Part III
Complex Adaptive Health Systems: Theory Meets Praxis

All theories are legitimate, no matter.
What matters is what you do with them.

Jorge Luis Borges (1899–1986)
Argentine writer and poet

It is the theory which decides what can be observed.

Albert Einstein (1879–1955)
German-born theoretical physicist

Part I of this book described the foundational elements that underpin the formation of a complex adaptive health system, and Part II outlined how to apply the principles of complexity sciences to the (re)design of health systems. Three examples from three very different context illustrated how—under the guidance of *committed leaders*—adherence to these principles—the shared understanding of *purpose, goals, and values* resulted in the bottom-up/top-down emergence of complex adaptive health systems:

- A primary health care system in the slums of Nairobi
- A national integrated realignment of health and community services to contain HIV/AIDS in Brazil
- A community-owned, community-run, and community-focused health system for the Alaska Native and American Indian people in the greater Anchorage area

This next part of this book will explore how to better understand the structure and dynamics of health system organisations. Fundamentally this will require a change in mindset; continuing to use the prevailing one is unlikely to gain fundamentally different understandings.

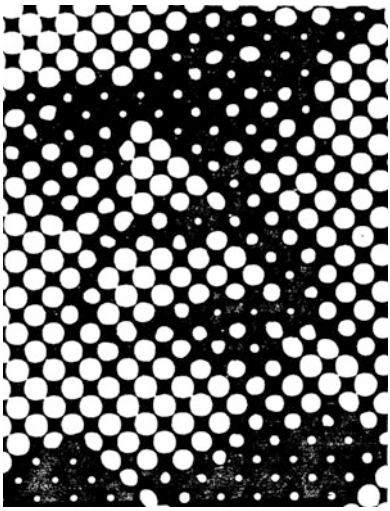


Fig. 1 An array of dots [1]

Passioura's Visual Parable[1]

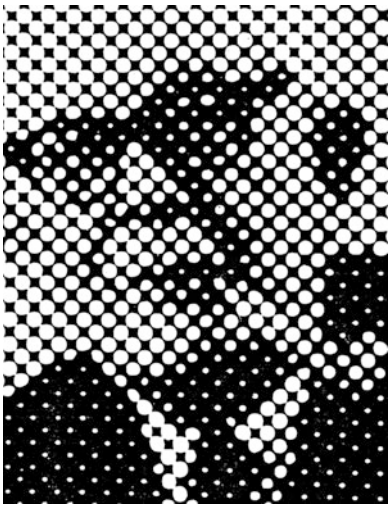
Figure 1 shows an array of dots [1]. If we were asked to make a study of these dots, we would probably start by looking for pattern in them. We would note that their centres form a square array whose rows are at 45° to the horizontal, that most of the dots are circular, that there is a bimodal distribution of their size, and that dots of a given size tend to be clustered together. We might note that some of the dots appear to be malformed, and if we have tenured appointments we might have time to reflect that by using such a pejorative word as "malformed" we have already developed expectations about our observations, that is, that we have started to make theory—dots should be circular, and if they are not, it is an error.

It is clear then that there is plenty of pattern here. But is there significant pattern? What does "significant" mean? Have we been making the right observations? Could the large and small dots be a two-letter alphabet similar to that of the Morse code, so that we should be looking for lineal rather than areal pattern? There seems to be no way to find out.

But if we look at an extended field of the dots as shown in Fig. 2, and if we blur our eyes to the extent that the dots almost disappear, they suddenly gain significance, and do disappear. We are no longer looking at dots. We are now looking at the face of a man who is smoking a pipe. Figure 1 is now seen to be a picture of his eyes, nose, and mouth, and almost all our previous discussion on arrays, and rows, and size, and shape, is now seen to be irrelevant. All that matters is the gross distribution of the different-sized dots to give the illusion of light and shade. The significance of the dots can be seen only by abandoning almost all the detailed information we

[1]Passioura JB. Accountability, Philosophy and Plant Physiology. Search 1979;10(10):347–350.

Fig. 2 An array of dots? [1]



have about them, and only by changing the language that we use to describe them. We cannot discuss their significance by restricting ourselves to words like size, and shape, and array. We have to use words like light, and shade, and nose, and mouth.

It is this transition from one language to another that epitomises the way our minds deal with layered systems. And it is by perceiving the world as being organised into conceptual layers that we manage to make sense of it; the use of such terms as "molecular level", "cellular level", ["organ level", "person level", "primary care level", "secondary care level", "tertiary care level", "community level", "regional level", and "whole health system level"], *attests to that. . . . What follows is a description of the main properties of layered systems, or hierarchically organised systems as they are sometimes called. The account is based on that of Mesarovic MD. and Macko D. (1969)* ['Foundations for a scientific theory of hierarchical systems,' in Hierarchical Structures (L. L. Whyte, A. G. Wilson and Donna Wilson, eds.). American Elsevier, New York. pp. 29–50].

