problems rather than certainties. Causes and effects are not directly linked – the whole is not simply the sum of the parts. Taking the system apart does not reveal much about its overall behaviour, and the related processes do not steer the systems to inevitable and distinct ends.

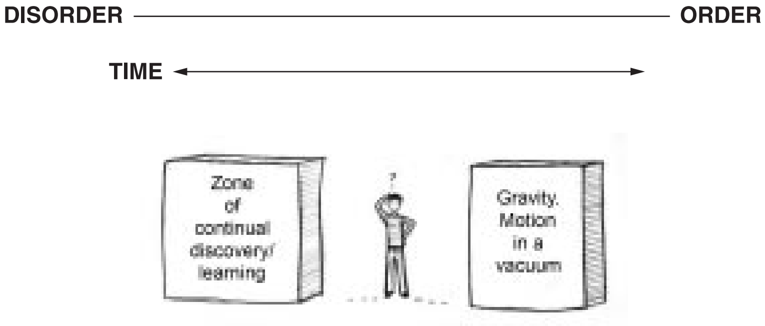


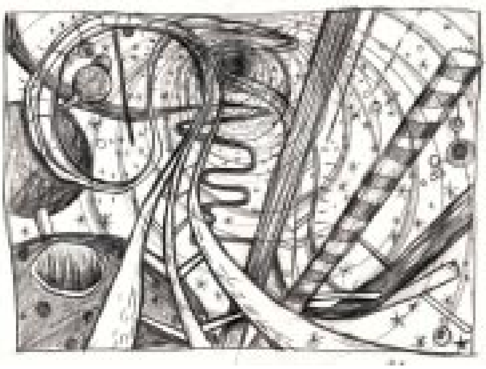
Figure 2.2: Phenomena in the paradigms of disorder and order.

Given these complex phenomena and their non-adherence to the golden rules of order, new expectations were necessary for this expanding paradigm.

- Over time, human knowledge may increase, but phenomena will not necessarily shift from the disorderly to the orderly.
- Knowledge does not always equal order. Greater knowledge may mean the increasing recognition of the limits of order/knowledge.
- Greater knowledge does not necessarily impart greater prediction and control. Greater knowledge may indicate increasing limitations to prediction and control.
- There is no universal structure/end point to phenomena/knowledge.

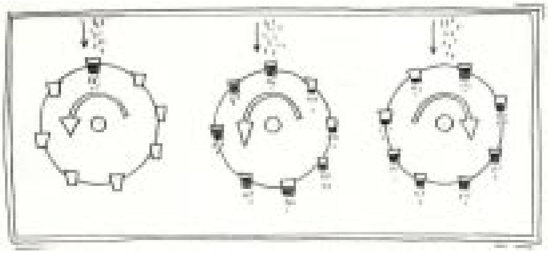
It is important to note that the shift in scientific analysis from utter certainty to considerations of probability was not accepted lightly. High levels of specialisation meant that even scholars involved in the same discipline were not immediately aware of discoveries being made by their colleagues. Moreover, the language of science itself became almost unintelligible beyond a select circle of specialists, and their intriguing speculations were not at first thought to be of everyday concern. Nevertheless, uncertainty was eventually recognised as an inevitable feature of some situations. In effect, the envelope of orderly science was expanded to add complex phenomena, also known as *complex systems*, to those that were already in place.

Complexity in the physical world



Once the door was open to probability and uncertainty, a new wave of scientists began studying phenomena that had previously been ignored or considered secondary or uninteresting – Rutherford's 'stamp-collecting' activities. Weather patterns and fluid dynamics were just two of the areas that saw the growing acceptance of non-linear complex phenomena and systems. For example, one of the earliest people to conceptualise and model a complex system was the American meteorologist, Edward Lorenz. In 1961, he developed a computer program for modelling weather systems. However, to his dismay, due to a slight discrepancy in his initial program, the program produced wildly divergent patterns. How was this possible? From an orderly linear framework, small differences in initial conditions should lead to only small differences in outcomes. Yet in Lorenz's program, small discrepancies experienced feedback and reinforced themselves in chaotic ways, producing radically divergent outcomes. Lorenz called this phenomenon, whereby small changes in initial conditions lead to radically divergent outcomes in the same system, the 'butterfly effect', arguing that given the appropriate circumstances a butterfly flapping its wings in China could eventually lead to a tornado in the USA. Small causes did not always lead to small effects. Order was not certain. Chaos/complexity was an integral part of physical phenomena.

