

## **Chapter 2**

# **Clinical Reasoning in Medicine: Practice and Education**

### **2.1 Introduction**

This chapter presents a critical evaluation of literature on the topic of clinical reasoning in medicine and how it is taught and learned. This forms a substantial body of work emanating predominantly from the traditions of behaviourism and cognitivism, which share philosophical foundations. Closely related to this, but forming an identifiably separate and substantial body of work, is research into clinical reasoning based on probability mathematics and logic. This is generally referred to as medical decision making (Sox, Blatt, Higgins, & Marton, 1988) and is reviewed separately in the next chapter. Research into clinical reasoning within other health care professions is also reviewed later, as more of this research has been conducted within an interpretive framework.

The approach to clinical reasoning in this thesis is based on hermeneutic phenomenology, about which more is said in Chapter 5 on research methods. According to hermeneutic phenomenology the researcher cannot adopt a totally detached viewpoint, and the researcher's historically formed horizon of understanding is a key aspect of the research project and how it will be interpreted. Gadamer (1976; 1989) described how researchers bring their prejudices (or prejudgments) to projects. Therefore, in keeping with the spirit of hermeneutic phenomenology I begin with a personal anecdote to set the scene. This will go some way to establishing how my horizons of understanding and my prejudgments were formed before the project began.

### **2.2 Personal Anecdote**

My involvement in clinical reasoning research dates back to the 1970s and my time as an undergraduate dental student. I was persuaded to be a participant in research into the process of diagnostic reasoning. My most vivid memory of this experience is predominantly one of humiliation. For a long time it was a memory I did not like to dwell upon, and I suppressed it until my interest in the subject was re-awoken in recent years. Now, with the benefit of many years' hindsight and of a deepening understanding of the

subject, I can reflect upon the experience more dispassionately, and draw some lessons from the episode which inform the current study.

The experiment involved three distinct phases. The first two involved using a computer (a mainframe and still a novelty at that time). Phase one was a learning phase of some 20 or 30 minutes, followed by a testing phase of about the same duration, with a final debriefing with the researcher, who briefly interviewed me about what was going through my mind when I was doing the first two phases. The whole exercise took approximately an hour.

In the learning phase I was presented with a number of diseases to consider. These had Latin or Greek sounding names. Each one also came with a list of signs and symptoms. Some signs and symptoms appeared in more than one disease. I was required to memorise the lists. In the testing phase I was presented with disease names and had to pick the matching signs and symptoms. Alternatively, I might be presented with a number of signs and symptoms and had to decide which disease most closely fitted the list.

An immediate major problem for me with this experiment was that the disease names were made up and meant nothing. Likewise, the lists of signs and symptoms associated with the diseases were arbitrary. This was only explained to me after the experiment. When the learning phase began I realised that I could not make any real sense of any of the lists, which induced a sense of panic. There did not seem to be any underlying logic that linked signs and symptoms into a sensible whole. I quickly realised that I would have trouble even remembering the names of the diseases. This proved to be true. During the testing phase I floundered, and knew that I floundered. During the debriefing phase I could only tell the researcher that there had been insufficient time to learn the information, and I was very glad to get out of the building. My self-respect as a diagnostician was in shreds. This in itself raises ethical issues about this kind of research, but these are beyond the scope of the present project.

My sense of humiliation began almost as soon as the first phase began, and simply grew as the time passed by. However, I can now engage in some metacognition and reflect on my learning techniques and why I was doomed to “fail” the experiment. Having learned some Latin at school I had always found it useful when learning both anatomy and

pathology. Knowing the meaning of the Latin names often helped with remembering them. *Pericoronitis*, for example, is a mixture of Latin and Greek and means inflammation around the crown of a tooth. This is an exact description of what the condition is. The names of the diseases in the experiment sounded like Latin or Greek but were not. They were essentially meaningless names devised solely for the experiment and therefore it was difficult to attach meaning to them.

When I studied pathology, medicine, and surgery I had always found it important to learn the underlying causes of a disease, and then trace these through to see how they produced the various signs and symptoms. This approach also led naturally to an understanding of what treatment might be appropriate. For example, in the case of *pericoronitis* the cause is often an upper wisdom tooth impinging on the gum of the partially erupted opposing tooth in the lower jaw. The treatment is to remove one or both teeth. Unfortunately, in the experiment this approach to learning was not possible. There was no underlying meaning structure, and little time to devise one. Subjects were reduced to committing lists to memory in much the same way as one might try and memorise a list of telephone numbers.

On reflection, the most striking feature of the experiment was the set of assumptions on which it was apparently based. I can now see that the whole approach revealed a deep misunderstanding of what might be involved in clinical reasoning and how it could be learned. As Harré (1978, p. 44) wrote: “Mistakes in methodology may sometimes seem to be only superficial flaws in a science, but on reflection they can usually be seen to be consequences of quite deep confusions about its subject matter.”

I think Harré’s words are applicable to the experimental approach that was used on this occasion in the late 1970s. It also illustrated the truth of Wittgenstein’s words:

“In psychology there is experimental method and conceptual confusion. ... The existence of the experimental method makes us think that we have the means of solving the problems which trouble us; though problem and method pass one another by.” (Wittgenstein, 1958 #14)<sup>1</sup>

---

<sup>1</sup> Wittgenstein’s work is frequently written as a series of numbered aphorisms. The convention is to refer to the number of the aphorism rather than the page number. This convention is followed here.

The experimental setup that was used in my example reveals the underlying assumptions behind the research. One assumption was that student clinicians simply learn signs and symptoms as lists of words, and use these when attempting a diagnosis. This memorisation technique is now recognised as a superficial or surface approach to learning, and modern education works hard to avoid it (Ramsden, 2003). My own approach reflected a deeper way of learning, one that is now explicitly encouraged in educational theory and practice. With the hindsight of many years I can reassure myself that my undergraduate understanding of what was required in “good” learning was better than that of the experimenters conducting that early research. It also shows that, even though I may not have been able to articulate it at the time, my clinical reasoning bore little resemblance to that assumed to be the norm or ideal in the experimental design.

