

In recent years, dual process theory (DPT) from cognitive psychology has been applied to investigate diagnostic errors in practice (1). In this paper, we shall investigate the relevance of this approach in learning about diagnostic errors.

DPT has been developed from study of day to day reasoning of human beings (2). It divides all everyday reasoning into System 1 and System 2. System 1 reasoning is fast, intuitive, effortless and prone to errors due to heuristics and biases while System 2 reasoning is slow, deliberate, requiring effort and less prone to errors.

It has been estimated most reasoning is System 1, in one account 95 percent of all reasoning is System 1 (3).

It has been claimed System 1 reasoning is a major cause of diagnostic errors (4). It appears to be assumed in making this claim that diagnostic reasoning in practice is mostly System 1 reasoning.

We shall now examine the process of diagnosis in practice to see if the assumption of diagnostic reasoning being System 1 reasoning is correct.

Let us suppose a 65 year old man presents to us with highly characteristic chest pain.

If diagnostic reasoning was System 1 reasoning, we would infer (diagnose) acute myocardial infarction (MI) directly from the presentation due to the heuristic of representativeness as this patient resembles a typical patient with acute MI.

But diagnosis in this manner is never made in practice in this (or in any other) patient in this manner as far we know.

In practice, the method of diagnosis in practice actually consists of first suspecting acute MI from the presentation in this patient due to the heuristic of resemblance.

We then evaluate the suspected acute MI by performing a test, an EKG.

If we observe acute ST elevation EKG changes, we consider this test result to be strong evidence from which we infer acute MI in this patient.

Thus diagnosis in practice in this (and in any other) patient is done by a two step method which we shall call the 'suspect and test' method.

This method is employed in practice due to its very high diagnostic accuracy. The overall diagnostic accuracy of this method in practice is 85 to 90 percent (5).

We note System 1 reasoning plays no role in the 'suspect and test' method of diagnosis.

This method is identical, as we have discussed elsewhere, to the scientific method (6), which is known to be the most reliable and accurate method of investigation in any field.

Thus the method employed by Richard Feynman, the Nobel Prize awarded physicist, in investigating the cause of explosion of space capsule Challenger in 1986 (6) is no different than the method employed by us in investigating the cause of illness in a patient during diagnosis.

The scientific method was invented in the 17th century to eliminate errors, which are present in day to day reasoning due to cognitive biases, and gain accurate knowledge in an investigation (7). Many of the cognitive biases known to us today were known to Sir Francis Bacon, one of the founders of the scientific method, who called them ' Idols of the Mind' (8). His description with an example of confirmation bias (9) (Appendix) rivals any modern description of this bias.

The decisive step in developing the scientific method was taken by Galileo in his studies on motion, when he made experiment the final and only judge of correctness of an explanation (10) An experiment is an interrogation of Nature which forces it to give an answer about an explanation (8).

The scientific method has been adopted as a method of investigation in many fields including diagnosis in medicine.

A test is to diagnosis what an experiment is to science, it is a procedure to evaluate if a suspected disease is present or not. With a test, we interrogate a

patient, so to speak, forcing him or her to give an answer in the form of a test result about a suspected disease.

We note that testing is central to diagnosis. Thus performing an EKG is essential in diagnosing acute MI, a chest CT angiogram in diagnosing pulmonary embolism, venous ultrasound study in diagnosing deep vein thrombosis, checking TSH level in diagnosing hypothyroidism and so on.

A test in diagnosis is usually a laboratory, imaging or biopsy study, but it may be, looking for a sign or asking a question. Thus in a patient presenting with unilateral back pain, in whom we suspect herpes zoster, we look for unilateral, blistering skin lesions. And in a patient in whom we suspect leptospirosis, we would ask if he is a sewer worker.

In DPT based on everyday reasoning , the concept of testing is totally lacking. With this reasoning, we infer from what we see or hear based on association and make no attempt to investigate the cause of what we see or hear.

Diagnostic reasoning on the other hand is all about investigation of a disease causing illness in a patient with symptoms. This goal is only achieved by employing the scientific method in practice as we have discussed above.

Therefore, we believe, DPT with its System 1 and System 2 reasoning may not be relevant in studying diagnostic errors in practice as it is derived from study of day to day thinking while diagnostic reasoning is scientific.

What would be relevant, we suggest, would be to review literature about scientific reasoning and learn what causes us to come up with fruitful hypotheses and how are these hypotheses evaluated by experiments (tests) in a scientific investigation. We could then apply these lessons to investigate diagnostic errors in practice.

Appendix

The human understanding when it has once adopted an opinion (either as being the received opinion or as being agreeable to itself) draws all things else to support and to agree with it. And though there be a greater number and weight of instances to be found on the other side, yet these it either neglects and despises, or else by some distinction sets aside and rejects, in order that by this great and pernicious predetermination the authority of its former conclusions remain inviolate. And therefore it was a good answer that was made by one who, when they showed him hanging in a temple a picture of those who had paid their vows as having escaped shipwreck, and would have him say whether he did not now acknowledge the power of the gods-“ Aye “ asked he again, “ but where are they painted that were drowned after their vows ?” And such is the way of all superstition, whether in astrology, dreams, omens, divine judgments, or the like; wherein men, having a delight in such vanities, mark the events where they are fulfilled, but where they fail, though this happen much oftener, neglect and pass them by. But with far more subtlety does this mischief insinuate itself into philosophy and the sciences; in which the first conclusion colors and brings into conformity with itself all that come after, though far sounder and better. Besides, independently of that delight and vanity which I have described, it is the peculiar and perpetual error of the human intellect to be more moved and excited by affirmatives than by negatives; whereas it ought properly to hold itself indifferently toward both alike. Indeed, in the establishment of any true axiom, the negative instance is the more forcible of the two.

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