One of the most famous and simple examples of this type of fluid-based complex system is the Lorenzian waterwheel. This is a wheel that pivots around a centre point and has hanging buckets at the wheel's rim. There are holes in the bottom of each bucket, and water is poured in from the top. If the flow of water is too low, the bucket will not fill, friction will not be overcome and the wheel will not move. If the flow is increased, the buckets will fill and the wheel will spin in one direction. However, if the flow is increased to a certain point, the buckets will not have time to empty on their upward journey. This will cause the spin to slow down and even reverse at uneven intervals. Thus even a simple mechanical system can exhibit chaotic non-linear behaviour. Riding the diabetes rollercoaster is very similar to the motion of Lorenz's waterwheel – small changes (e.g. in diet) can have big effects that can turn a 'hypo' into a 'hyper', or a life-building challenge into a personal catastrophe.



It is important to note that these systems are not necessarily complicated or random. Orderly systems are found at or near equilibrium. A ball bearing inside a bowl is a classic example – it quickly settles at the bottom and that is that. However, these systems can be very complicated. A jet engine is a wonderfully complicated piece of orderly machinery which creates highly predictable physical outcomes that millions of pilots and passengers successfully depend upon every year. Complex systems may be very simple but never settle into a final stable point – equilibrium. A basic example of this is the height of sand piles on a table. Consider a continual stream of sand that is pouring on to a common table (say 1 metre in diameter). The sand will generally form a pile that is around half a metre high (depending on the sand, the conditions, etc.). However, the height of the pile will continuously vary as small avalanches occur due to the continually added sand pouring on top. After a very short time, you can roughly predict the height of the pile in the future, give or take 20 centimetres. However, even if you watch it for a very long time – for years – you will still find it very difficult to improve on your predictions, as each new grain of sand combines with the pile in a unique way. This is the simplest form of complex system.

The range of physical phenomena can be visualised as shown in Figure 2.3.

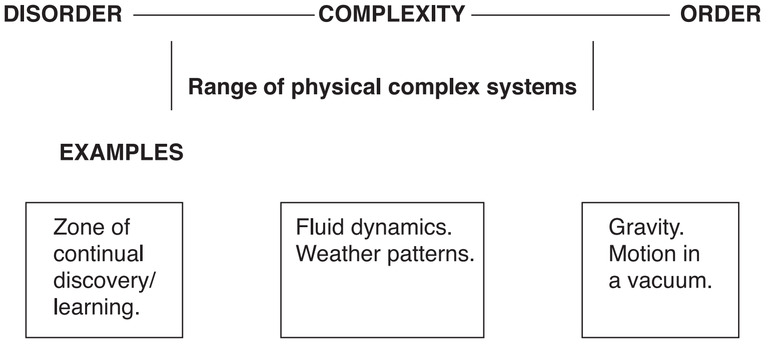


Figure 2.3: The range of physical phenomena in a complexity paradigm.

Box 2.1 Golden rules for physical systems in a complexity framework

- **Partial order:** phenomena can exhibit both orderly and chaotic behaviours.
- **Reductionism and holism:** some phenomena are reducible to their parts (e.g. mechanical clocks), while others are not (e.g. water flows).
- **Predictability and uncertainty:** phenomena can be partially modelled, predicted and controlled.

- **Probablistic:** there are general boundaries to most phenomena, but within these boundaries exact outcomes are uncertain. The best experts can do is to say what is likely to occur, or probable.

Complex systems in the living world

By the latter half of the twentieth century, with complexity already deeply penetrating the physical sciences, biologists, geneticists, environmentalists and physiologists also began to consider their respective disciplines within the context of complexity. Analysts in these fields set out to investigate the properties of systems, including human beings, comprised of a large number of internal parts that interact locally in what looks like a state of anarchy that somehow manages to engender self-organised, stable and sustainable global order. These systems are not only complex but also adaptive, and display *emergent properties* or *emergence* (i.e. the creation of a new structure or process).