### **2.3 Clinical Reasoning as a Search for Meaning**

Reflection on this experience provides an insight that is one of the major assumptions of my research project; that clinical reasoning is essentially a quest for meaning. A clinician tries to gather information from and about the patient, and uses it to discover the underlying meaning structure of the patient’s problem and how this fits into the patient’s lifeworld. Svenaeus (2000) adopted a hermeneutic phenomenological approach to medicine and health, describing patients’ health as their sense of “homelike being in the world”, and illness as a departure from this. Any clinical encounter is intended to facilitate health. This is the view that is taken in this project. This view, based on hermeneutic phenomenology, is grounded in analysis of the interpretations of many patients and clinicians (Svenaeus, 2000). It is not the way health and the clinical encounter are articulated in most clinical reasoning research. Within the mainstream of this body of work, the meaning structure has traditionally been articulated and conceptualised in the strictly clinico-pathological terms that characterise the biomedical model. A definitive diagnosis, together with an appropriate treatment plan, is seen in this tradition as being the ideal outcome of discovering this underlying meaning structure. This manner of reasoning is assumed to be the norm in the vast majority of acute conditions seen in clinical practice, and can be referred to as clinical reasoning within the acute biomedical model. This model has been dominant in medical thinking for many decades and, as a process of medical diagnosis, has had considerable success when

applied to acute conditions. The success of the biomedical model is more debatable when it comes to health care in general and as provided by other health care professions, where patient-centred care and wellness models are more strongly supported (Fulford et al., 1996; Binnie & Titchen, 1999; Ersser & Atkins, 2000).

In relation to the management of chronic conditions, the search for meaning in the form of a definitive diagnosis within the biomedical model may be more elusive and the model may be inadequate to encompass the nature, complexity and dynamics of the patient's lifeworld. Engel (1977) proposed a biopsychosocial model as a way to comprehend and formulate a patient's problems in a manner that lends itself to more effective management. Here the clinician seeks to formulate the patient's problems in as much detail as possible and to include relevant psychosocial aspects in addition to the clinico-pathological features.

In the pain clinic which is one of the settings for this study there is a conscious effort to undertake the clinical reasoning process within a biopsychosocial model of illness. The common feature of the two models is the underlying quest for meaning, in the sense that reaching a diagnosis aims to place the patient's problem within a coherent world view, which will also provide a clear direction as to what can be done to help the patient progress towards improved health. The essential difference is that the biomedical model uses the conceptualisations and terminology of clinical pathophysiology almost exclusively. The biopsychosocial model includes this dimension, but extends it with the conceptualisations and terminology appropriate to the psychosocial problems, situation, and maladaptation to the activities of daily living the patient may be facing in chronic conditions. These can complicate diagnosis and management. In the clinic under study, clinical psychologists and physiotherapists, as well as doctors and sometimes dentists, play an important role in the formulation of the patients' problems. In this context it is implicitly accepted that problems in the lifeworld of the patient need to be assessed and addressed.

How problems in the lifeworld of the patient are addressed can be problematic in itself. There are calls for clinical reasoning to be seen as a collaboration between patients and practitioners (Edwards et al., 2004). In such collaborations the goals and strategies of management are jointly planned by patients and practitioners, as opposed to treatment

plans being imposed by practitioners upon patients. There is a shift in emphasis away from patient compliance, seen as obedience, to an emphasis on patient cooperation. Edwards et al. pointed out that even though collaboration has been demonstrated to improve outcomes, many practitioners resist it as they perceive a loss of authority and power. Power and authority in clinical encounters are generally weighted in favour of practitioners. Many practitioners simply expect the patient to comply. Researchers adopting a perspective from the critical paradigm place great emphasis on exploring the assumptions and values held by both practitioners and patients (Trede & Higgs, 2003; Trede et al., 2003). Such researchers encourage both patients and practitioners to critically reflect on what their expectations are of each other, and what their aims and interests are, in order to bring these power relations to consciousness. Trede and Higgs gave the example of educating people about the dangers of smoking. In a more traditional biomedical model, patients are simply given didactic teaching about the physical damage done by smoking, ignoring the fact that many patients, young people in particular, take up smoking as a gesture of resistance and emancipation. Practitioners using a more critical and collaborative approach would take steps to recognise and take account of these aspects of clinical encounters and the fact that health cannot be considered in isolation. Decisions about health are always taken in a context made up of the lifeworlds of both patient and practitioner.

## **2.4 Research Traditions in Clinical Reasoning in Medicine**

Clinical reasoning has been a topic of research for several decades. As recently as 2000 there have been calls for more normative and descriptive research into clinical reasoning (Elstein & Schwartz, 2000). Normative means prescriptive. The aim of this kind of research is to establish precisely how clinical reasoning should be conducted, under the assumption that there are standards to which one can appeal as being normative, and to set out these standards in as much detail as possible. These standards are examined in Chapter 3 which deals with medical decision making. The aim of descriptive studies is to describe how clinical reasoning is actually done. However, description also includes the interpretation and understanding which are a necessary part of any description.

Elstein and Schwarz are among the researchers who have devoted considerable effort to the study of clinical reasoning (Elstein, 1988, 1994; Elstein et al., 1993; Elstein, Shulman, & Sprafka, 1978). Their somewhat surprising more recent call to engage in more normative and descriptive studies arises from a growing realisation that clinical reasoning is a complex multidimensional phenomenon. If we are to really understand it for what it is, then we need studies that bring to bear perspectives from a range of academic disciplines. Elstein and Schwarz (2000) suggested that insights into clinical reasoning can come from such varied disciplines as sociology, economics, health policy and, of course, psychology (presumably meaning cognitivism, as this is currently the dominant paradigm in psychology). To this list we could add perspectives from anthropology, philosophy and other types of psychology founded on the work of Vygotsky (1978).

Traditionally, clinical reasoning studies have tended to focus on medical practitioners and medical students. However, in recent years this focus has widened and there is a growing number of clinical reasoning studies in other health care professions such as nursing, physiotherapy and occupational therapy (e.g. Higgs & Jones, 2000). Researchers in the other health care professions have tended to adopt more interpretive approaches to their subject matter.

Clinical reasoning studies have naturally reflected the prevailing philosophical assumptions and trends of their time. As discussed in more detail below, early studies were based predominantly on behavioural psychology. These were followed by studies based on cognitive psychology. This body of research is by far the largest. In more recent years research based on interpretive paradigms has started to appear and grow in volume, especially in health care professions other than medicine. Researchers in these professions have been actively seeking alternatives to the medical/illness model. The interpretive studies are based on quite different philosophical foundations from their cognitive and behavioural counterparts. Many emphasise patient-centred care, wellness models of health care, and a more holistic approach. As noted, these latter studies are reviewed in a separate chapter. The rest of this chapter focuses on behaviourist and cognitive psychology studies of clinical reasoning.

