INDUCTIVE REASONING: An Overview

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Introduction

As a supplement to other approaches to inductive arguments, the following overview provides information on some key – though certainly not all – forms of inductive reasoning.

In the most basic sense, inductive arguments are the result of inductive forms of reasoning. Inductive reasoning is, in other words, a process which typically consists of taking past experiences and using them to explain a present or future circumstance. Specifically, "inductive reasoning is that in which we extrapolate from experience to further conclusions about what will happen. The assumption behind inductive reasoning is that known cases can provide information about unknown cases."[1]

While we might not think of it in these terms, we rely on inductive reasoning all of the time. We assume that the gas pedals in our cars will trigger a process that moves our car in a desired direction and that the brake pedal will stop our car from moving. We assume that grapefruits are sour and that bananas are sweet. Some of us know better than others how five beers will affect our ability to think, talk, and walk. All of these predictions are based on past experiences and all are examples of inductive reasoning. One trick to remembering the difference between inductive and deductive arguments is that inductive arguments rely on taking individual instances and compiling them to construct a conclusion. Using the car example, we take all of the individual instances in the past of stepping on the gas and pressing on the brake pedal to form a conclusion that the one leads the car to accelerate while the other leads the car to stop. So we use past experiences as an inventional resource to help us deal with specific situations.

That all said, a caveat: All inductive reasoning shares a common factor and that is that inductive forms of reasoning can only maybe, probably, and/or provisionally support the conclusion of the argument. To repeat, inductive reasoning *never* conclusively supports a conclusion. It is always subject to the degrees of confidence that range from the plausible to the probable.. This is not a shortcoming of inductive arguments in themselves, but rather is a result of the way in which inductive reasoning is structured. In the following section, particular forms of inductive reasoning, as well as the uncertain conclusions they produce, are discussed. Fat this point, though, let's just say that sometimes our inferences can be wrong and that can then lead to some incorrect solutions. Again, what matters is the reasoning process.

Inductive arguments can be sorted in various ways. For simplicity's sake, we will divide them into four categories of reasoning: analogical, signal, causal, and inductive generalization.

Analogical Reasoning

Given the prevalence of metaphors in our society, it is not difficult to find examples of arguments that employ analogies as a form of reasoning. An analogy is a comparison of two things, ideas, persons, phenomena, and so on that are said to be similar in some way. An argument by analogy is a form of reasoning that "argue[s] from *one* specific case or example to another example, reasoning that because the two examples are alike in [some] ways they are also alike in one [or more] further specific way[s]."[2]

We often use analogies (a) *to explain complex ideas or processes* (explaining how a cell responds to a virus by comparing the process to an enemy attack on a fort), (b) *to explain common experiences in a new or different way* (comparing the addictive nature of television shows on The Learning Channel to crack), and/or (c) *to assist in making or rationalizing a choice* (buying a pair of shoes by the same manufacturer as your old pair because you figure that the new pair will be of the same quality and comfort). Analogies are used for other purposes but these are some of the most prevalent forms of argument that are associated with them.

Reasoning by analogy can occur in one of two ways. First, you might analyze an unknown event or situation based upon a known one. For example, you might argue for the abolition of gun ownership in the United States (unknown) by discussing the strict restrictions on gun ownership in France (known). Second, you might compare or contrast two known situations. An simple example would be to compare or contrast French and American attitudes toward gun ownership. Another example, taken from history, can be found in discussions about communism in the 1950s, wherein communism was compared to a cancer in order to argue that it be stopped lest it spread throughout the world. In this later case, the analogy takes two known quantities (communism and cancer) and uses a comparison to advocate a certain form of action (a swift and total response). Notice how these analogies also imply the use of other metaphors, not to mention some measure of action. In the case of communism and cancer, the proper treatment is to extract the cancerous cells or the tumor as quickly as possible.