Unlike non-living physical phenomena, the ability of biological or living complex systems to adapt and evolve creates a whole new range of complex outcomes. The Lorenzian waterwheel discussed above does display unpredictable movement, but it could run for ever and it will never change into a different waterwheel. Living biological systems have the ability to fundamentally alter over time, from single cell to multi-cellular organisms, from dinosaurs to birds, and from primates to humans. Just give them enough time and who knows what will evolve!

A simple example of a biological complex system would be the evolution of a species or the interaction of a given plant or animal in a particular ecosystem. A fish in a small pond will evolve and interact with the various food sources (small plants and animals) in the pond to create a stable complex system (e.g. a stable total number of fish). However, if a change is introduced to the system (e.g. a new competitor or food source), the fish may adapt and alter the nature of the system in totally unforeseen ways. Over time, new emergent properties may evolve in the system and/or in the fish itself. The fish may develop powerful eyes for seeing the bottom of the pond, giving it a comparative advantage over other fish. A larger example is that of the concept of *Gaia* developed by James Lovelock. For Lovelock, the Earth was not a ball of rock with a layer of life on the surface, but a huge organism that combined physical and biological properties in very complex patterns and demonstrated fascinating emergent behaviour – from the large-scale interaction of plant and animal life to the responses to occasional massive extraterrestrial influence (large meteorites, not alien invasions!).

Due to the emergent nature of biological systems, the level of complexity can be significantly higher than that of non-living physical phenomena and systems. Therefore, on our simple scale of complexity, biological complexity is placed on the more disorderly side of the scale relative to physical complexity.

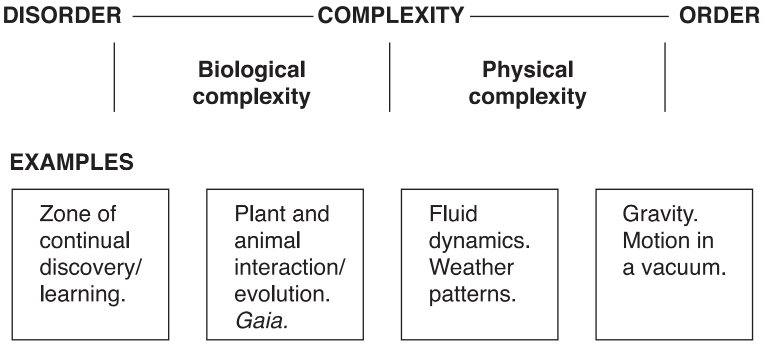
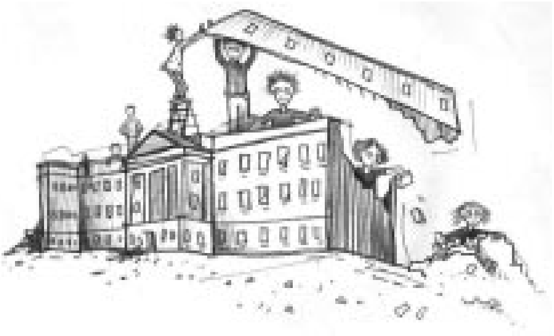


Figure 2.4: The range of physical and biological phenomena.

Box 2.2 Golden rules for biotic systems in a complexity paradigm

- **Partial order:** phenomena can exhibit both orderly and chaotic behaviours.
- **Reductionism and holism:** some phenomena are reducible, whereas others are not.
- **Predictability and uncertainty:** phenomena can be partially modelled, predicted and controlled.
- **Probabilistic:** there are general boundaries to most phenomena, but within these boundaries exact outcomes are uncertain.
- **Emergence:** these systems exhibit elements of adaptation and emergence. New plants and animals emerge out of the old.

Complexity in the human world



Despite the dominance of the orderly framework, there continued to be a huge variety of potent critics of the mechanical view of nature and society and of the limits of human rationality. In the late eighteenth century, Immanuel Kant (1724–1804), the German scientist and philosopher, argued that an organism 'cannot only be a machine, because a machine has only moving force; but an organism has an organising force . . . which cannot be explained by mechanical motion alone.'[6] In the late nineteenth and early twentieth century, Sigmund Freud (1865–1939) and Max Weber (1864–1920) challenged the belief in human rational capabilities and the degree to which humans can understand and control their environment and society. In the 1960s, the Nobel prize-winning economist FA Hayek argued that 'in the field of complex phenomena the term "law" as well as the concepts of cause and effect are not applicable.'[7] Consequently, from the 1970s onwards as social scientists continually failed to capture the 'laws' of society and economic interaction, and were continually frustrated by their inability to do so, they began to significantly question the Newtonian framework.