## 2.5 Behaviourism

The oldest research tradition in clinical reasoning research is behaviourism. Behaviourism is the view that mental phenomena like clinical reasoning can only be understood by analysing behaviour. According to this theory, clinical reasoning is an exclusively individualistic mental phenomenon. While Edward Thorndike was probably the first behaviourist of note, some of behaviourism's better known proponents are Watson and Skinner. The task of behaviourism is the explanation and prediction of behaviour. To this end, behaviourist researchers adopted the empirico-analytical research methods of the natural sciences. In this research paradigm, behaviour was taken to be a dependent variable, and the independent variables that produced it were the stimuli that might lawfully cause that behaviour. These behavioural laws were assumed to be similar in kind to the laws of physics and chemistry. According to this approach all variables must be specifiable by experimental procedure, and there must be an underlying set of causal laws relating them to each other. Internal states of consciousness were excluded from this view of psychology as being beyond scientific study. Cognition itself was seen as being something of a "black box" or invisible function. Some behaviourists were prepared to admit internal neurophysiological conditions as intervening variables, but the more radical, such as Skinner (1938) insisted that these intervening variables would themselves be functions of environmental conditions. Some basic responses were considered to be inherited, but most were seen as learned. Skinner's functional analysis survives as a research tradition today (Howard, 1995). Skinner focused on the control and subsequent prediction of behaviour rather than its explanation. It was he who introduced the notion of reinforcement as a condition of learning.

Two types of learning can occur in this world view. One is classical or *respondent conditioning*. This dates back to the original work of Pavlov (1927). A response under the control of a given stimulus can be elicited by a new stimulus if the new stimulus is repeatedly paired with the old one. Pavlov showed that the ringing of a bell when food was given to dogs could eventually stimulate salivation without the presentation of food. It was assumed that this is essentially how humans learn to respond to new situations. The behaviourist world view also allows for a form of learning called *operant conditioning*. A response that has been repeatedly followed by a reinforcing stimulus (reward) will occur with greater frequency and will therefore be selected over other possible responses. It was



assumed that this is how humans learn new responses. These conditioned responses can be unlearned or extinguished if prolonged dissociation from the old stimuli occurs or if reinforcing stimuli are repeatedly withheld.

It is accepted that some kinds of learning can occur in this behaviourist manner, but to assume that all learning occurs this way is grossly oversimplistic. At the time of writing there are many different theories of learning (Kearsley, 1994-2004) and this shows that the phenomenon we call learning is extremely complex; it is multifaceted, multidimensional and multilayered.

Some research into clinical reasoning has been conducted within the behaviourist paradigm. Rimoldi (1988) tested diagnostic skills of medical practitioners and students in the 1950s and 60s, showing that as expertise increased so the numbers of questions asked and the time taken to solve diagnostic problems decreased. Taylor (1985) argued that this approach was an oversimplification of the kind that occurs when the humanities are studied along the same lines as the natural sciences. The truly interesting questions are avoided, or the research ends up stating the obvious and being irrelevant. Rimoldi's method was an early attempt at simulating clinical problems. However, it can be argued that simulation approaches are probably better suited for assessment rather than research. To be fair to examination candidates, assessment needs standardised and controlled situations with some degree of realism, which a simulation can provide. However, simulations are by their nature always out of context, which makes them problematic for research purposes.

Behaviourism has affected teaching and learning practice in significant ways and continues to do so, in education generally but also specifically in medical education and the teaching of clinical reasoning. One of the insights of behaviourism is that learning should be rewarding for the learner. In higher education this has been translated into providing feedback on performance. This insight was also the driving force behind the programmed learning schemes of the 1960s. These have had a more recent renaissance with the appearance of personal computers and computer-based learning systems. Many of these are based on principles of instructional design (Gagné & Briggs, 1979) that are in turn derived from behaviourism. It is now also common practice when writing educational materials to base them on explicit objectives and intended outcomes. The

objectives are intended to be observable and overt behaviour that demonstrates an underlying mastery of some body of knowledge or skill (Greeno, Collins, & Resnick, 1996). Certainly it can be argued that these behavioural goals focus the attention of teachers and learners alike onto what is important, and are thus useful.

Behaviourist principles have made their way into medical education and the teaching of clinical reasoning, even though this may not be explicitly recognised (Custers & Boshuizen, 2002, p. 184). Custers and Boshuizen drew attention to frequent references in the literature to the requirement that students receive immediate corrective feedback on their performance. This comes from the behaviourist principle of contiguity, which is that feedback works best when administered immediately. They also noted that the learning objectives which are an explicit part of problem-based learning, as originally conceived, could be traced back to the behaviourist emphasis on measurable outcomes (Bloom, Engelhart, Furst, Hill, & Kratwohl, 1956). Likewise, the behaviourist principle of contingency, which is the requirement for learners to see the outcomes of their actions, is referred to as recently as 1997 (e.g. Smith & Irby, 1997). Many features of modern medical curricula can be traced to influences from behaviourist principles, such as frequent and progressive testing, close monitoring of students, and using lectures and demonstrations as vehicles of motivation rather than merely as sources of information (Custers & Boshuizen, 2002). This shows that although behaviourism may have many weaknesses it has been of some benefit when intelligently applied. However, as an explanation of all learning behaviourism is conceptually weak and does not go far enough. It ignores context, sociocultural interaction and intersubjectivity. Meaning structure, as such, has no place in behaviourism's conceptual world or its vocabulary. In the endeavour to address some of these weaknesses cognitivism emerged as a more powerful conceptual model for thinking about mental phenomena such as clinical reasoning (Patel & Arocha, 2000). Growing dissatisfaction with the limitations of behaviourism eventually led to its being superseded (or subsumed) by the so-called cognitive revolution that began in the 1950s and 60s, as typified in the early work of people such as Jerome Bruner.

## **2.6 Cognitive Sciences/Cognitivism**

Cognitive science seeks to account for intelligent activity as exhibited by living organisms or machines. It is not one single discipline. Its core is constituted by cognitive psychology and artificial intelligence. However, significant contributions to this cross-disciplinary enterprise come from neuroscience, linguistics, computer science, philosophy and other branches of psychology such as developmental psychology. Cognitivism replaced the behaviourist metaphor of cognition as a black box having environmental inputs and behavioural outputs with the metaphor of cognition as a form of computation and information processing, similar in kind to that carried out by computers.

