

Out of Observation, Intuition and Deduction, Which Could We Do Without and Still Be Able to Continue to Practise Modern Science?

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The quest for knowledge and the desire to understand the world around us are behind all our discoveries and advancements. In modern times, we have developed a set of systematic procedures to be adopted in scientific discovery so that we can be reasonably confident of our knowledge base. This type of inquiry is often termed “modern science”. Modern science is defined as acquiring knowledge based on the hypothetico-deductive method, whereby a hypothesis is formed based on current knowledge of the topic and predictions are deduced from the hypothesis. The predictions are then tested experimentally. If the results of the experiments differ from the predictions made, the hypothesis is falsified and a new hypothesis that incorporates the new data must be made. If the experimental data corroborates with the predictions, the hypothesis is assumed to be correct until proven otherwise. Moreover, the spirit of modern science requires the scientists to be skeptical and willing to constantly challenge established “laws” and “theories”. Observation, intuition and deduction are three important skills associated

with modern science. In this essay I will argue that we cannot practise modern science if we are unable to make either observations or deductions but that we can do without intuition.

Observation encompasses all sensory input from the world around us, similar to what Plato (Lindberg 13) and Aristotle (Groarke) would consider as sense experience. The hypothetico-deductive method requires us to form a hypothesis to be subject to experimentation. To make a meaningful hypothesis however, we must have some prior knowledge on the subject, otherwise we cannot even begin to form the hypothesis. For example, if from birth a person cannot see, hear, touch, smell, or taste, he will know nothing at all. Although the other skills of intuition and deduction required in modern science are innate in the person, he is unable to apply these skills because the collection of facts through observation is absent. In other words, he cannot even conduct thought experiments since he has no observable facts to start with.

In *The Beginnings of Western Science*, Lindberg mentions that Aristotle believed that “acquiring knowledge begins with sense experience” (20) and although Plato was generally dubious about the role sense experience could play in enabling us to reach the truth, he did not completely dismiss it. Lindberg summarised the three uses Plato saw for sense experience, or observation: it could serve as recreation; to remind the soul about what it has seen previously in the world of forms; and the soul could potentially arrive at certain objects in the world of forms by just observing geometrical objects in the corporeal realm (14). Thus, even Plato realised that we could not hope to arrive at the truth without any observation whatsoever. Hence, observation and the collection of facts are the first steps in modern science. We can argue that without observation, humans cannot practise modern science and so intuition+deduction on their own would not work.

Can modern science be practised using observation+intuition only? Intuition is defined as the ability to arrive at an idea or solution without any conscious effort. Socrates is supposed to have said that “an unexamined life is not worth living” (Longstaff). A life of observation and intuition without deduction seems to be such a life. It is more akin to the life of an animal than that of scientific inquiry. The best a squirrel can do is to remember that there is a food scarcity during the winter months by recalling past experiences and adapting their behavior by storing food in the summer or eating more to fatten up for the winter (Hunt). It is merely reacting to a phenomenon, and not trying to figure out what causes the seasons. Like most other animals, we are able to practise observation and intuition. What sets us apart is that we are equipped with sophisticated deductive skills, and this is the reason why we are able to practise modern science whilst other animals are unable to.

The Birth of a New Physics discusses the approach of various scientists in explaining observed elliptical orbits of planets around the sun. The intuition that the force of attraction of planets towards the sun is reciprocal to the square of the distance from it (Cohen 51) does not automatically corroborate with the observational data that the orbits of planets are elliptical. Intuition without subsequent deduction is of no more value than guess work. For example, Kepler’s (wrong) intuition that the sun’s anima motrix kept the planets in circular revolutions and that magnetic interactions squeezed those revolutions into elliptical orbits (Cohen 50) can neither be proven right nor wrong without deduction. As for Newton’s Laws of Motion, which are arguably intuitions, it was Newton himself who finally provided the mathematical proof, which is a deductive process, for elliptical orbits. This is a clear example that modern science cannot be practised with observation and intuition alone.

