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Reasoning by deduction

Gleaned from the stories of Sherlock Holmes written by Sir Arthur Conan Doyle are these quotes from Mr. Sherlock Holmes regarding his techniques and methods for solving mysteries and crimes using deductive reasoning. Simply Stated - Deduction is Reasoning Backwards "In solving a problem of this sort, the grand thing is to be able to reason backwards. That is a very useful accomplishment, and a very easy one, but people do not practise it much. In the every-day affairs of life it is more useful to reason forwards, and so the other comes to be neglected. There are fifty who can reason synthetically for one who can reason analytically...Let me see if I can make it clearer. Most people, if you describe a train of events to them, will tell you what the result would be. They can put those events together in their minds, and argue from them that something will come to pass. There are few people, however, who, if you told them a result, would be able to evolve from their own inner consciousness what the steps were which led up to that result. This power is what I mean when I talk of reasoning backwards, or analytically." Sherlock Holmes Quote -A Study in Scarlet -Chapter 7 - Conclusion Do Not Theorize Before Gathering Data "It is a capital mistake to theorize before you have all the evidence. It biases the judgment." Sherlock Holmes Quote -A Study in Scarlet "It is a capital mistake to theorize before one has data. Insensibly one begins to twist facts to suit theories, instead of theories to suit facts," Sherlock Holmes Quote -A Scandal in Bohemia "Still, it is an error to argue in front of your data. You can find yourself insensibly twisting them round to suit your theories." Sherlock Holmes Quote -The Adventure of Wisteria Lodge Suggested by: Bill Saunders "Let me run over the principal steps. We approached the case, you remember, with an absolutely blank mind, which is always an advantage. We had formed no theories. We were simply there to observe and to draw inferences from our observations." Sherlock Holmes Quote -The Adventure of the Cardboard Box Do Not Reason From Insufficient Data "Data! Data! Data!" he cried impatiently. "I can't make bricks without clay." Sherlock Holmes Quote -The Adventure of the Copper Beeches "I had," he said, "come to an entirely erroneous conclusion, my dear Watson, how dangerous it always is to reason from insufficient data." Sherlock Holmes Quote -The Adventure of the Speckled Band Data "There is nothing like first-hand evidence." Sherlock Holmes Quote -A Study in Scarlet Notice Trifles "You know my method. It is founded upon the observation of trifles." Sherlock Holmes Quote -The Bascombe Valley Mystery "They say that genius is an infinite capacity for taking pains," he remarked with a smile. "It's a very bad definition, but it does apply to detective work." Sherlock Holmes Quote -A Study in Scarlet "It has long been an axiom of mine that the little things are infinitely the most important." Sherlock Holmes Quote -A Case of Identity Obvious Facts Can be Deceptive "There is nothing more deceptive than an obvious fact." Sherlock Holmes Quote -The Bascombe Valley Mystery Don't Just See, Observe! "The world is full of obvious things which nobody by any chance ever observes." Sherlock Holmes Quote -The Hound of the Baskervilles Chapter 3: "The Problem 'You see, but you do not observe. The distinction is clear.' Sherlock Holmes Quote -A Scandal in Bohemia Avoid Emotion "Detection is, or ought to be, an exact science, and should be treated in the same cold and unemotional manner." Sherlock Holmes Quote -The Sign of Four "The emotional qualities are antagonistic to clear reasoning." Sherlock Holmes Quote -The Sign of Four Recognize Vital Facts "It is of the highest importance in the art of detection to be able to recognize, out of a number of facts, which are incidental and which vital. Otherwise your energy and attention must be dissipated instead of being concentrated." Sherlock Holmes Quote -The Reigate Puzzle Eliminate the Impossible and What Remains Is Truth "Eliminate all other factors, and the one which remains must be the truth." Sherlock Holmes Quote -The Sign of Four Chapter 1: "The Science of Deduction" "How often have I said to you that when you have eliminated the impossible, whatever remains, however improbable, must be the truth?" Sherlock Holmes Quote -The Sign of Four "...when you have eliminated all which is impossible, then whatever remains, however improbable, must be the truth." Sherlock Holmes Quote -The Blanched Soldier — "It is an old maxim of mine that when you have excluded the impossible, whatever remains, however improbable, must be the truth." Sherlock Holmes Quote -The Beryl Coronet Additional Notes "Nothing clears up a case so much as stating it to another person." Sherlock Holmes Quote -Silver Blaze — "I have already explained to you that what is out of the common is usually a guide rather" than a hindrance." Sherlock Holmes Quote -A Study in Scarlet -Chapter 7 - Conclusion — "'The more outre' and grotesque an incident is the more carefully it deserves to be examined, and the very point which appears to complicate a case is, when duly considered and scientifically handled, the one which is most likely to elucidate it." Sherlock Holmes -The Hound of the Baskervilles Chapter 15 - "A Retrospection" — "Any truth is better than indefinite doubt." Sherlock Holmes Quote -The Yellow Face — "I never guess. It is a shocking habit — destructive to the logical