Evaluating Analogical Reasoning

When evaluating analogical arguments, two concepts are important: *frequency* and *reliability*. First, in terms of frequency, one needs to determine if there are a sufficient number of shared features between the two objects of comparison. While there is not a set number of characteristics that delineate a good analogy from a bad analogy, a better analogy has a greater number of shared features. In American society, analogies are commonly argued enthymemetically, whereby an audience is left to fill in the comparison. When President Obama is compared to Heath Ledger's portrayl of the Joker or even to Hitler, for example, no one needs to explain all of the reasons why they are "similar." Instead, an audience is allowed to fill in the gaps. But consider the "similarities" proposed and decide if there are enough points of comparison to make for a strong analogy. Obviously we might disagree. Some might feel that the analogies encapsulate Obama's gravitation toward socialism, if not social anarchism, in his policymaking. Others might feel that they pervert the President's political ethos with hateful, and perhaps even racist, overtones. Either way, the frequency of points of comparison remains important to evaluating analogical reasoning.

The second way to evaluate analogical reasoning is to examine its reliability, or to determine how relevant the shared features are to the comparison (and conclusion). Notice that this sort of examination could be applied to the example of Obama as the Joker/Hitler animated above. But to use another example, consider an instance in which someone argues that "cars are like apples." This is not a sufficient claim by itself. That is, one would expect that an advocate would follow up this statement with some other arguments to support it. Imagine, then, that the points of comparison are as follows: both cars and apples come in a number of colors; moreover, they are not flat objects. If those were the only points of comparison, it is easy to discern how this would be a relatively weak analogy. However, imagine that someone argues that "Arnold Schwarzenegger and Ronald Reagan are similar kinds of politicians," using the following points of comparison: they were both actors turned politicians; they became more conservative with age; they were both from California; they were both ferocious anti-Communists; they both had a lot of children; they both cheated on their wives, etc. In this instance, there are not only a greater number of points of comparison but many of them are more directly related to the question of politics. Some of them are not political per se – which might hurt the comparison – but many of them are, and this creates a situation in which the analogy can be more effectively used.

In review, analogical reasoning takes two objects or ideas and tries to link them together through points of comparison. Like the other forms of inductive reasoning to be discussed below, one can examine the frequency (the number of shared features) and reliability (relevancy of the features to the conclusion) of the compared objects or ideas in order to determine the strength or weakness of the argument.

Signal Reasoning

Signal reasoning, like analogical reasoning, makes a connection between two events, persons, ideas, etc. However, in signal reasoning, the presence of one event is used to indicate the *presence* of a larger condition. Unlike causal forms of reasoning, signal reasoning is not used to imply a cause and effect relationship. Rather, it is used to show the concurrence of two events—to show that one is the sign, or symptom, of another. For example, "a doorbell sound is a sign of someone at the door; a flag flown at half-mast is a sign of the passing of an important person; [and] a fever is a sign of an infection."[3] Notice that in each of these examples we are not making an analogical argument (the doorbell, the flag, the fever—none of these things is compared to anything else). Nor, as will be shown below, are we making a causal argument (the doorbell did not cause the person to appear at the door, the flag at half-mast did not kill the important person, and so on). Yet we are employing a form of reasoning that relies on *the capacity of one event to indicate the presence or occurrence of another event*.

Oftentimes, signal reasoning requires an intimate connection with the communicative practices of a culture. For example, if one does not know what a flag flying at half-mast represents, then the sign argument might lose (if not change altogether) its meaning. We therefore rely on past *shared* experiences to code and decode signal forms of reasoning, which enables us to perform another critical function of reasoning by signs: *to make predictions*. If someone announces that a prominent member of Congress passes away, for instance, it would be appropriate to assert that "flags will be flying at half-mast in the Capitol today." However, it should be easy to imagine some ways in which a reliance on past shared experiences might, at times, limit the reliability of signal reasoning.