The fields of medicine and health were no exceptions in moving away from the more orderly and mechanical framework. As early as 1876, Theodor Billroth was worried that:

> The object of our modern endeavour is to make the physician's skill . . . independent of the talent of the individual and may be reduced to an absolute science. All knowledge and skill are to be determined and controlled by means of the laws of arithmetic and logic in order to make everything absolute and permanent. . . . I doubt if this good will ever be reached, at least in the art of healing.[8]

Not long afterwards, other doctors actively opposed the growing diagnostic testing and specialisation of medicine for overshadowing the importance of personal knowledge of the patient. For example, in 1905 Richard Cabot established the first social service department in American medicine at the Massachusetts General Hospital to train social workers and doctors to explore how patients' personal and social situations affected their health. Of particular relevance is Cabot's conclusion regarding a patient with diabetes:

> It was useless to hand her out a diet-list without finding out whether she can get at her boarding-house any such diet as we recommend. It turns out that she cannot, that there is no boarding-house for diabetics, and that she had no money to spend on specially selected diets. Shall we simply pass to the next case and let the woman's disease run on to its fatal termination unimpeded? The physician in charge has no time to investigate her case. . . . He needs the help of social workers to make his treatment effective.[9]

Similarly, in 1919 a leading medical practitioner, Sir James Mackenzie, was arguing that 'the conception of specialism dominant today is a wrong one . . . instead of enlightening, it tends to darken in a cloud of detail.'[10] More recently, experts have increasingly recognised that specialisation produces its own problems of fragmentation of care. This growing concern over the increasing fragmentation of care is neatly captured by the words of one frustrated patient with multiple complications, dealing with different specialists, who said to them 'Do none of you [specialists] talk to each other?'[11] Finally, others rejected the fundamental notion of specialisation which assumes that the body is no more than the sum of its various parts and that greater specialisation represents medical progress. As medical historians have pointed out, specialisms and specialisation have risen and fallen over time. According to one historian, the society with the greatest degree of specialisation was that of the Ancient Egyptians![12]

But how do human beings fit into the complexity paradigm? Obviously they are part of the complex web of their physical and biological surroundings, but what makes them distinct from this environment? Their most fundamental difference is consciousness – the ability to ask 'Who am I?', 'How did I get here?' and 'What does life mean?' This ability to be self-aware, to understand aspects of the world around them, to be aware of their history and to evolve interpretations of themselves and their surroundings makes human beings fundamentally different from all other life forms and physical phenomena. However, this advanced ability to interpret themselves and the world around them does not produce unified or orderly interpretations. The uniqueness of individual human experience combined with multitudinous possibilities of collective human interaction and the evolutionary nature of human society produces an incredible variety of interpretations or human stories. A simple glance at the competing cultures that make up our world, let alone the diverse opinions that can be found in our own neighbourhood, clearly demonstrates the power of human diversity. Therefore conscious interpretive outcomes (norms, values, historical interpretation) must be positioned on the more disorderly side of our complexity scale. This does not imply that there are no universal norms, values or interpretations. For example, a prohibition against murder is a common societal trait. However, the definition of murder, the mitigating circumstances that could surround it and the punishment for the act all vary widely over time and between different societies and cultures. The position of conscious phenomena is outlined in Figure 2.5.

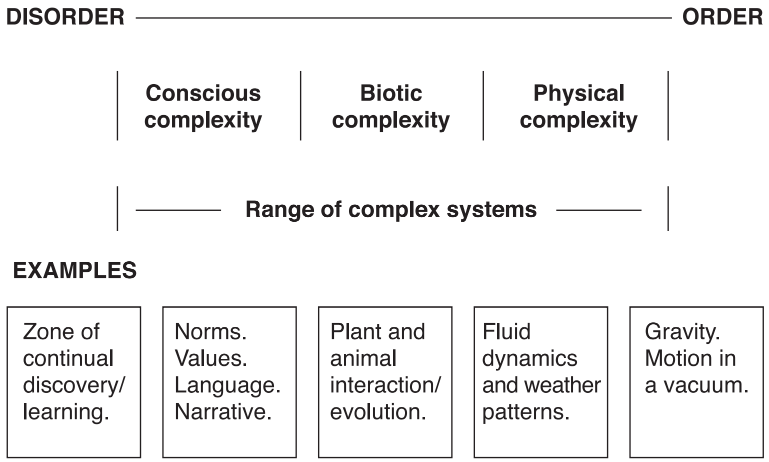


Figure 2.5: The range of physical, biological and conscious phenomena.