Now let us consider whether modern science can be practised using only observation+deduction. Deduction is the employment of logical reasoning to arrive at a conclusion (Sternburg and Mio). Deduction is an integral part of the hypothetico-deductive method, as we must deduce certain predictions that would occur based on our hypothesis to be tested.

Of course, intuition is a very useful trait. The discovery of benzene by German chemist Kekulé was said to be a result of intuition. It is said that he had a dream of a snake biting its own tail, and upon waking up he had an intuitive feeling that the structure of benzene could be cyclic (Roberts 75).

Whilst this example highlights the role that intuition plays in discoveries, the very same discovery could have been made without intuition. Since there are a finite number of configurations for 6 carbon and 6 hydrogen atoms (since benzene is C_6H_6), the structure could also be derived by sketching every single possible structure and eliminating all but the correct one experimentally. Such a trial and error method could be time consuming and less efficient, but we can arrive at the same correct conclusion nonetheless.

In *Science and Method*, Poincaré talks about how he found classes of Fuchsian functions intuitively during one sleepless night (171). Though he thought highly of intuition, the fact is he could have arranged for a hundred “lesser” mathematicians to perform combinations systematically to arrive at the same result. Today, supercomputers do exactly those kinds of number crunching work on complex problems. The supercomputer can be thought of as mimicking intuition by processing many ideas, and filtering out all but the best ones to be evaluated by the conscious human mind.

Moreover, there are situations in which intuition is not even required.

DNA: The Secrets of Life chronicles the events leading up to the discovery of the double-helix structure of DNA. Instead of attributing the discovery to one big leap in understanding owing to intuition, the discovery was a result of piecing several facts together; namely that DNA was made of four bases and that the X-ray pattern suggested a helix structure (Watson 130). The double helix structure was arrived at primarily through deduction and a degree of trial and error. The same could be said about other famous discoveries. For instance, Thomas Edison's invention of the light bulb was a result of testing thousands of different materials to find a suitable filament (Bedi) rather than intuitively figuring out that carbonized thread was the "right" material ("Thomas").

If modern scientific breakthroughs occur due to sudden great intuitive insights, then arguably people would not make the same discoveries around the same time. For instance, Newton and Leibniz invented calculus independently (Cohen 49); Darwin and Wallace arrived at the ideas of evolution and natural selection independently, although Darwin is often solely credited for the discovery (Wyhe).

In short, intuition in modern science is analogous to a catalyst in a chemical reaction. Intuition is a catalyst that merely speeds up the process, but modern science can still be practised without it, albeit with advancements occurring at a slower rate. The three skills of observation, intuition and deduction all play important roles in the process of modern science. However, intuition is not essential unlike observation and deduction, without which we could not hope to practise modern science.

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Teacher’s comment:

Human knowledge of Nature is usually the result of processes that
involve observation, intuition, and deduction. These are employed to
various degrees and with different roles depending mainly on what type

of knowledge is considered more valuable and trustworthy. It is easy to recognize the debate on the role of such three human abilities throughout the whole history of philosophy. Cheung Tak Yiu addresses the problem for that particular approach known as “modern science” and asks whether the three abilities are all strictly necessary.

The first noteworthy aspect of the essay is that modern science is identified by its method, not by its theories or applied consequences. In this, Tak Yiu seems to echo Thomas Huxley’s conviction that “the scientific spirit is of more value than its products”. He shows that at the heart of modern science there is empirical truth as the chief criterion for the validity of a theory and that this requires an attitude of continuous questioning and testing of the hypotheses.

The essay clearly explains that, besides observation which is automatically required by his operational but meaningful definition of modern science, deduction becomes necessary in order to produce testable predictions from often abstract hypotheses. On the other hand, intuition is shown to be extremely important, but not strictly necessary to carry on the study of Nature according to the requirements of modern science. Tak Yiu explains the non-necessary role of intuition in a remarkably comprehensive manner and in doing so he also shows the value of such a human ability in enormously accelerating the production of meaningful hypotheses and theories, by working not only on the empirical data, but also on the material of human imagination. (Klaus Colanero)