Evaluating Signal Reasoning

As with all forms of inductive argument, signal reasoning can only probably support its conclusion or, as abovementioned, predict its outcome. And here again we return to the questions of frequency and reliability. First, if we consider the frequency of certain signs, we must also consider the number of corroborating signs in relation to the conclusion. One might look outside and see lightning, then make the argument that it is going to rain. However, lightning is only *one* sign of a storm. Other signs would be needed in order to corroborate the argument that it will rain, such as the presence of rain clouds, a rise in humidity, changes in barometric pressure, a 90 percent chance of rain delivered by a local forecaster, and so on. Simply stating the presence of lightning does not ensure that it will rain—in fact, it often rains *without* lightning, not to mention that it is also possible to have lightning without rain. So, signal reasoning can only indicate the presence of an event; it cannot establish a cause-and-effect relationship. To recall an example from above, one might drive by a state building and see a flag flying at half-mast. This might lead one to think that an important public official has died—an appropriate prediction. However, such signal reasoning would still have to be backed up with other signs such as news reports or pictures. If a flag flying at half-mast is the only sign, one might be led to a weak argument. This is not to say that there is a specific number of signs that make an argument either good or bad. It is to say that one needs to remember the following dictum: the greater the number of corroborating signs in a given situation, the better an argument by signal reasoning. But to reiterate, a high number of corroborating signs does not mean that one will *necessarily* come to the "right" conclusion; it simply suggest that one is more likely to arrive at a strong conclusion.

The second way that you can assess forms of signal reasoning is by evaluating the reliability of the sign according to the presence of a condition. To clarify this statement, let's take the following argument as an example:

> In the past, I've noticed that my dog barks whenever there is a stranger in the yard. My dog is barking now, so there is probably a stranger in the yard.

This is clearly an inductive argument. The arguer is using past examples of particular instances to make sense, or predict the likelihood, of a current situation. Yet a mindful advocate should still inquire: what is the dog actually barking at, and why? It might be that there is a stranger in the yard. It might also be that a squirrel is taunting the dog from a tree, or the dog is cold and it is barking to illustrate its desire to come back inside. The fact that the dog is barking is not enough; one would have to know more about the situation to make a stronger case for this argument. Again, these examples are illustrative of the rule that inductive arguments can only probably support the conclusions of the argument. So, when evaluating forms of signal reasoning, one must always consider the number of signs alongside the reliability of these signs in order indicate or predict a particular condition.

In review, signal reasoning is contextually situated. It is used to evaluate the concurrence of certain signs concurring according to their frequency and reliability. As the foundation of an argument, signal reasoning can be a powerful indicator and/or predictor of the presence of a stated condition.

Causal Reasoning

Of all of the forms of inductive reasoning, causal (or cause-and-effect) reasoning is probably the most prevalent and influential in our everyday lives. Consider how often people argue about whether or not fossil fuels are causing global warming, if sex education leads to more or less teenage sex, if tax cuts will lead to positive or negative economic growth, whether or not violent television programs lead to more violent tendencies in children, whether or not fast food advertising causes people to become addicted to unhealthy food, and so on. Causal arguments are premised upon a relationship between two or more events such that one event leads to another. Specifically, "every causal argument has at least two events, one of which precedes the other, and both are connected to the other."[4] This seems a straightforward claim on its face, but claims to causality rely upon an advocate's ability to prove a direct relationship between a cause and its effect. In claiming that one action or condition or event causes another, one moves beyond the level of prediction (signal reasoning) and into the realm of explanation. Consider the following, rather crude, argument based on causal reasoning:

> Hannibal Lecter gets indigestion every time he eats one of his therapists. He determines that eating therapists causes indigestion.

The argument suggests that Hannibal Lecter has eaten his therapists on multiple occasions and that he has witnessed a similar result: indigestion. Therefore, as a result of a supposed cause-and-effect relationship, he has isolated the cause (eating therapists) and effect (indigestion).

Many times causal arguments employ enthymemes, which means that part of the argument is not stated and the advocate assumes that the audience will fill in the blank. The following example demonstrates this tendency:

Students who bully and pick on their peers instigate school shootings.

Implied in this argument are multiple assumptions—the main one being that past examples of school shootings have been the result of bullies or groups of students picking on one another. In this example, it is easy to follow the logic of cause (past examples of students bullies) and effect (school shootings). The claim that connects the cause and effect are not stated but implied.