Box 2.3 Golden rules of conscious systems in a complexity paradigm

- **Partial order:** phenomena can exhibit both orderly and chaotic behaviours.
- **Reductionism and holism:** some phenomena are reducible, whereas others are not.
- **Predictability and uncertainty:** phenomena can be partially modelled, predicted and controlled.
- **Probablistic:** there are general boundaries to most phenomena, but within these boundaries exact outcomes are uncertain.
- **Emergence:** they exhibit elements of adaptation and emergence.
- **Interpretation:** the actors in the system can be aware of themselves, the system and their history, and may strive to interpret and direct themselves and the system. *You* make a difference just by being *you*!

How does this relate to everyday human events?

The next step is to explore how this relates to everyday human life. Using Figure 2.5 as a template, we can produce an overview of the range of complexity dynamics of human phenomena. The key point to recognise is that there are both orderly and disorderly dynamics and that they are not hierarchically organised. A given human outcome – a decision to have coffee at breakfast or to bomb a particular village – could be based on orderly, complex and disorderly dynamics, with all being equally essential to the final outcome.

Beginning with orderly dynamics, the most fundamental and universalistic elements of human complexity are basic physiological functioning, in particular life and death. These physical boundaries and requirements – carbon-based life forms requiring air, water and food in order to survive and reproduce – are the most orderly aspects of human existence. Deprived of these fundamentals, a human will die. What could be more orderly?

Moving into the range of complex systems, examples of mechanistic complexity in human systems would involve situations where individuals are forced to act in a mechanistic fashion. Traffic dynamics (choosing one road or another), crowd dynamics (choosing one exit or another) and electoral outcomes (choosing one candidate or another) are all examples of mechanical complex systems. These systems are relatively simple and stable patterns will emerge. However, this is no guarantee that these patterns (traffic jams, crowd delays, landslide elections) will be continuously stable, nor is it possible to perfectly recreate the exact conditions of these events at a later time. The golden rules of physical complex systems apply.

Examples of biological complex systems in the human world can easily be seen in the organisational dynamics of economic and social institutions. As demonstrated by the huge growth in management and complexity literature, a business is a complex system that interacts with a larger complex environment (the market) that is very similar to the earlier model of a fish in a pond. General patterns emerge and the business is able to adapt to changes in its environment, but exact predictions and explanations of how a change in the environment will affect the business, or the best strategies for the business to survive in the altered environment, are impossible to know in advance.

An added layer of complexity in the human condition is its faculty of consciousness. Human beings create signs, symbols, myths, narratives and discourse in order to understand, control and exchange information about their surroundings. This ability adds another layer of complexity to the human condition that is distinctive from the natural world. Examples of this conscious complexity include the creation of language, norms and values and discourse, and can be taken from virtually any type of human verbal interaction. A seemingly simple student–teacher relationship can be layered in historically, culturally and personally specific aspects that would be impossible to recreate in a different time and place.

Lastly, like the natural world, disorderly human phenomena are nearly impossible to explain using examples, since they are without a pattern and would have to be completely random. These could range from the influence of random events to the chaotic nature of dreams and the unconscious, random effects of certain disorders on the complex functioning of the brain, and the phenomena of luck. In essence, this is the ultimate area of individual experience that is constantly in the process of discovery and learning. (*See* Figure 2.6.)

