

The Relationship between Reduction and Deductive & Inductive Reasoning

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1. Introduction

It is known to all that science is to try to find “real things”. But how can we approach to the “real things”? Usually science can be viewed as experimental sciences. Because we often use experiments and tests to prove the hypothesis and assumption we make. Then we can get the theory and confirmation if experiments and tests succeed. Deductive and inductive reasoning are the main methods to make a scientific research. It is obvious that science should be in logic thinking. These two kinds of reasoning are always used in the procedure of logic thinking. Reduction which is also important in science is another kind of method or reasoning compared to deductive & inductive reasoning. In this article, I will make a discussion about the relationship in reduction and deductive & inductive reasoning in the importance and impact to science.

2. Conception Thinking

2.1 Deductive & Inductive Reasoning

Deductive and inductive reasoning (deduction and induction) are the basic methods to scientific research. They have strong relationship with each other. In my opinion, inductive and deductive reasoning can form a circular process in which they are strongly linked.

Induction is to generalize the conclusion from single or more phenomenon based on specific observation. For example:

All observed birds are white, therefore all birds are white.

Induction begins with observations and methods. Then we can acquire some similarities or patterns to make some hypotheses, at last develop those hypotheses to theory. It is hard to tell whether the conclusion is true, even though all the premises from the observations are true [1]. So the conclusion from induction should be tested in experiment and deduction.

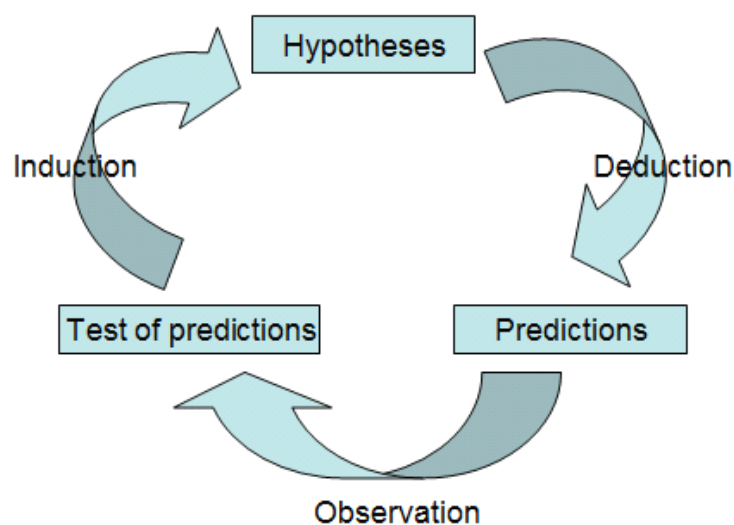
Deduction is reasoning to apply general theories and principles to reach specific consequence. [2] This consequence or conclusion is based on premises and assumptions. If the premises are true, so the conclusion will be true. For example:

All birds live on the trees, sparrow is a bird. Therefore, sparrow lives on the tree.

In deduction, we should narrow down the hypotheses and premises from further observation and experiments in order to test the conclusion. The mathematical induction can be viewed as deduction because mathematics is based on deduction. If

the first statement which can show the truth of any one statement in a sequence is true, the next one is true. Then all the statements in it are true [3]. It is a very strict reasoning.

The process of these two reasoning are in an opposite direction. In my opinion, they can form a circle in the procedure of scientific research in the relationship showed below. Deduction is used as the standard way by many scientists in scientific research, mainly because the start of deduction is wide theories rather than the limited observation in induction. Many ancient scientists use induction to gain a basic hypothesis from observation. The conclusion gained from induction can be tested in deductive reasoning.



2.2 Reduction

Reduction is considered to be a way to acquire a simple reason from a complicated effect. For example:

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In Nagel's reduction theory, the reduction is to find an explanation of a theory or a new theory through reducing and absorbing on previous formed theories [4]. In scientific research, it is also an effective and important method to get conclusions and theories. It is desirable by scientists in science research, because it explains a theory in a more explicit and simple way. In this article, I'll talk discuss the reduction mainly based on Nagel's reduction model.