Cognitivism allows for “mental” structures and processes, whereas behaviourism does not. Information processing, memory representation and problem-solving are three core concepts (Case & Bereiter, 1984). However, learning does not play a prominent role in cognitivism and is relegated to basic functions such as memory storage and representation. As Voss (1978, p. 13) wrote, “... the cognitive view of learning is vague, is abstract, and most important, is lacking a substantive data base”. In behaviourism the assumption is that behaviour is what is learned, whereas in cognitivism the assumption is that behaviour is the outcome of what is learned (Stevenson, 1983). Cognitivism also includes the notion of metacognition, that people can monitor their own thought processes. These thought processes are assumed to be active selection of stimuli, organisation of material, construction of responses and learning strategies. There have been a number of attempts to characterise knowledge structures according to a cognitive view, and these feature prominently in much clinical reasoning research within the cognitive paradigm. The mental structures which purportedly play such a prominent role include categories, prototypes, instances, schemas, scripts, and networks (Gruppen & Frohna, 2002).

## **2.7 Cognitive Structures in Clinical Reasoning**

The notion of categories dates back at least to Aristotle. Categories represent the essence of something. They may have clear boundaries but may not be clearly defined internally. They may be useful for classification but are limited, as few real world concepts possess the clear-cut features which are necessary for classification. In diagnosis it is common to

find that not all the critical features normally associated with a particular disease are present. This phenomenon has given rise to the notion of the prototype.

Prototypes can be thought of as the “best example” of something (Gruppen & Frohna, 2002). The concept allows for variation around a family resemblance. Bordage and Zacks (1984) claimed that prototypes are consistent with the knowledge organisation of doctors and students. A problem with the prototype in that milieu is that it does not reflect the fact that context has been shown to influence knowledge retrieval (Brooks, Norman, & Allen, 1991). Instance theories were devised in response to this deficit.

According to the theory of instances, knowledge organisation occurs around individual instances rather than as an abstract based on several cases. The idea was proposed in response to the perceived weaknesses of prototypes (Brooks et al., 1991; Homa, Sterling, & Treppel, 1981). However, instance theories leave open questions of how specific instances can be grouped together, and of how instances are extracted from experience. The assumption is that the selection and grouping of instances is a key stage, but it is not clear how this comes about. Schema theory is an attempt to deal with this weakness.

Schemas have featured prominently as knowledge structures in much clinical reasoning literature. They are conceived as higher order structures providing broad abstract frameworks onto which exemplars can be mapped (Jeffries, Turner, Polson, & Atwood, 1981). There does not need to be a central tendency as in the prototype concept. Instead there are “slots” which identify features. Problem schemas are a more dynamic version which incorporate solution alternatives and procedures to be implemented once a schema has been “activated” (Gruppen & Frohna, 2002). The difference between experts and novices is attributed to the differences in sophistication of these schemas. Chi et al. (1981) found that novices worked with superficial characteristics whereas experts relied on deeper features because their schemas are more abstract and generalised. The work of Chi et al. was in physics, but Jolly et al. (1984) claimed to confirm the findings in clinical reasoning. However, it seems that the popularity of the schema concept is a problem. It has been said that the notion has been accepted uncritically and is no longer a precise term, having become too vague and general in its application (Gruppen & Frohna, 2002). Gilhooly (1987) claimed that schemas are too static. This apparent weakness of schemas led in turn to the concept of the script.

Scripts are presented as a specialised version of schemas, in an attempt to resolve the perceived generality of schemas. Scripts are used to explain complex sequences of causally and temporally linked events, and were first described by Schank and Abelson (1977). In clinical reasoning, illness scripts have been used to account for the organisation of clinical knowledge (Feltovich & Barrows, 1984; Hobus, Schmidt, Boshuizen, & Patel, 1987; Charlin, Tardif, & Boshuizen, 2000). Schmidt and Boshuizen (1989) proposed that experts solve problems by searching for and activating the appropriate script. However, as Gruppen and Frohna (2002) pointed out, the sequence of events that was important in the original notion of script has in fact largely disappeared when applied to clinical reasoning. Therefore, in practice the idea is almost identical to the schema. The latest conceptualisation of cognitive structures in this world view is that of a semantic network.

Semantic networks have been proposed as a more dynamic and sophisticated way of representing knowledge. The construct arose from research into artificial intelligence and is essentially a graphic way of representing entities and the relationships between them using nodes and links between the nodes. The structure of the network defines the meaning of the topic being represented. According to proponents of this idea, semantic networks can incorporate pathophysiological processes and principles (Schmidt, Boshuizen, & Hobus, 1988). It is also argued that repeated exposure to clinical experience will enable individual networks to be incorporated into wider networks (Schmidt & Boshuizen, 1993). Semantic networks can be used to represent knowledge graphically, for instance with concept maps. In this way, it is reasonable to assume that some clinicians might well use semantic networks as cognitive tools to aid their clinical reasoning. However, any assumption that this is foundational to the way that knowledge is represented and manipulated in the human mind is fraught with problems. Semantic networks are high level cognitive tools, and assume a great deal of knowledge and understanding before people can make sense of them or use them.

## **2.8 Elaboration**

The cognitive structures mentioned above are believed to be similar to data structures in a computer program. A problem for the cognitive approach, therefore, is to explain how these cognitive structures are activated and manipulated. It is assumed that this must bear

some similarity to the ways in which computer programs manipulate data structures. Custers and Boshuizen (2002) proposed an underlying mechanism to be elaboration, which they described as occurring in two basic forms. One form operates by providing an alternative retrieval pathway to the stored information. The more ways that one item of information is associated with other items, the more routes there can be to access the original item. The second form of elaboration operates by connecting new knowledge to existing knowledge, by which “meaning is increased” (ibid. p. 174), enabling learners to reconstruct knowledge. The language used here implies an underlying metaphor of knowledge and meaning as substances that can be quantitatively increased.

