**Philosophical Method Day 8: Non-Deductive Arguments**

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| **Content:**1. Inductive Arguments (15 minutes)2. Abduction (25 minutes)3. Deductive vs. Non-Deductive Logic (10 minutes) | **Method:**1. Lecture2. Lecture and class exercise/discussion3. Lecture |

***Instructor’s Introduction***: This lesson will examine types of non-deductive arguments, including inductive arguments (e.g., enumerative induction and argument by analogy) and abductive arguments. Students also revisit the distinction between deductive and non-deductive arguments in more detail.

# *Goals and Key Concepts*

1. Students should understand the general nature of non-deductive arguments.
2. Students should understand the main types of non-deductive arguments, namely inductive and abductive, and the general differences between them.
3. Students should understand in more detail the differences between deductive and non-deductive arguments.
4. Key concepts: **induction, strength, cogency, enumerative induction, argument by analogy, abduction, gestalt psychology, retroduction, inference to the best explanation, probability, likelihood, monotonicity, ampliative, non-ampliative**

**1. Inductive Arguments**

An inductive argument is one in which the author is trying to show that the conclusion is probably true. Whereas deductive arguments are evaluated in terms of validity and soundness, inductive arguments are evaluated in terms of strength and cogency.

Strength:

* Strength is essentially probability.
* Strength is a matter of degrees, not all or nothing like validity.
* We think an argument is strong iff (if and only if) whenever the premises are true, the probability that the conclusion is also true is high (often people assume high probability means greater than ½).

Cogency:

* An argument is cogent iff (if and only if) it is strong and all the premises are in fact true.

Examples:

1) Raven 1 is black.

 Raven 2 is black.

 Raven 3 is black.

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 All ravens are black.

This is a form of inductive argument known as **enumerative induction**. It involves generalizing from specific observations or instances to a general conclusion.

The basic idea is that as we enumerate each instance (or observation) without finding a negative instance (i.e., in this example, a raven which is not black), the probability that the conclusion is true keeps getting larger. If we know how many ravens there are in the world, we could even give a rough estimate of the probability. For example, if we know that there are 100 ravens in the world and we have observed 60 of them, all of which have been black, then the probability of the conclusion is 0.6 (or 60%). That’s a strong argument. But if we had observed 75 of the ravens, then the strength would be 0.75, and that argument would be stronger. Of course, if we then see a raven which is not black, then the probability drops to 0, and the argument is no longer strong.

To express the probability of some conclusion given some premises, we write a probability statement. Typically, we use “H” for the conclusion (because we also call it the hypothesis) and “e” for the set of premises (because we also call the set of premises the evidence). We write the probability statement as follows:

P(H/e) = p, where p is some number between 0 and 1.

For example, if our hypothesis is that all ravens are black and the evidence is that we have observed 60 of the 100 ravens in the world, all of which have been black, then p would be 0.6, e.g., P(H/e) = 0.6

For evaluating inductive arguments, often we use the branch of mathematics known as probability theory to calculate probabilities, which then allows us to easily assess strength. However, in many cases we don’t have the information that would be needed to make an exact calculation of a probability, in which case we are left to make a more qualitative estimation of relative strength. Some philosophers have worked out heuristic “rules of thumb” that give us some guidance in certain sorts of circumstances. For example, John Stuart Mill proposed five methods (rules) to help us illuminate issues of causation.

2) Watches are made by watchmakers, who are intelligent designers.

 The universe is like a watch.

 The universe was made by an intelligent designer.

This is a form of argument known as **argument by analogy**. It involves saying that object A has property X and object B is similar to object A. Therefore, object B probably also has property X. The strength of an argument by analogy (the probability that object B also has property X) is measured by the similarity between objects A and B; the more similar B is to A, the more probably it is that object B also has property X. Sometimes we write an argument by analogy as such:

Object A has property X.

[n] Object A and object B are similar to degree n.

Object B has property X.

Where, the “[n]” to the left is to show that the strength of the conclusion is proportional to n.

**2. Abduction**

Some people claim that there is also a form of reasoning called abduction. Abduction is also sometimes called retroduction or inference to the best explanation (IBE), although it’s not clear that all of these names refer to exactly the same thing. It’s also not exactly clear what their relationship is to induction, but they seem to genuinely reflect a somewhat different form of reasoning.

Whereas induction is the process of generalizing from specific instances, abduction is loosely the sort of reasoning we use when finding or filling in patterns. A very simple example is when we are asked to find the next item is a sequence:

1, 1, 2, 3, 5, 8, 13, x, 34, …

What is the value of x? It’s 21, because each number is the sum of the two numbers that precede it. How did we get that answer? It seems like the natural way we do so is by first just trying to come up with some possible patterns (hypotheses), then testing whether and how well each fits or explains the data. How we come up with the hypotheses is an interesting question. We might just brainstorm possibilities, or maybe there’s a (possibly subconscious) psychological process; gestalt psychology is a branch of psychology concerned with exploring how people recognize patterns. If more than one hypothesis fits the evidence, it’s also an interesting question how we evaluate which is the best. We’ll have more to say about that shortly, as part of the exposition of inference to the best explanation.