Unlike Kitcher's reduction theory which paid more attention to decompose a complicated statement or theory into many elements and components, Nagel pointed

widely in his reduction model that reduction can be viewed as an explanation which shows the relationship between a series of statements or theories. That is to say, reduction is an epistemological process to understand the statement or theory rather than proving or confirming the existence or truth of them.

Gained from Kuipers's comprehensive model of explanation and reduction, Nagel mainly discussed the difference between two kinds of reduction, the homogeneous reduction and heterogeneous reduction. In homogeneous reductions, all the terms in the conclusion are showed in the premises of original theory or at least can be related to the known terms, whereas in heterogeneous (inhomogeneous) reductions, at least one term which is used to reduce the theory does not come from the original law or theory [5]. What makes homogeneous and heterogeneous reduction different is the range in using the original theory in reduction. The original conclusion and reduced one use the same terms in homogeneous reduction, while in the heterogeneous reduction, some terms are not related to the original one.

3. Relationship between Induction and Reduction

General speaking, deduction and induction both are the foundation of science. But induction begins with observation of phenomenon or sometimes the specific outcome on the particular phenomenon. So many philosophers of science point out that induction can not be used in science.

The most famous suspecter is David Hume. He thought the induction is a circulation of proving without any effective evidence. It just came from people's wish and prediction that the same thing would happen again. Based on Hume's opinion, Popper pointed out that no matter how many times a phenomena we observed happened, even though there is no counter example, we could not prove it to be true. Actually, in the inductive reasoning, it is impossible to get a real theory or truth. We get a conclusion in phenomenon and verifications which can just be described as a "provisional truth". We will believe sun will rise everyday according to induction, but it can not be explained by induction why sun will rise. So we can not get a real confirmation and truth about this just by induction. There is always a problem in the justification of the induction.

The famous Charles Darwin used induction to form his theory evolution. This theory is based on his observation on finches in different islands. The common features of finches observed and found by him lead him to believe that all finches have a common ancestor. Although nowadays, the evolution is a great disputed theory, its value can not be ignored.

I think the inductive reasoning in evolution is showed in a relatively vague way. Darwin just used observation to conclude a conclusion. There is a lack of premises

and assumptions which should be combined in and narrowed down. In my opinion, an inductive reasoning can be better accepted with a combination of reduction process. It is obvious that Darwin combined many observations into considerations and also found the patterns, but his observation and appearances are so wide and general. In this aspect, the observations and appearances are amplified without assumption and extracting. I think this process can be viewed as a kind of homogeneous reduction in induction.

The process of putting forward the law of gravitation and the first law of motion founded by Newton showed the relationship between reduction and induction. In the first law of motion, Newton found the phenomenon that the motion of an object was influenced by the environment (external force). The speed of the object will become slower when there is resistance. It will change the direction if the external force comes from side. So, if there is no external force, what will happen? The object will move in a stable status - uniform linear motion. Newton observed the different motion of objects and found the patterns. Then he reduced it to a general condition which can be viewed as the hypothesis or assumption of his law. In this way, if the final theory can not be defined or explained, we can check the hypothesis and assumption according to the observations. In other words, the reduction comes after the induction, which can help gain a better theory or conclusion, or the induction is made to be the premise of reduction.

4. Relationship between Deduction and Reduction

Compared with induction which has no explicit principles, the deduction is easier to be accepted by scientists. Popper's put forward the falsification as a deductive method in scientific research. The truth of deduction is based on its premises, if they are true, the conclusion will be true. With the premises which are always some previous formed theories or conclusions, the process in deduction is more logical and reasonable. Moreover, deductive reasoning can be tested and verified through observation or practical methods, such as experiments.