This preoccupation with mental structures and access to them is typical of cognitivism and is symptomatic of the underlying conceptual model of cognition as a form of computation. When developing a computer program a fundamental process is devising and implementing the data structures which form a core component of the system. Hence there is a concern in cognitivism to find and identify the corresponding cognitive structures which it is assumed must be present, and without which it will not be possible to comprehend cognition in any depth. However, if cognition is in fact not a computational process then the search for these purported cognitive structures may be misguided and doomed to failure. The similarities between cognition and computation are trivial, such as the ability to do simple mental arithmetic in one’s head. Much of the research referred to above, which sets out to establish the nature of the cognitive structures in clinical reasoning and other forms of cognition, assumes what it sets out to prove. For example, the experiment in which I took part, described at the start of the chapter, tried to force people to use list memorisation as a strategy to solve the problems that were presented. Those experimental subjects who were able to utilise this strategy were presumably judged to be successful at clinical reasoning, providing ‘proof’ that this was how clinical reasoning worked. Although this experiment could be considered more behaviourist than cognitive, the same critique applies.

Along with the concern for cognitive structures is an interest in the cognitive processes by which individuals make use of such structures. The most popular process for utilising these cognitive structures in clinical reasoning is held to be hypothetico-deductive reasoning.

## 2.9 Hypothetico-Deductive Reasoning

This process is seen as a combination of two ways of thinking attributed to two seventeenth century figures: Francis Bacon, who promoted induction and Reneé Descartes, who was in favour of deduction.

Induction predated Francis Bacon, but it is his name that is associated with the use of induction as an empirical method. The essence of the method is to meticulously gather information by observation and use this to seek laws that might explain those observations. One reasons from the particular to the general (Bradley, 1993). In a broader sense induction includes argument by analogy, predictive inference, inference to causes from signs and symptoms, and confirmation of scientific laws and theories. John Stuart Mill improved upon the concept with his five “methods” which made induction more systematic. These are procedures for discovering necessary conditions, sufficient conditions, and necessary and sufficient conditions (Mill, 1941). However, induction as a reasoning method on its own is not without problems. It depends upon unbiased observations, and it can be argued that these do not exist. Some observations must be preferred over others and judged as being significant in some way. In hermeneutic terms we cannot avoid bringing our prejudices (or prejudgments) to bear on the observations we make. As Medawar (1969, p. 29) put it, “We cannot browse over the field of nature like cows at pasture”. Another weakness, that Hume (1740/1992) pointed out, is the amount of data that needs to be gathered before a conclusion can be reached. It is not possible to make an infinite number of observations, but one more might provide the one crucial piece of evidence needed. On its own induction is seen as being inadequate.

The other aspect of the hypothetico-deductive method is deduction. Deduction as a logical system was described and developed as a method by Descartes. It differs fundamentally from induction by taking the opposite approach. That is, deduction is reasoning from the general to the particular. Essentially the method relies on using self-evident axioms combined with infallible rules of inference to derive a conclusion. However, its weakness relates to the dependability of the axioms and the reliability of the inference rules used. The axioms could be based on observations that are as flawed as those used in the inductive method. It is believed that clinicians use induction in order to generate hypotheses. Deduction is then used to decide what information will be needed to

test the hypotheses. As data is gathered, deductive rules are used to either eliminate a hypothesis or increase its likelihood. Then there is a reiterative process. New or more refined hypotheses can be generated and tested until a diagnosis is reached. This then becomes the hypothetic-deductive method. The inductive generation of hypotheses combined with their deductive testing is central to the process.

William Whewell (1840) first proposed that in scientific research (and by extension clinical reasoning) a hypothesis is generated early in the process and forms the framework that guides the data gathered. Karl Popper (1959) pointed out that it may not be possible to prove a hypothesis. The “all swans are white” hypothesis is a good example. He proposed the null hypothesis idea in which one attempts to disprove or falsify a hypothesis. “No non-white swans will ever be found” is falsifiable (Bradley, 1993). It is now widely believed that the hypothetico-deductive method is the basis of most scientific research, and work has also been conducted to establish the extent to which it is used in clinical reasoning.

Bradley (1993) divided the research into the hypothetico-deductive method as a foundation in clinical reasoning into two groups, research using think-aloud protocols with patients or simulated patients (e.g. Leaper, Gill, Staniland, Horrocks, & de Dombal, 1973; Elstein et al., 1978; Kassirer & Gorry, 1978; Barrows, Norman, Neufeld, & Feightner, 1982;), and that using case vignettes (e.g. Balla, 1982; Eddy & Clanton, 1982). There are weaknesses with both kinds of study, such as the artificial nature of the think-aloud protocols that tend to be used. However, Bradley (1993) claimed that a clear finding emerging from this research in general is that clinicians do generate hypotheses, and do so early. He pointed out a potential weakness of the hypothetico-deductive method, which is that the hypothesis being used may distort the information gathered and the way it is interpreted. Becoming fixed on a particular hypothesis may encourage premature closure of options. There is also research that shows people have a tendency to prefer positive findings and ignore negative findings in order to favour a chosen hypothesis (Gorry, Pauker, & Schwartz, 1978). The ability to assess information accurately may be one of the features that distinguishes experts from novices. However, the concept of hypothetico-deductive reasoning appears to be a robust element of the cognitive paradigm, and one which can be adopted in different paradigms that may be opposed to many of the assumptions of cognitivism.



## 2.10 Expert/Novice Research

A large part of the cognitive research into clinical reasoning has consisted of attempts to delineate differences between novices and experts, and is therefore sometimes called the contrastive method. Most of this research has been experimental. A problem-solving approach is generally used, in which cognitive processes are studied in tasks that attempt to represent medical thinking. Typically protocol analysis has been used, as in the work of Ericsson and Simon (1993), who asserted:

“ One of the most robust findings in the study of medical problems is experts’ use of forward-directed reasoning in solving routine problems in their own domain.” (p. 132)

Forward reasoning is supposed to occur when someone gathers data and, with the aid of a great deal of pattern recognition which invokes “if-then” production rules, eventually reaches a conclusion (Patel & Groen, 1986). Backward reasoning is supposed to occur when someone selects a hypothesis early and then proceeds to test it by gathering data that will confirm or refute it. This is believed to work well if the hypothesis is correct, but means that the problem-solver may need to start again if it becomes clear that the data being gathered is tending to refute the hypothesis. This view of expert/novice difference is widespread in the clinical reasoning literature (e.g. Ericsson & Charness, 1994; Patel & Groen, 1986). It began about 1980 when researchers claimed that these differences existed between experts and novices in physics (Larkin, McDermott, Simon, & Simon, 1980), although this research had its origins in earlier study of the solving of chess problems (Chase & Simon, 1973). The chess studies influenced the research of Elstein et al. (1978) into clinical reasoning, seeking the same phenomenon of forward and backward reasoning.