How can all of these dynamics be combined to explain everyday human phenomena? Let us begin with a simple daily event – going to a shop to get a cup of coffee and something to eat. You have a basic human need for water and nutrition that is very orderly and highly predictable, particularly for those with diabetes. This is combined in the case of the coffee with the desire for a mildly addictive stimulant and a snack to maintain normal blood glucose levels. As you leave home to walk to the coffee shop, you immediately encounter crowd dynamics that may speed or impede your journey to the shops. When you reach your favourite coffee shop, you see that a new coffee shop has opened on the opposite corner of the street, competing for your business. These shops are engaged in the complex biological process of competition. In a process of conscious complexity, you are enticed to enter the new shop by its pleasant name, ‘Vic’s Coffee Shop’, which reminds you of a childhood friend. As you enter the shop a woman is leaving with a cup of coffee. You open the door for her and say ‘good morning.’ As she turns to thank you a fly lands randomly on your face and you

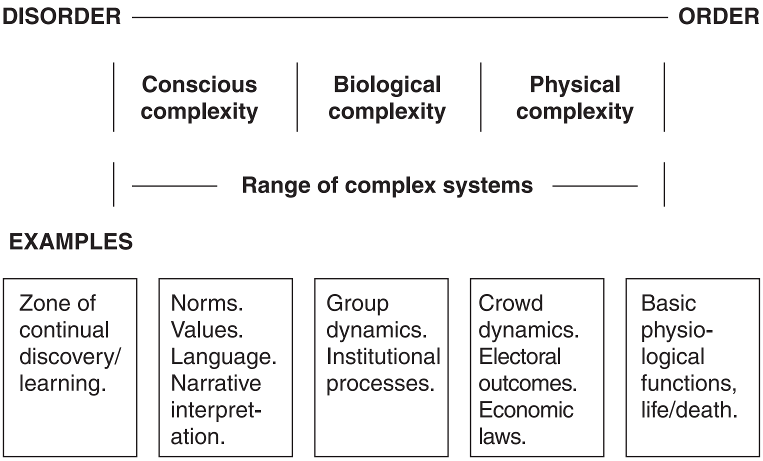


Figure 2.6: The range of complexity systems in human phenomena.

immediately flinch, accidentally hitting the woman so that she spills her coffee all over your clothes. You return home, embarrassed by the stains and worried that you need food quickly in order to avoid a hypo. You have a quick snack and change your clothes, but given all of the 'mess' you forget to have a cup of coffee! The point of detailing this pursuit of coffee is to demonstrate the remarkable orderly, complex and disorderly processes that are the foundation of most commonplace, everyday events in human life.

The amazing and even entertaining thing about a complexity framework is that you can apply it to virtually any aspect of human life and trace out the orderly, complex and disorderly bits. What this shows is that complexity is really the science of common

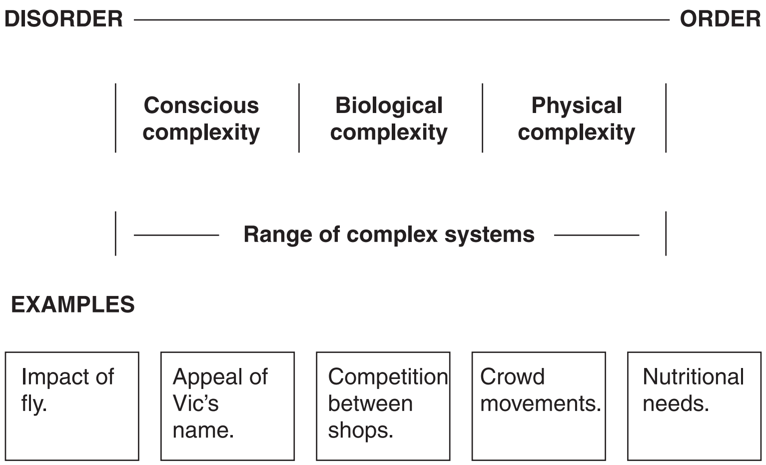


Figure 2.7: The range of complexity in everyday life.

sense, and that we are all experts in complexity. We deal with it on a constant basis, from the physical demands of our bodies to the social demands of our partners, families and work colleagues. The strange thing is that despite all of this complexity, many individuals, societies and scientific frameworks in particular seem desperate to find some sort of certainty or final order in their lives, systems or structures. In many ways, it is the pursuit of this 'final order' that leads to much worse individual and social outcomes than the original uncertainty and complexity.

Now this may be very interesting, but the obvious question still remains. How does all of this relate to diabetes and the triangular relationship between the patient, the carer and the health professional? To answer this question requires a new chapter.

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