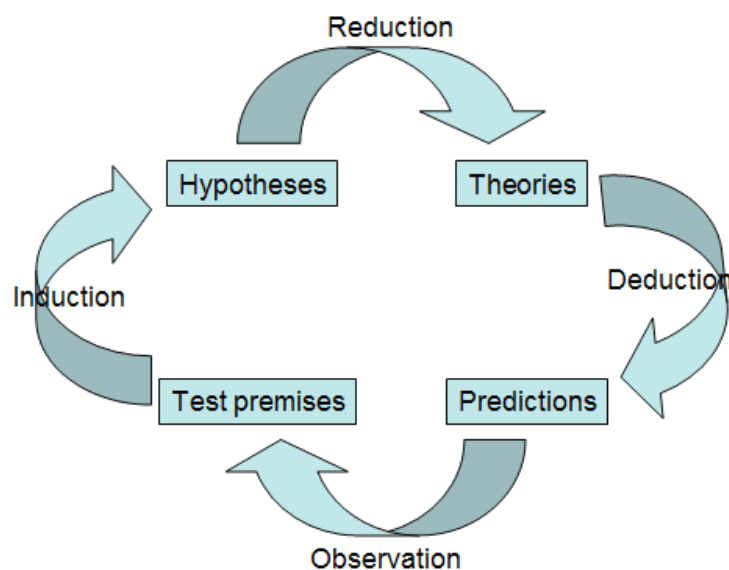
In Nagel's theory, reduction can be viewed as a method to gain a conclusion in deduction. But, Feyerabend was against the reduction because he thought the process of reduction is not reliable. [6] It is not difficult to see in the relationship of induction and deduction that the conclusion of induction can be tested or confirmed in deductive ways. For deduction, the premises or previous theories or statements can be generalized to specific one. Then we can get a relationship between generalization and characteristic. In deduction, the theory or statement can not be fixed if it is proved to be true. We care about the confirmation in deduction rather than whether the theory or statement from beginning is true or not. But if the original statement or theory is changed, the final confirmation of the deduction will be changed.

Deduction sometimes is formal and complicated compared with induction. Although its original theory and statement is much easier to collect, getting a real conclusion is not always easy. Einstein just used aberration of light and Fizeau's experiment which were inadequate premises to put forward the principle of relativity and permanent principle of light velocity. The deductive reasoning used by Einstein showed not only his talent, but also the strictness in deduction [7].

In my opinion, the reduction, especially the homogeneous reduction is already combined in the deduction, because the deductive reasoning uses the original theory and statement as its premises which should be narrowed down from a general opinion to a specific one. Those used theories from the beginning are reduced in the deductive reasoning. But after reduced, these gained statements are also related to the previous ones. Combined with reduction, the deductive process can start from a more reliable premise. In the meantime, the theories and statements can be reduced to more explicitly specific ones. Then the reality in the final conclusion will be better proved after this procedure.

5. Interaction

From the relationship in deductive and inductive reasoning mentioned before, I come up with the new circulation combined with reduction. As far as I am concerned, although reduction is not a basic method to scientific research compared with deduction and induction, it acts as an important role in science. In the circulation below, the reduction comes after the induction. Induction starts with the observation and gain a series of patterns. Then the hypotheses are put forward and reduced to final conclusions. After this procedure, the deduction can be used to check the conclusion or theories and then acquire confirmation. Moreover the reduction is also important in the process of induction and deduction.



6. Conclusion

According to the understanding of my own in reduction and deductive & inductive reasoning, I think the reduction comes after the induction, which can help gain a better theory or conclusion, or the induction is made to be the premise of reduction. In the procedure of deduction, reduction can give a better method to narrow down the premises and help make a better confirmation. I just talked about homogeneous reduction. There are still many things which are hard to understand to me, but the philosophy of science course makes me understand the science and research better, which complement my knowledge in this aspect. I think further discussion can be made to the relationship between the three concepts, such as the different kinds of reduction and the verification of induction.

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