faculty" Sherlock Holmes Quote -The Sign of Four Sherlock Holmes Expounds on Logic, Inference and Deduction Then I [Dr. Watson] picked up a magazine from the table and attempted to while away the time with it, while my companion munched silently at his toast. One of the articles had a pencil mark at the heading, and I naturally began to run my eye through it. Its somewhat ambitious title was "The Book of Life," and it attempted to show how much an observant man might learn by an accurate and systematic examination of all that came in his way. It struck me as being a remarkable mixture of shrewdness and of absurdity. The reasoning was close and intense, but the deductions appeared to me to be far-fetched and exaggerated. The writer claimed by a momentary expression, a twitch of a muscle or a glance of an eye, to fathom a man's inmost thoughts. Deceit, according to him, was an impossibility in the case of one trained to observation and analysis. His conclusions were as infallible as so many propositions of Euclid. So startling would his results appear to the uninitiated that until they learned the processes by which he had arrived at them they might well consider him as a necromancer. "From a drop of water," said the writer, "a logician could infer the possibility of an Atlantic or a Niagara without having seen or heard of one or the other. So all life is a great chain, the nature of which is known whenever we are shown a single link of it. Like all other arts, the Science of Deduction and Analysis is one which can only be acquired by long and patient study nor is life long enough to allow any mortal to attain the highest possible perfection in it. Before turning to those moral and mental aspects of the matter which present the greatest difficulties, let the enquirer begin by mastering more elementary problems. Let him, on meeting a fellow-mortal, learn at a glance to distinguish the history of the man, and the trade or profession to which he belongs. Puerile as such an exercise may seem, it sharpens the faculties of observation, and teaches one where to look and what to look for. By a man's finger nails, by his coat-sleeve, by his boot, by his trouser knees, by the callusities of his forefinger and thumb, by his expression, by his shirt cuffs—by each of these things a man's calling is plainly revealed. That all united should fail to enlighten the competent enquirer in any case is almost inconceivable." "What ineffable twaddle!" I cried, slapping the magazine down on the table, "I never read such rubbish in my life." "What is it?" asked Sherlock Holmes. "Why, this article," I said, pointing at it with my egg spoon as I sat down to my breakfast. "I see that you have read it since you have marked it. I don't deny that it is smartly written. It irritates me though. It is evidently the theory of some arm-chair loungier who evolves all these neat little paradoxes in the seclusion of his own study. It is not practical. I should like to see him clapped down in a third class carriage on the Underground, and asked to give the trades of all his fellow-travellers. I would lay a thousand to one against him." "You would lose your money," Sherlock Holmes remarked calmly. "As for the article I wrote it myself." "You!" "Yes, I have a turn both for observation and for deduction. The theories which I have expressed there, and which appear to you to be so chimerical are really extremely practical—so practical that I depend upon them for my bread and cheese." "And how?" I asked involuntarily. "Well, I have a trade of my own. I suppose I am the only one in the world. I'm a consulting detective, if you can understand what that is. Here in London we have lots of Government detectives and lots of private ones. When these fellows are at fault they come to me, and I manage to put them on the right scent. They lay all the evidence before me, and I am generally able, by the help of my knowledge of the history of crime, to set them straight. There is a strong family resemblance about misdeeds, and if you have all the details of a thousand at your finger ends, it is odd if you can't unravel the thousand and first. Sherlock Holmes Quote -The Sign of Four Chapter 2 - "The Science of Deduction" All quotes on this web site were written by Sir Arthur Conan Doyle unless otherwise stated. In logic, we often refer to the two broad methods of reasoning as the deductive and inductive approaches.Deductive reasoning works from the more general to the more specific. Sometimes this is informally called a "top-down" approach. We might begin with thinking up a theory about our topic of interest. We then narrow that down into more specific hypotheses that we can test. We narrow down even further when we collect observations to address the hypotheses. This ultimately leads us to be able to test the hypotheses with specific data - a confirmation (or not) of our original theories.Inductive reasoning works the other way, moving from specific observations to broader generalizations and theories. Informally, we sometimes call this a "bottom up" approach (please note that it's "bottom up" and not "bottoms up" which is the kind of thing the bartender says to customers when he's trying to close for the night!). In inductive reasoning, we begin with specific observations and measures, begin to detect patterns and regularities, formulate some tentative hypotheses that we can explore, and finally end up developing some general conclusions or theories.These two methods of reasoning have a very different "feel" to them when you're