Properties of Layered Systems

1. *Each level has its own language, concepts, and principles. In our discussion of Fig. 2 we used words belonging to three different levels: "array" and "dot" belong to the lowest (i.e. least organised) level; "light" and "shade" belong to the middle level, and summarise the important features of the organisation of the dots; "nose" and "mouth" belong to the highest level, and summarise important features of the organisation of light and shade. Our understanding of a layered system is, in part, measured by our ability to inter-translate the languages of adjacent layers. Translating to a lower layer provides us with explanations, translating to a higher layer provides us with the significance, of the phenomenon we are studying.*

2. *Discovery at a given level is stimulated by thinking of adjacent levels. We have seen that to discover a face while concentrating on the dots of Fig. 1 is virtually impossible. Yet had we been told that the organisation of the dots represents light and shade, our discovery of the face would probably have been facilitated as we blurred the figure for the first time. Similarly, our appreciation of the significance of the dots in terms of light and shade might concentrate our attention on an important feature that we have not previously considered, namely the spatial frequency. If the array of dots were on a finer grid, we would be able to see more detail in the picture.*
3. *Interaction between levels is not symmetric: a higher level requires all lower levels in order to operate effectively, but not vice versa. If we transformed Fig. 1 by cutting it up into several pieces and rearranging them, we would still have an array of dots, even though they formed a meaningless pattern. But if we transformed the dots by, say, squashing them so that they formed thin overlapping lines instead of discrete areas, we would have neither dots nor picture.*
4. *Higher levels result from constraints being imposed on lower levels. Randomly arranged dots would give no picture. It is only after the dots have been constrained to form groups that a picture can arise. A group of large dots gives a patch of light; a group of small ones, a patch of shade.*
5. *A constraint is expressed in the language of the higher level. Dots are grouped (constrained) to form a patch. One could express the grouping in terms of the size and position of individual dots, but such a description would be tedious and befuddling and would give no clue to the significance of the constraint.*

Implications for Understanding Complex Adaptive Health Systems

Readers are reminded that every system consists of a number of subsystems and is itself part of a larger supra-system. Passioura alludes to the important relationships between systems levels; subsystem levels provide ***explanations*** for the characteristics of the system level of interest, the supra-system level explains the ***significance*** of the system level to the whole (Table 1).

These interrelationships highlight that *breaking systems into their components is flawed with danger as the parts do no longer contain the properties of the whole system*. Missing this point can lead to erroneous interpretations of the system's behaviour and not infrequently results in overly simplistic managerial interventions.

In line with Passioura's notions we also have to distinguish the understanding of issues along a continuum of changing contexts (Fig. 3). Deconstructing *what we know* into its constituents is explanatory and associated with a high level of certainty. However, *what we would like to know* about an issue can only be envisaged and will result in novel insights.

Table 1 Health system phenomena at different levels of organisation

	Primary care	Person	Community
Supra-system level SIGNIFICANCE	Resource allocation for secondary/tertiary care	Community morbidity and mortality	Socioeconomic determinants of health
System level DESCRIPTION	First point of care	Personal health experience	Social capital
Subsystem level EXPLANATION	Nurses and doctors practicing in the community	Personal morbidity family support environmental exposures	Number of friends community halls sporting facilities, etc.

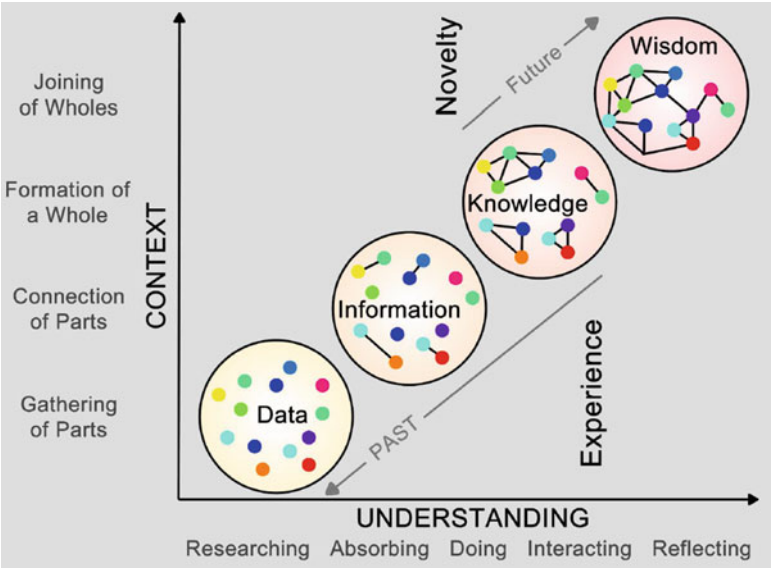


Fig. 3 The continuum of understanding and context. Real understanding arises from being able to link diverse knowledge domains. Adopted from: Cleveland H. "Information as Resource", The Futurist, December 1982, p. 34–39

The following two chapters consider two broad approaches to understanding *complex adaptive systems (organisations)*:

- A posteriori *approaches* that illuminate the historical features of the system—its structure and its outcomes, and by deduction its driver(s)
- *Prospective approaches* that provide insights to the possible future achievements of the system, i.e. its potential dynamic behaviour, given what is known so far

These two approaches are then applied to the problem of obesity. Only an appreciation of the interdependence between all "*partial insights*" allows an "*overall understanding*" of the problem, i.e. the obesity epidemic as a whole is "*greater and different*" to the "*sum of its parts*".

Further Readings

Morin E (2008) On complexity. Hampton Press, New Jersey