The finding that forward and backward reasoning distinguish experts and novices has now been extensively investigated and “confirmed” within medicine (Patel & Groen, 1986; Patel, Groen, & Arocha, 1990). The existence of backward and forward reasoning differences between novices and experts is now widely accepted as a given fact. However, the studies were experimental and can be criticised as being highly artificial. In general, they used written protocols with all the relevant information presented

simultaneously on a single page. They then asked individuals to read the case and verbalise or write down their thoughts. Analysis of these verbalisations produced the apparent distinction between forward and backward reasoning.

Variations on the research into novice/expert differences in reasoning have continued to recent times. For example, Norman and Schmidt (2000) also devised experiments to test forward and backward reasoning strategies among novices and experts. Their findings showed clearly that novices did better when using backward reasoning. This kind of finding has been used to provide a theory of what happens during problem-based learning, and this is why the hypothetico-deductive model is still an important theory in the teaching of clinical reasoning at the present time (Barrows & Feltovich, 1987; Elstein, Shulman, & Sprafka, 1990).

However, as Norman et al. (1999) have stated, the concept of forward reasoning by experts is problematic. What might in fact be occurring is:

“an epiphenomenon derived from the use of verbal case descriptions and written summaries, where the ambiguity of the original case presentation has been eliminated and the increased certainty of experts is reflected in summaries of reasoning that tend to be organized coherently and linearly from data to solution” (Norman et al., 1999, p. 446).

This observation emphasises a fundamental weakness in much cognitive research in medicine and other fields. The findings are based on laboratory studies in which people are asked to perform artificial tasks out of context. In other words, these findings may be a laboratory artefact. Lemieux and Bordage (1992) discussed the issue of research into forward versus backward clinical reasoning at length. They concluded that laboratory-based studies were far too limiting, and that the results were often more a reflection on the method of investigation than the actual reasoning of the clinician.

However, the hypothetico-deductive model is not the only one proposed for clinical reasoning. There is wide acceptance of the notion that experts use intuition and pattern recognition. Intuition and pattern recognition are not well understood. The cognitive continuum is a construct that some have used in an attempt to accommodate all these

different types of thinking within one model (Hamm, 1988). The proposal is that different modes of thinking are invoked under different circumstances. For example, Hammond et al. (1980) claimed that intuitive thinking is favoured when many cues are available. Dreyfus and Dreyfus (1986) argue that experience is crucial. An experienced clinician will resort to hypothetico-deductive thinking with an unfamiliar problem whereas novices must do this all the time until they acquire sufficient experience. Being on a cognitive continuum these modes of thinking do not need to be exclusive. The generation of a hypothesis may be intuitive and its subsequent testing can follow a more analytical path (Bradley, 1993). Other authors (Higgs et al., 2001) question the casual and pervasive use of the notion of intuition, regarding the use of advanced reasoning skills of experts to be a form of professional judgment and practice wisdom, grounded in deep experience-based knowledge, which is learned and is a highly refined form of reasoning ability; instead, intuition is seen as an important adjunct to reasoning.

Studies of forward and backward reasoning from a more interpretive perspective reveal a radically different picture from those based on cognitivism. For example, the research of Laufer and Glick (1996) raises serious doubts about the laboratory-based work on expertise. Their research comes from the emerging discipline of workplace studies, which has been strongly influenced by the cultural psychology of Vygotsky. They based their work on ethnographic observations and interviews of people in a real-world work situation, and painted quite a different picture from that usually provided in cognitive research. Their research concerned problem-solving in the workplace, which has much in common with clinical reasoning. For them the unit of analysis was the whole person engaged in a concrete type of activity or task, people engaged in real problem-solving in the real world. This approach

“allows for an examination of expert/novice differences in the development of structure and content of the activity. The unit of analysis must be relative to the domain and how it is investigated. Selecting the unit of analysis on the level of activity enabled the study of components that possess characteristics of the whole.” (Laufer & Glick, 1996, p. 189)

For example, it became clear that the experts they studied often employed backward reasoning, which cognitive psychology normally attributed to novices. It emerged that as

people became experts they changed their approach to problem-solving according to the circumstances. Context was an overwhelming factor in how problems were conceived and dealt with. Novices in the study simply followed the protocols provided which, in this setting, meant reasoning through a problem in a forward-directed manner. From an information-processing point of view, the work presented well-structured problems for novices, but for experts in the study the problems were construed as ill-structured. The information-processing view is that experts change ill-structured problems into well-structured ones. However, the ethnographic perspective showed that the experts had in fact transformed the problems entirely. Experts had much more complex personal agendas, in which several competing motives were combined. As the authors wrote:

“To be an expert one must participate in a particular work activity and transform it and in the process be transformed oneself” (Laufer & Glick, 1996, p. 196).

This study highlights a number of problems with the cognitive view of clinical reasoning. Schön (1987) pointed out that much real world problem-solving, which would include clinical reasoning, is poorly conceptualised within the cognitive model. Cognitivism ignores context and assumes that cognition is essentially an individual phenomenon. In the real world it seems clinicians make heavy use of contextual factors.

## **2.11 Situated Cognition**

Contextual factors play a significant role within more situated theories of cognition (Lave & Wenger, 1991; Chaiklin & Lave, 1996; Engeström & Middleton, 1996; Wenger, 1998; Engeström, Punamäki, & Miettinen, 1999). These theories reflect the growing influence of Vygotsky on theories of cognition, and have a richer conceptualisation of the ways in which context can play a role in cognition. For example, Engeström (1995) used a Vygotskian approach, cultural historical activity theory, to study medical expertise in clinical consultations with real patients, using a combination of videotapes, audiotapes and interviews. Engeström emphasised a number of elements in these situations, including the orientation of the clinicians and patients to what he describes as objects of cognition (such as the diagnosis), the role of contradictions in cognition, and the importance of collaboration between the people involved. He accepted that patients share

in the clinical reasoning that is occurring. This view contrasts with the highly individualised vision of clinical reasoning and cognition in mainstream cognitivism.