conducting research. Inductive reasoning, by its very nature, is more open-ended and exploratory, especially at the beginning. Deductive reasoning is more narrow in nature and is concerned with testing or confirming hypotheses. Even though a particular study may look like it's purely deductive (e.g., an experiment designed to test the hypothesized effects of some treatment on some outcome), most social research involves both inductive and deductive reasoning processes at some time in the project. In fact, it doesn't take a rocket scientist to see that we could assemble the two graphs above into a single circular one that continually cycles from theories down to observations and back up again to theories. Even in the most constrained experiment, the researchers may observe patterns in the data that lead them to develop new theories. Most everyone who thinks about how to solve problems in a formal way has run across the concepts of deductive and inductive reasoning. Both deduction and induction help us navigate real-world problems, such as who committed a crime, the most likely cause of an accident, or how many planets might contain life in the Milky Way galaxy.But while they're both practical tools for practical problems, but they approach problem-solving in opposite ways.Both deduction and induction are a type of inference, which means reaching a conclusion based on evidence and reasoning.Deduction moves from idea to observation, while induction moves from observation to idea.Deduction is idea-first, followed by observations and a conclusion. Induction is observation first, followed by an idea that could explain what's been seen.The other big difference is that deduction's conclusions are bulletproof assuming you don't make a mistake along the way. The conclusion is always true as long as the premises are true. With induction you don't get absolute certainty: the quality of the idea or model or theory depends on the quality of the observations and analysis.ExamplesAll men are mortal. Harold is a man. Therefore, Harold is mortal.DeductionThis third sentence is absolutely true because the first two sentences are true.I have a bag of many coins, and I've pulled 10 at random and they've all been pennies, therefore this is probably a bag full of pennies.InductionThis gives some measure of support for the argument that the bag only has pennies in it, but it's not complete support like we see with deduction.Further clarificationDeduction has theories that predict an outcome, which are tested by experiments. Induction makes observations that lead to generalizations for how that thing works.If the premises are true in deduction, the conclusion is definitely true. If the premises are true in induction, the conclusion is only probably true—depending on how good the evidence is.There's another type of reasoning called Abductive Reasoning, where you take a set of observations and simply take the most likely explanation given the evidence you have.Deduction is hard to use in everyday life because it requires a sequential set of facts that are known to be true. Induction is used all the time in everyday life because most of the world is based on partial knowledge, probabilities, and the usefulness of a theory as opposed to its absolute validity.Deduction is more precise and quantitative, while induction is more general and qualitative.More examplesIf A = B and B = C, then A = C.DeductionSince all squares are rectangles, and all rectangles have four sides, so all squares have four sides.DeductionAll cats have a keen sense of smell. Fluffy is a cat, so Fluffy has a keen sense of smell.DeductionEvery time you eat peanuts, your throat swells up and you can't breathe. This is a symptom of people who are allergic to peanuts. So, you are allergic to peanuts.InductionRay is a football player. All football players weigh more than 170 pounds. Ray weighs more than 170 pounds.DeductionAll cars in this town drive on the right side of the street. Therefore, all cars in all towns drive on the right side of the street.InductionWe can see here that deduction is a nice-to-have. It's clean. But life is seldom clean enough to be able to apply it perfectly.Most real problems and questions deal more in the realm of induction, where you might have some observations—and those observations might be able to take you to some sort of generalization or theory—but you can't necessarily say for sure that you're right. It's about working as best you can within a world where knowledge is usually incomplete.Summary Deduction gets you to a perfect conclusion—but only if all your premises are 100% correct.Deduction moves from theory to experiment to validation, where induction moves from observation to generalization to theory.Deduction is harder to use outside of lab/science settings because it's often hard to find a set of fully agreed-upon facts to structure the argument.Induction is used constantly because it's a great tool for everyday problems that deal with partial information about our world, and coming up with usable conclusions that may not be right in all cases.Be willing to use both types of reasoning to solve problems, and know that they can often be used together cyclically as a pair, e.g., use induction to come up with a theory, and then use deduction to determine if it's actually true.The main thing to avoid with these two is arguing with the force of deduction (guaranteed to be true) while actually using induction (probability based on strength of evidence).

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