Class exercise: show the Rubin’s vase figure, below, and ask students what they see. Presumably, some will see a vase while others see two people’s faces staring at each other. Discuss how we recognize patterns.



Coming back to the terms abduction, retroduction, and inference to the best explanation, there isn’t a consensus way of using these names. However, it seems reasonable to use abduction as the general title for this branch of reasoning, and loosely to finding or filling in patterns, whether done by some method or just more intuitively. Retroduction and inference to the best explanation have been used as somewhat more technical terms for specific methods of reasoning by assessing the ability of proposed hypotheses to explain the observed data.

Here’s how inference to the best explanation (IBE) is supposed to work:

* We have some evidence *e* and hypotheses H1, H2, … , Hn.
* We ask which hypothesis, if true, best explains the evidence *e*.
* We then adopt that hypothesis.

Example:

1) *e*: I hear a knocking sound.

 I form some hypotheses about what could be causing that sound.

 H1: My friend is knocking on my door.

 H2: Gremlins in my attic are bowling.

 H3: Angels are throwing things at each other.

 H1, if true, best explains *e*, so I adopt it (believe it is probably true) and go open my door.

IBE is sort of the inverse of induction (it’s like reasoning “backwards” compared to induction):

* Induction: maximize the probability of the hypothesis given the evidence, P(H/e)—for example, the more ravens I observe that are black, without observing one which is not, makes the probability that all ravens are black higher, making it a stronger argument
* IBE: maximize P(e/H)—we want the hypothesis which makes the evidence observed have the highest probability of being true, or, in other words, the hypothesis which is most likely to have caused the observed evidence (in fact, while P(H/e) is called the probability of the hypothesis given the evidence, P(e/H) is known as the likelihood of the hypothesis)

How do we evaluate what is the “best” explanation? Some suggestions include: simplicity, coherence, plausibility, explanatory power, etc. These notions seem vague, but in practice they do seem to give us useful guidance. Occam’s razor—the principle that we should select the simplest hypothesis, or equivalently the hypothesis that makes the fewest new assumptions—is a powerful and time-honored principle. Likewise, even in science, we often pursue those hypotheses that, if true, seem most capable of truly explaining *why* we get some set of data, rather than those which fit but don’t help us really understand why.

**3. Deductive versus Non-deductive Logic**

Now that we have described how deductive and non-deductive reasoning work, let’s discuss some more detailed differences between them.

Before, we had this basic explanation of the difference between them.

1. **Deductive arguments**
* Deductive arguments, if sound, prove the conclusion must be.
* The archetypal example of a deductive argument is a mathematical proof.
1. **Non-deductive arguments**
* Non-deductive arguments, if strong, show that the conclusion is probably true (if inductive) or likely true (if abductive).
* Most everyday claims are non-deductive.

Another important difference between deductive and non-deductive arguments has to do with **monotonicity**:

Deductive arguments are monotonic.

* If a deductive argument is valid, adding new premises can’t change that.
* For example, a proof is a proof; no new premises could “unprove” a math theorem which has been proven)

Non-deductive arguments are non-monotonic.

* New premises can change the strength of a non-deductive argument.
* New information can be relevant.

Example:

1) Most people who are treated with penicillin don’t have a reaction.

 Jones is being treated with penicillin.

 Jones won’t have a reaction.

This seems like a strong argument. But new information that Jones is allergic to penicillin completely undermines it.

A very fundamental difference between deductive and non-deductive arguments, which in a sense underlies other distinctions, concerns how much information is in the conclusion of the argument relative to in the premises of the argument. We can use the term “ampliative” to make this difference more clear.

Deductive reasoning is **non-ampliative**:

* The conclusion actually just makes clear information that is already in the premises (though perhaps hidden). It doesn’t amplify or add anything new. That’s why it can’t go wrong (as long as the premises are true the conclusion must be, too).

Non-deductive reasoning is **ampliative**:

* The conclusion claims more than what is in the premises. (For example, claiming that *all* ravens are black after having observed *many* that are black, even though you haven’t seen all ravens.)

Finally, as is probably obvious from our study of these forms of reasoning, deductive logic is well understood by logicians, with very clear rules for how to evaluate arguments. Generally, we can use mechanical procedures to solve many problems in deductive logic. Non-deductive logic is not as well understood, and, while there are some loose rules or guiding principles, there generally aren’t such clear cut, precise rules or mechanical procedures like for deductive logic.