Engeström (1995) pointed out that the way medical work is construed has deep cultural roots in the historical evolution of its practice. For example, his study showed that emergency cases were restricted to the management of an immediate presenting problem, even if it was clear that the patient had a number of complex, interacting problems. Engeström described how doctors sometimes used a *linearisation* strategy, moving forward toward a solution, and, in some cases, actively excluding difficult possibilities that seemed awkward to tackle immediately. He also described a *lateralisation* strategy. For example, the doctor might explore potential connections between the acute biomedical complaint and other problems (psychological or social) the patient might have which could have some bearing on the clinical decision making that needs to be done. The role of contradictions in these cases related to how the participants in a situation dealt with difficulties as they arose. For example, a doctor may have begun dealing with a patient as a complex, biopsychosocial whole. However, this scenario required the patient's collaboration. If the patient insisted on presenting him/herself as a simple example of a somatic biomedical disease then a contradiction emerged which had to be negotiated and resolved in a collaborative fashion. Engeström concluded that these instances of clinical reasoning were

“in constant imbalance and development. Actions shape the development and are shaped by it. Development takes place as emergence and resolution of internal contradictions in the activity system. The influence of such systemic contradictions on medical reasoning has been neglected by traditional cognitivist approaches” (Engeström, 1995 p. 411).

There have been attempts to reconcile the more individual cognitive approach to clinical reasoning with situated cognition. Patel et al. (1996) acknowledged that cognition is shaped to some extent by the social context and artefacts in the environment. They dismissed the activity theory approach as underestimating the role of the individual. Presumably they did this in order to maintain continuity with their “symbolic information processing theory”. However, they further stated that their study focused on team cognition rather than the individual. They admitted that the study of cognition in

naturalistic settings was new and complex and could require the development of novel methods. They also acknowledged the need to make the research problem tractable by selecting a few relevant factors to study, at the same time trying to capture the environment in its entirety.

Patel et al. (1996) also pointed out that the majority of expertise research had focused too narrowly on the automatising of skill. Rasmussen (1993) identified three levels of cognitive control: skill-based, rule-based, and knowledge-based behaviour. These bear a close resemblance to the cultural historical activity theory constructs of operations, actions and activity. Skill-based behaviour involves knowledge that has become automatised into an automatic operation that can be performed almost without thinking. Rule-based behaviour is involved in conscious actions that can utilise automatic operations. Knowledge-based behaviour is equivalent to an overall goal (the activity) one wishes to achieve. The original example given by Leont'ev (1978), a colleague of Vygotsky, was that of a hunter in a group. The hunter's overall activity is to catch game. His conscious action is to chase the prey noisily towards other hunters lying in wait, and to do this he uses automatic skills, such as running. A health care equivalent might be the overall activity of improving the health of a patient. In order to improve a patient's health a clinician will make conscious actions in pursuing a diagnosis that can, in turn, utilise automatic skills in observing the patient. It seems that in an attempt to capture cognition in teams and in the workplace, terms and concepts remarkably similar to those used in cultural psychology are being adopted by cognitive psychologists.

Cognitive scientists sought to resolve many of the problems that became apparent with behaviourism. Unfortunately, there is much that is problematic with the cognitive science approach. The cognitive sciences are based on the assumption that the human mind works by representation and computation, is a symbol manipulation system, and that thought is essentially a private "in-the-head" phenomenon. These are empirical conjectures. This position was expressed most explicitly by Pylyshyn (1984, p. xii): "... my proposal amounts to a claim that cognition *is* a type of computation". However, even in 1980 researchers within the field itself realised that there were problems with this approach. Norman (1980, p. 2) wrote:

“The problem seemed to be in the lack of consideration of other aspects of human behaviour, of interaction with other people and with the environment, of the influence of the history of the person, or even the culture, and of the lack of consideration of the special problems and issues confronting an animate organism that must survive as both an individual and as a species.”

Much of this critique remains unanswered by cognitive psychologists. In other fields, such as human–computer interaction, the cognitive approach has increasingly been considered unsatisfactory as a theoretical basis for research and development, and there is a move to adopt more sociocultural approaches (e.g. Bannon, 1990; Lave & Wenger, 1991). Problems with the cognitive approach also include the neglect of emotions, consciousness and physical environments. For example, humans undertake procedures like mathematical calculations differently from computers, and the way they do them will vary depending on the circumstances.

A sociocultural view is that human thought is inherently social, in ways that cognitive science ignores. Some writers, such as Thagard (1996) and Patel et al. (1996) have maintained that the computational-representational approach needs to be expanded and supplemented, although they have not clarified how this might be done. Cognitivism has an essentially individualistic view that expertise in skills like clinical reasoning is a collection of behaviours and thoughts which are unique personal constructions. This directly contrasts with the sociocultural view that expertise is fundamentally best viewed as a social phenomenon. From this perspective expertise would, in large part, be selective assimilations of prevalent social practices and values (Ratner, 2000).

A sociocultural critique of the cognitivist approach can, in fact, go much further than this. Social structures, it is claimed, develop a person’s psychology by imposing rules of behaviour, benefits and punishments. Cognitive psychology tends to attribute behaviour to personal dispositions rather than situational influences. This has been described as the “fundamental attribution error” (Norenzayan & Nisbett, 2000). A number of authors (Flick, 1998; Hacking, 1999; Ratner, 2000) have argued that social reality is not reducible to the individual meanings and symbols so important in cognitive psychology.

In a sociocultural view, meanings are inspired and constrained by socially organised activities. These meanings are collective, emergent representations that are shared by members of a culture.

An even more extreme sociocultural view is present in the literature, in which the approach and findings of cognitive psychology are more severely criticised. Ratner (2000) pointed out what he saw as the fundamental weakness of “individualistic psychology” or personalism. To him, the divide between individualistic cognitive psychology and a sociocultural view is almost unbridgeable. This point of view, that an individualistic interpretation of cognition is misleading, was expressed even more forcibly by Bourdieu (2000, p. 132):

“ Personalism is the main obstacle to the construction of a scientific vision of the human being.”

Bourdieu went even further, claiming that “individualistic” psychologists

“are not only ignorant of social constraints on individual behaviour; they are also unaware of their ignorance of the social basis of behaviour; and they are unaware that their ignorance has a social basis. The individualistic view is a product of modern society.” (Bourdieu, 2000, p. 15)

The argument continues that there can be no compromise between the two viewpoints. However, this seems an extreme position, and means denying all the insights that cognitivism has provided. As we saw with behaviourism, its limitations mean that it has largely been abandoned, but behaviourism has left us with a legacy of ideas that are still seen as important in medical education. A critical approach should be able to discern the difference between insights that are genuinely useful and those that are restricted to the philosophical assumptions of a particular field. For example, some of the insights of cognitivism, such as the use of the hypothetic-deductive method in clinical reasoning, seem to be robust findings, whereas the purported cognitive structures such as schemas and scripts, etc. are more questionable as comprehensive explanations.