Evaluating Causal Reasoning

Before moving on to how one can test causal reasoning, it is worth stepping back to remind that each kind of inductive reasoning can be questioned. Just because the word "reasoning" is attached to each of the four kinds of argument under study, it does not mean that "inductive reasoning" is "true" or "more correct" than other forms of argument. Reasoning simply means that there is a formal structure to the argument. In other words, reasoning is a fancy word for pattern, or process. Henc why each kind of inductive reasoning can be evaluated in two ways: frequency and reliability. If one can remember these two terms, one can remember how to look at each kind of inductive argument.

With that in mind, we return to frequency as it relates to causal reasoning. Evaluating causal reasoning in terms of frequency is, in a word, a stretch. It is therefore helpful to think of it as referring to whether or not the alleged cause was present at the time of the event. Going back to the school violence example, we might ask ourselves if there really were bullies present at each of the past instances of school shootings. There may or may not have been. If there is evidence that there was bullying, then we *might* be able to say that this is what led to the shootings. While we do not know if it directly led to the violence, we at least know that we have met the requirement that the condition was present. But notice that this is not necessarily enough to prove causation (and might actually belie the fallacy of multiple causation).

Second, then, we need to examine the reliability of causal arguments. That is, we need to ask ourselves: is a particular cause capable of producing a particular effect? In the first example we would need to determine if eating therapists is capable of causing indigestion. We can speculate that eating people might cause indigestion—from the stated argument we don't know if patients are more likely than nurses to cause indigestion or if people are more likely to cause indigestion than, say, a lamb, but we can assume that ingested food in general is capable of causing indigestion. In the second example, we can similarly assume that interpersonal dilemmas between school children can lead to school violence. We can think of other examples that are less clear or are at least a little more contestable, such as the link between smoking and cancer. Cigarette companies have funded research for decades that disputes the direct link between smoking and various forms of cancer. It is a little harder to prove that cigarette smoking (and more recently second-hand smoke) leads to specific cancers such as breast and prostrate cancer. Another scientific debate rages over whether or not global warming is caused by human activity or if it is a natural ecological phenomenon. The basic question in this debate is whether the carbon dioxide released by fossil fuels actually traps greenhouse gases and thereby increases the Earth's surface temperature? Again, credible scientists have come up with wildly different and contradictory answers to this question, making causation a bit more difficult to prove.

Both of these preceding examples help prove the point that causal forms of reasoning (as with all inductive arguments) can only probably support some conclusions. They also illustrate an important relationship between analogical, signal, and causal reasoning: that each yield a different level of confidence, with analogical reasoning being the "easiest" to establish but "weakest" form, and causal reasoning being the "hardest" to establish but the "strongest" form. It might be that smoking does not lead to cancer but that people who smoke also happen to be people who are more likely to eat fried food and fried foods actually lead to higher rates of cancer. If this is the case, then smoking does not cause cancer (or at least it does not do it alone), and that means that the cause can only maybe lead to the effect. It also might be the case that global warming is caused by a combination of fossil fuels along with heat islands (large sections of land that are paved such as cities that trap heat), natural fluctuations in ozone layers, and so on. If this is the case, then again the claim to causation can only maybe support the conclusion that fossil fuel burning leads to global warming.

To recap, causal forms of reasoning can either imply or explicitly state a cause-and-effect relationship between two events, which can be evaluated by examining whether or not the cause was present at the time of the effect and if the cause is capable of producing that effect.