The debate between the individual and the social is echoed in education. There is a current trend in education to adopt a more social or “situative” perspective in learning. According to Sfard (1998), the situative approach is based on a participation metaphor, in which knowledge is seen as constructed by people when participating in a learning community, whereas the cognitive approach to learning is based on an acquisition metaphor, in which knowledge is considered simply to be acquired by individuals. There is currently vigorous debate as to the various merits of these two perspectives. The debate is important because the metaphors we use profoundly affect the way we envisage what is significant in education, and how education should be conducted and organised. As Sfard (1998) and Anderson et al. (2000) have pointed out, these two approaches may inform each other, and accepting insights from both may serve as a means of obtaining a balanced approach to educational practice. Their argument is that because learning is a complex phenomenon, education needs a healthy mixture of the two theories. Salomon and Perkins (1998) discussed this issue at length. They argued the case that the cognitive “acquisition-oriented” and the “situative, participatory” conceptions represent two levels of analysis, in much the same way that cell biology and epidemiology provide two different but valid perspectives on a viral flu epidemic.

Of relevance to this debate is the work of Rogoff (1994), who showed that peers working together to solve a problem usually aim simply to accomplish a task, whereas an expert tutor will attempt to encourage explicit articulation of critical planning and decision making. The social mediation here is important because it encourages this active participation at a deeper level. Learners are transforming their understanding and problem-solving skills at a deep level through active construction. According to Resnick and Omanson (1991) this is why social learning and constructivism have become close allies.

The sociocultural approach to learning assumes that knowledge is jointly constructed. Knowledge, understandings and meanings gradually emerge through interaction and become distributed among those interacting (Pea, 1993). As Greeno (1997) pointed out, this knowledge is also intimately connected to the context and activity in which, and by means of which, knowledge is constructed.

Salomon and Perkins (1998) explored ways in which individual and social views of learning might be related. They proposed that although all individual learning is social in some sense, the degree of active social mediation may vary from one situation to another. Thus learning is both individual and social. Individuals need to exercise some autoregulative functions, even in the most social of learning situations.

Other authors have also pointed out the importance of learners choosing to engage actively in deeper learning and metacognition (Bereiter, 1997; Bereiter & Scardamalia, 1989) and that it is overly simplistic to assume that knowledge construction is all unidirectional, from the collective to the individual (Damon, 1991). Salomon and Perkins (1998) contended that, over time, the individual and social aspects of learning can interact to strengthen one another, in what they described as a “reciprocal spiral relationship”, using the analogy of the individuals in a sports team. Many problem-based learning curricula fit this model. Cases are presented over time (sometimes years) which increase in complexity and are aimed at facilitating deep learning (i.e. learning that is intentional and conceptually oriented) as opposed to shallow learning (i.e. learning that involves routine practice and is oriented towards automaticity) (Salomon & Perkins, 1998).

The debate continues. The more conciliatory voices argue that the individual and social or situated perspectives are different aspects of the same phenomenon, in the same way that chemistry and physics present different but complementary accounts of matter. Anderson et al. (2000) and Sfard (1998) have argued for a middle course in which both cognitive and situative approaches can be used to shed light on the educational process. They used the arguments of Kuhn (1996) and Rorty (1979) to support contentions that the two approaches may overlap but cannot be mixed. However, Kuhn also pointed out that in a time of paradigm shift there is a period in which theorists might attempt to hold both approaches. Kuhn claimed that eventually the new theory becomes dominant and the old one is subsumed within it or simply discarded. The nature of the debate suggests that we may be in such a time of paradigm shift. It remains to be seen what the eventual outcome of the debate will be.

An example of such thinking is Kaptelinin (1994), who suggests that an approach based on Vygotskian sociocultural ideas does not necessitate rejecting the findings of cognitive sciences, but that those findings might fit within a broader sociocultural theory. They are

the workings of cognition as measured in the context of a research laboratory. There is a need for further empirical research to explore real-world learning and to move our understanding forward.

My interpretation of this situation is that we are probably in a time of Kuhnian paradigm shift. Some findings of cognitivism, such as the use of hypothetico-deductive reasoning with unfamiliar cases, will be subsumed by the newer sociocultural approaches. However, there are fundamental conceptual differences between the sociocultural and the cognitivist approaches which make a marriage between the two problematic.

For example, Vygotsky advocated a dialectical approach to the study of human activity and psychology. This is in contrast to the approach of cognitive scientists who assume we can divide the world up into systems of discrete variables and subvariables that can be mathematically manipulated and correlated, in order to discover underlying laws that govern them. A dialectical approach takes the view that an idea (a thesis) needs to be compared with an opposing idea (an antithesis) until a resolution (a synthesis) is achieved. The resolution is more than the sum of its parts and is qualitatively different from them. From a Vygotskian perspective, dialectical pairs can be thought/language, social/individual, biological/cultural, and immediate experience/mediated memory. The dialectical approach seeks to identify the tension in the relationships between these things, and to construe them as the unity of diverse processes rather than as distinct unities or discrete variables. In a dialectical view, psychological phenomena interpenetrate each other and are internally related rather than discrete (Ratner, 1991). The implication is that higher mental processes such as clinical reasoning are not the sum of the lower level mental processes they begin with. Clinical reasoning ability may begin with everyday thinking and problem-solving skills, but as it develops it becomes transformed and qualitatively different, and should be recognised as an increasingly complex phenomenon comprising interrelated dimensions including dialectical goals (patient/clinician, health promotion/remediation) and dialectical processes (helping/letting go, listening/educating, evaluating/advising). Edwards (2001) identified dialectics in the clinical reasoning of the physiotherapists in his study. This study utilised a qualitative approach and conceptualised dialectical pairs, such as biomedical knowledge of a disorder and the lived experience of it. The individual and social aspects of learning clinical reasoning were seen as another dialectical pair. In a dialectical view, attempts to

characterise clinical reasoning by methods such as high level statistical modelling between sets of variables, as advocated by Norman and Schmidt (2000), would be entirely inappropriate.

The aim of this project is to undertake a descriptive philosophical approach to clinical reasoning research in an attempt to clarify the phenomenon as part of ongoing endeavours to resolve these issues.