Inductive Generalizations

While all of the preceding forms of arguments indicate specific forms of inductive reasoning, inductive generalizations are a bit more generic. Inductive generalizations are basically those forms of reasoning that take a small sample and try to create a larger "truth" out of it. Put another way, "in inductive generalization, an inference is made from a subset of a population, called a sample, to the whole of the population. A sample may consist of people, objects, events, or processes, about which something is observed. The results of the observation are generalized to the larger group or population."[5] This form of reasoning is pervasive in our everyday lives. The easiest example so point to are poll results. News organizations and independent organizations invest enormous sums of money in this form of reasoning when conducting research on questions ranging from the President's job approval rating to the kinds of coffee that consumers prefer most. In each case, the polling organization tries to compile a representative sample, to ask its respondents targeted questions, and to predict the answers of a larger sample. So, for example, pollsters knew before the 2000 election that Florida would probably decide the election. They also knew that it would depend on voter turnout. Statistically speaking, Florida was a tie. However, we also know that inductive generalizations can fail given the problems with the predictions of these models. In short, the mathematical models that were used to declare Al Gore the winner of the state did not match the reality of the situation (well, maybe it did but that is another story for another day). Regardless, the exit polls in the more Democratic areas did not accurately predict the margin of victory for Gore. Again, there are other examples besides polls, but they are the clearest example of this form of reasoning.

Evaluating Inductive Generalizations

As with the other three forms of inductive reasoning, one needs to question the frequency and reliability of inductive generalizations. This translates into the following two questions: (1) Is the sample size large enough? and (2) Is the sample size representative of the larger population? We turn first to the question of frequency. While there is no correct sample size or percentage of a population that ensures a good argument, it is safe to say that the larger the sample size, the more likely it is that you will be able to craft a strong argument. For example, if one wanted to make arguments about the attitudes of the citizens of the state of Indiana, he or she would do better to poll five cities rather than just Bloomington. Moreover, he or she would do even better to poll fifty cities. It might be the case that we would see wildly different results as we moved from polling one to five to fifty cities. It might also be the case that the numbers do not change all that much. Put differently, more results are not always going to change one's ability to make or support an argument. In fact, when the Gallup Polling group takes polls, they usually only sample 1,000 people to discern numbers about the attitudes of all Americans. And while this is less than 0.1 percent of the entire population of America, their polls (especially political ones) tend to be incredibly accurate. How are they able to accomplish this? The answer lies in the representativeness of the sample, which is the second question one needs to address.

Returning to the poll of Indiana's attitudes toward issues, it would be important to canvass the entire state in order to more accurately reflect the citizens' viewpoints. For example, if the poll focused on a proposal to raise the minimum wage and pollsters only called homeowners in Bloomington, Gary, Indianapolis, Terre Haute, and West Lafayette, the results might be a little skewed. Notice first that the calls would only be placed to homeowners. Immediately there are biases built into the study because owning a home privileges a particular segment of the population while ignoring the opinions of those people who rent. It also isolates those people who have phone lines. Another problem with the study would be that it only reflects the opinions of more urban populations and ignores the Martinsvilles and Seymours of Indiana. While the minimum wage hike might help urban residents, it might hurt rural economies and that would not be represented in the survey. We could pick out other problems in this example, but it should be clear that the reliability of a survey is dependent on the reflection of the sample to the larger population. Going back to the Gallup Polling methods, they typically isolate a few zip codes in America that are deemed representative and then use those results to make generalizations about the larger population. While this might seem a little sketchy at first, you should also know that they have spent years developing models and formulas that work to ensure that their results are in fact representative of the American public as a whole.

In review, inductive generalizations take the results of a smaller sample size and then use them to create arguments about the larger population. When evaluating this form of reasoning, one needs to look at the frequency of the sample (is it large enough?) and the reliability of the sample (is it representative of the larger population?) to determine the relative merit of an inductive generalization.

Charting Inductive Reasoning

Below is a chart that should provide a snapshot of the information presented above and help students remember how to evaluate each form of inductive reasoning:

Type of Reasoning	**Frequency**	**Reliability**
Analogical	Number of shared features?	How relevant are these features to the conclusion?
Signal	Number of corroborating signs?	How reliable is the sign for indicating the presence of the condition?
Causal	Was the alleged cause present at the time?	Is the cause capable of causing the effect?
Inductive Generalization	What is the sample size?	What is the composition of the sample?

Notes

1 Trudy Govier, *Practical Study of Argument*, 289.
2 Anthony Weston, *A Rulebook for Arguments*, 19.
3 *Ibid.*, 250.
4 Nancy Goulden and William Schenck-Hamlin, *Creating Speeches*, 248.
5 *Ibid.*, 252.